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Not just different,
better

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in humans

SPACE GARDENING
Green fingers on
the Red Planet

NewScientist

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THE MATH OF DEMOCRACY WHY FAIRNESS IS IMPOSSIBLE



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Does moral action depend on reasoning?

Not really.

What if most humans, regardless of their culture or religious beliefs or age or sex, chose the same option when faced with a moral conflict? What if those same people gave wildly different reasons for why they made their particular choices?



This, in fact, is the state of affairs for much of our moral behavior. Recent research in human brain

science and ancillary fields has shown that multiple factors feed into the largely automatic and deterministic processes that drive our moral decisions. Some theorists think that our brains possess a finite number of moral modules that have certain response biases. These unconscious biases explain the reliability and predictability of our moral behavior, even though experimental subjects, when queried, will make up various stories about why they did one thing over another...

CONTINUED ONLINE.

Michael Gazzaniga is the director of the SAGE Center for the Study of Mind at the University of California, Santa Barbara. He is president of the Cognitive Neuroscience Institute and the author of, among many other books, The Ethical Brain: The Science of Our Moral Dilemmas.

Yes, if...

that means that moral action depends on reason. I prefer to put it this way because we do not have to go through a process of reason-ing in order to arrive at a view of what morality requires on every occasion. Often, we

simply know. But moral action does not merely *depend* on reason. Moral action is rational action, because the moral law is a law of reason.

Two distinctions will help to clarify this claim. The first is between intelligence and reason. Intelligence is a power that looks outward, to the world around the intelligent animal. Speaking roughly, an intelligent animal is one who learns from his experiences, displays some awareness of what causes what, and can use that awareness to solve problems. Reason, by contrast, looks inward, to what is going on in the animal's own mind. A rational animal is aware of the grounds of her beliefs and actions, of the way in which perception tends to influence her



beliefs or desire tends to influence her actions. She is able to ask herself whether the forces that incline her to believe or to do certain things amount to good reasons to believe or do those things, and then to determine what she believes and does accordingly.

Because we can make these assessments, rational animals can exert a kind of control over our beliefs and actions that other animals, even very intelligent ones, cannot...

CONTINUED ONLINE.

Christine M. Korsgaard is the Arthur Kingsley Porter Professor of Philosophy and the director of graduate studies in philosophy at Harvard University. Her books include The Sources of Normativity; Creating the Kingdom of Ends; The Constitution of Agency; and Self-Constitution: Agency, Identity, and Integrity.

Less than it should.

My camera has a set of handy, point-and-shoot settings ("portrait," "action," "landscape") that enable a bumbler like me to take decent pictures most of the time. It also has a manual mode that allows me to adjust everything myself, which is great



for those rare occasions when I want to try something fancy. A camera with both automatic settings and a manual mode exemplifies an elegant solution to an ubiquitous design problem, namely the trade-off between *efficiency* and *flexibility*. The automatic settings are highly efficient, but not very flexible, and the reverse is true of the manual mode. Put them together, however, and you get the best of both worlds, provided that you know when to manually adjust your settings and when to point and shoot.

The human brain employs a similar hybrid design. Our brains have "automatic settings" known as emotions. A fear response, for example, is the activation of an automatic program that recognizes dangerous things and tells us, quickly and forcefully, to back away. Our brains also have a "manual mode," an integrated set of neural systems that support conscious reasoning, enabling us to respond to life's challenges in a more flexible way, drawing on situation-specific knowledge:

"That's a deadly snake alright, but it's in a glass cage. Nothing to fear." Our automatic settings sometimes get things wrong, but we would be lost without them...

CONTINUED ONLINE.

Joshua D. Greene is an assistant professor of psychology at Harvard University and the director of the Moral Cognition Lab. He uses neuroscientific and behavioral methods to study moral judgment and decision-making, as well as other traditionally philosophical topics.

Reason isn't enough.

Would that reason were enough to keep us moral. But it isn't, and we know it isn't, and people have known this for a very long time. Aristotle pointed this out in his critique of Socrates' view that knowledge leads to virtue. What, he asked, about *akrasia*, weakness of the will? Knowing what is good and doing it are two very different things.



In his Epistle to the Romans, Paul was eloquent on the subject: "What I want to do," he said,

"I do not do, but what I hate I do." Our will seems to have a will of its own, only tangentially connected to the mind...

CONTINUED ONLINE.

Jonathan Sacks became Chief Rabbi of the United Hebrew Congregations of the British Commonwealth in 1991. A recipient of the Jerusalem Prize and a life peer in the House of Lords, he has written more than a dozen books.

To read these essays in their entirety, or to receive a printed version, visit www.templeton.org/reason.

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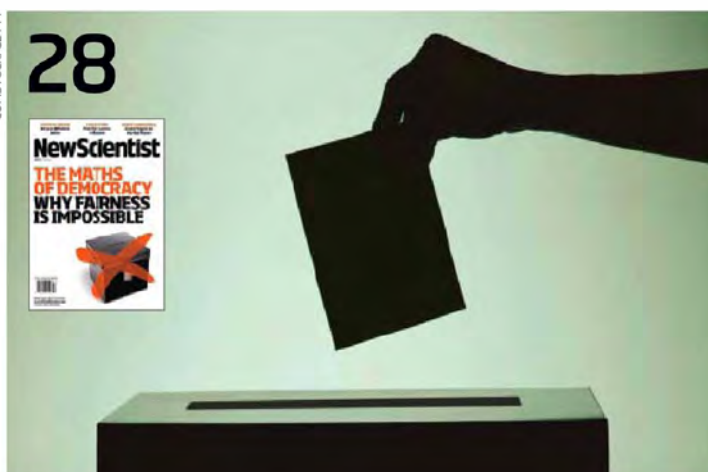
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JPL/NASA



Gardening on Mars

A starter kit for the first colonists on the Red Planet

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Deep space here we come

What's the point of President Obama's latest plan for NASA?

WHEN President Barack Obama announced that the next destination for a US astronaut would be an asteroid, it caught many by surprise. Yet the move is not as sharp a break as it might seem with the Bush-era plan to return astronauts to the moon.

Both missions would serve as intermediate steps in the long-term plan to send humans to Mars in search of life. Moon landings would help NASA develop the skills to land on a large celestial object – and get off it. On the other hand, visiting an asteroid would need a months-long journey through deep space, providing a taste of the challenges to be expected on the two-year round trip to Mars.

Although Obama's plan cancels the expensive rockets and lander NASA was developing to return astronauts to the moon by 2020, it does not rule out trips to the moon at a later time, with more affordable hardware. The decision then is not so much whether to go to the moon or an asteroid, but which to visit first. The problem with the idea of heading to the moon first is that it has failed to inspire Congress or the American public, who find it hard to get excited about repeating what was done more than 40 years ago. In contrast, a mission to an asteroid would be genuinely new. That is important because NASA will need all the public enthusiasm it can get if it is to hold onto its funding.

Still, the public-relations benefit must be weighed against the additional hazards of an asteroid mission (see page 12). Spending

months in deep space would increase the chances of the crew being exposed to a deadly blast of radiation from a solar flare. Much more work is needed to develop better ways to shield astronauts from such outbursts, and from the constant trickle of cosmic rays that can increase an astronaut's risk of cancer. Tackling the extra dangers of landing and staying on an asteroid with little gravity could pay back later: we would have a head start if we ever had to deflect or destroy an asteroid hurtling towards Earth.

Despite Obama's announcement, there is no real need to decide now whether to head first for an asteroid or the moon. It will take

"The decision to go to an asteroid is not as sharp a break as it might seem with the Bush-era plan for the moon"

years to develop the heavy-lift rocket, which he also announced, that will be needed for both missions. Until it exists, NASA cannot afford to begin work in earnest on a landing vehicle for a moon mission.

Rather than locking NASA into a hasty decision now, it makes more sense to let the debate continue for a few more years. By that time, robotic missions will probably have taught us more about the risks and potential rewards of visiting each destination, and new technologies for propelling spacecraft and warding off space radiation could tip the balance. ■

A shot in the arm for democracy

NEXT week's general election in the UK could be the most revolutionary for a generation. The anticipated race between the ruling Labour party and their Conservative arch-rivals has been derailed by the Liberal Democrats – the constant bronze medallists of UK politics – putting in an unexpectedly strong performance. Now all bets are off.

So why haven't the Lib Dems broken through before? They blame the UK's first-past-the-post electoral system, under which a large share of the vote does not necessarily translate into parliamentary seats. Unsurprisingly, the Lib Dems want to reform it if they come to power.

It is not only the Lib Dems who could benefit. The number of UK electors voting for minority parties has risen from 1 in 20 in the 1950s to 1 in 4 today, yet the existing system nullifies almost all those votes. Something fairer seems to be called for – but what?

There is no simple answer. The mathematics of democracy turns out to be so fraught with pitfalls and paradoxes that complete fairness is probably unattainable (see page 28). This should not, however, deter legislators from seeking systems that better represent voters' choices. It has been shown that the greater the opportunity for voters to participate in the democratic process and the more closely the outcome matches their preferences, the happier they are. In the UK, a system whose results better match the electorate's desires might even reverse the decades-long decline in the proportion who can be bothered to vote. ■

On NewScientist.com

ENVIRONMENT **Save the whales, save the planet**

Rescuing endangered baleen whales could boost the carbon storage capacity of the ocean. Whale faeces once added huge quantities of iron to a now anaemic Southern Ocean, boosting the growth of carbon-sequestering phytoplankton

HEALTH **Parkinson's protection without caffeine or nicotine**

Coffee and cigarettes seem to protect against Parkinson's – but tests on fruit

flies show that their best-known ingredients are not responsible

ZOOLOGER **Out of the mouths of lobsters**

Next time you eat a lobster, take a close look at its mouthparts. They are likely to be covered with swarms of tiny creatures called symbions, which are unlike any other animal on Earth

TECH **How to get more electricity from light** A technique borrowed from large-scale solar power plants

could help householders maximise their energy return from solar cells

ANIMAL BEHAVIOUR **Elephant-speak for 'Mind the bees'**

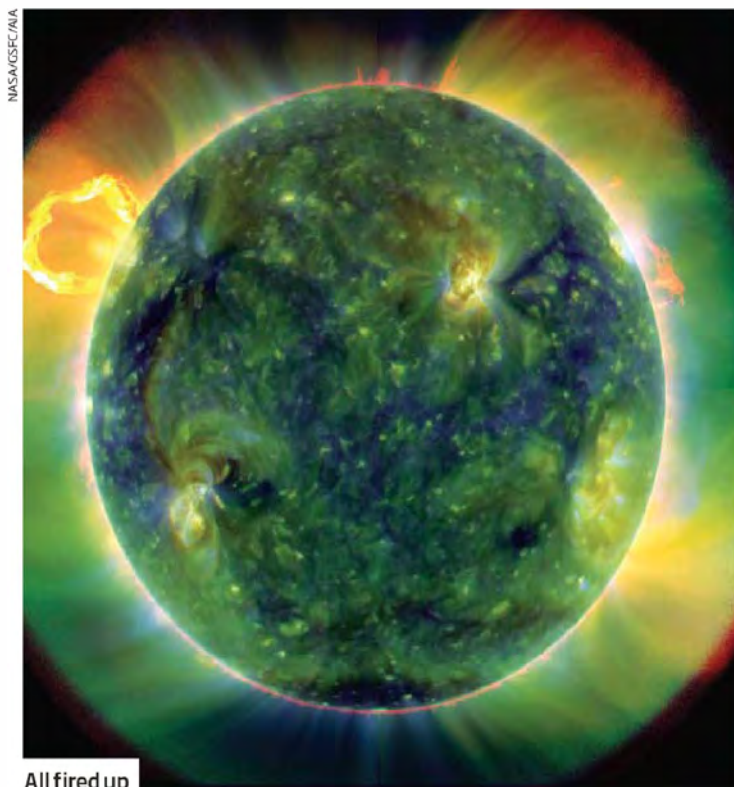
Elephants bolt when they hear recordings of trumpeting made by other elephants fleeing from bees – possibly showing for the first time that elephants make distinctive sounds to warn of specific threats

BUMPOLOGY **Guess the sex of the baby** Is there any truth to the old

wives' tales about predicting whether it's going to be a boy or a girl? From morning sickness to food cravings, we look at the science behind the lore

BLOG **Early humans may have bred with other species – twice** New genetic evidence suggests that early humans mated with other species – but was it the Neanderthals or someone else entirely?

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All fired up

Solar probe makes waves

THE sun has never looked so vibrant. Fiery rings of gas shoot out from its surface, then splash down again like molten magma, in the first images from NASA's Solar Dynamics Observatory (SDO). And these pictures are just a taste of what's to come.

The probe, which was launched in February, will provide unprecedented insights into the sun's activity. This could help us untangle the mysteries of its magnetic field and improve forecasts of solar storms on Earth. "It is going to revolutionise heliophysics, much as Hubble has revolutionised astrophysics and cosmology," Madhulika Guhathakurta, the mission's programme scientist at NASA, said at a briefing last week.

What makes SDO so powerful? For one thing, it is able to capture

ultra-sharp images of the sun at eight wavelengths every 10 seconds. This generates so much data that the probe was put in a geosynchronous orbit above New Mexico in order to keep streaming information to two ground stations at a rate of 60 gigabytes an hour - 50 times the rate of any previous NASA mission.

SDO can also observe the entire disc of the sun at high resolution, unlike previous spacecraft which could only focus on small parts of the sun's face at a time. That capability will allow researchers to track how waves travel through the sun and sometimes eject clouds of gas that damage satellites and power grids when they slam into Earth. "It is the most comprehensive view of the sun," says Guhathakurta.

First twin genome

DISAPPOINTING or what? The first whole genome sequencing of a pair of identical twins has uncovered little about the origins of disease - even though only one twin has multiple sclerosis (MS).

Identical twins inherit identical genomes but are exposed to different environmental influences. That means they can be enormously valuable in teasing apart genetic and environmental factors. But clearly even whole genome sequencing, the gold standard in genetics, has its limits, judging by the latest analysis from Sergio Baranzini of the University of California, San Francisco, and colleagues.

One thing Baranzini's team

the twins' shared egg split and could explain why one identical twin can have MS and not the other. The researchers found no such differences.

They also examined gene activity levels and epigenetic changes, which might silence a gene in one twin but not the other, leading to MS. But again, no key differences emerged (*Nature*, DOI: 10.1038/nature08990).

This leaves the causes of MS shrouded in mystery. However, the researchers point out that their analysis does at least rule out some possible culprits.

Run fast, run deep

MORE than 3 kilometres down in part of the freezing Southern Ocean, water is flowing at more than 700 metres per hour, making this the fastest-moving deep ocean current ever found.

The powerful current was discovered thanks to a 175-kilometre string of sensors on the eastern flank of the submerged Kerguelen plateau, some 3000 kilometres south-west of Australia (*Nature Geoscience*, DOI: 10.1038/ngeo842).

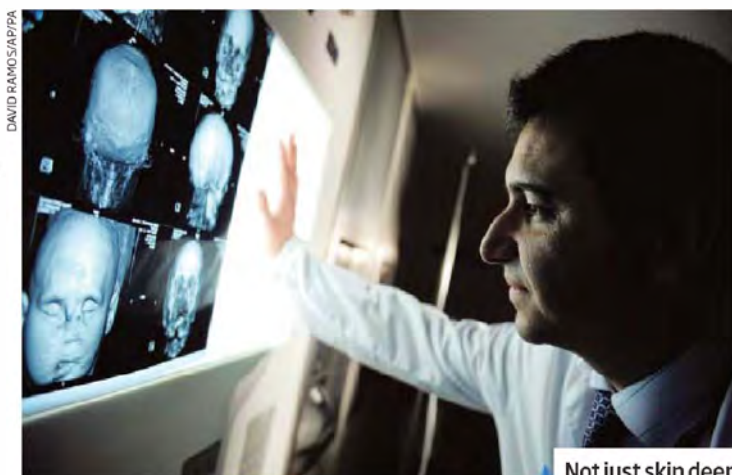
With a flow of more than

8 million cubic metres per second, the current transports 40 times as much water as the Amazon. It is likely to be an important component of the global ocean "conveyor belt", which pushes water from the ocean surface to its greatest depths and back again, and has a direct influence on global temperatures.

Deep ocean currents are now being monitored for signs of change. The measurements already suggest that deep Antarctic waters are warming and becoming less buoyant, perhaps because of climate change.

"Identical twins can be enormously valuable in teasing apart genetic and environmental factors"

looked for was "de novo" mutations - which are not inherited. If they had found these in just one of the twins, such mutations would have arisen after



Not just skin deep

Whole new face

A FARMER who accidentally shot himself in the face has become the world's first recipient of a full face transplant - including all facial skin, muscles and nerves, nose, lips, palate, all the teeth, cheekbones and the entire lower jaw. The operation was headed by Joan Pere Barret at the Vall d'Hebron University Hospital in Barcelona, Spain.

All the 10 previous face transplants since the first in 2005

replaced only sections of the face. "The most significant thing [in this case] is the transplant of both the upper and lower jaws," says Gordon Tobin, head of a transplant unit at the University of Louisville in Kentucky.

Maria Siemionow of the Cleveland Clinic Foundation in Ohio, who came close to replacing an entire face in December 2008, says the big challenge now is finding milder immunity-suppressing regimes. Such treatments are needed to prevent the rejection of donated tissue, but put recipients at high risk of infection and cancer.

Rover pinpointed

MIRROR mirror, on the moon, whose discovery has been a boon? The answer: a long-lost lunar rover. Now that we have a fix on its location, the rover's reflectivity could come in particularly handy for studying the moon's wobble.

Astronomers measure the moon's distance from Earth by bouncing laser beams off reflectors left behind by lunar missions. The Russian rover Lunokhod 1, which landed in 1970, has a reflector on its back but could not be targeted as its exact location was not known.

That changed in March when NASA's Lunar Reconnaissance Orbiter spotted Lunokhod 1. On 22 April, a team led by Tom Murphy of the University of California, San Diego, fired a laser at the new coordinates and got a reflected signal back. "We found it within minutes of our first attempt," Murphy says.

Lunokhod 1 is closer to the edge of the moon's Earth-facing side than any other reflector. That makes it useful for measuring slight wobbles in the moon's orientation, which could help reveal its internal structure. It could also allow precise tests of general relativity, which predicts how the moon should move in Earth's gravitational field.

ET stay home

WE DON'T want to hear from ET. So said Stephen Hawking this week, who is worried that aliens will plunder our resources. Is there a better way to judge the risk?

A measure called the San Marino scale is used to gauge the risk of broadcasting messages. Developed by Iván Almár of the Konkoly Observatory in Budapest, Hungary, it was adopted by the International Academy of Astronautics in 2007.

The index runs from 1 for an insignificant potential risk to 10 for an extraordinary risk. The number

is based on intensity of the signal, its duration and information content. For example, the Arecibo radio telescope message broadcast in 1974 included depictions of a man and woman and DNA's double helix encoded

"The Arecibo message would score 8 on a scale of 1 to 10 of the risk of attracting alien attention"

in binary and would score an 8.

Almár, for one, plays down Hawking's fears. He points out that Hawking is a physicist, not a SETI specialist.

Lead risk for regular game eaters

HOW much lead gets eaten along with wild-shot game? Enough to poison regular eaters of some wild birds, thanks to fragments of lead too small to be picked out during a meal.

Debbie Pain of the Wildfowl and Wetlands Trust in Slimbridge in Gloucestershire, and colleagues, bought wild-shot birds from supermarkets, game dealers and butchers across the UK. After X-raying them, they cooked them either in wine or cider or a pH-neutral preparation such as a cream sauce. As is traditional with game, only then did they pick out the larger, visible lead fragments.

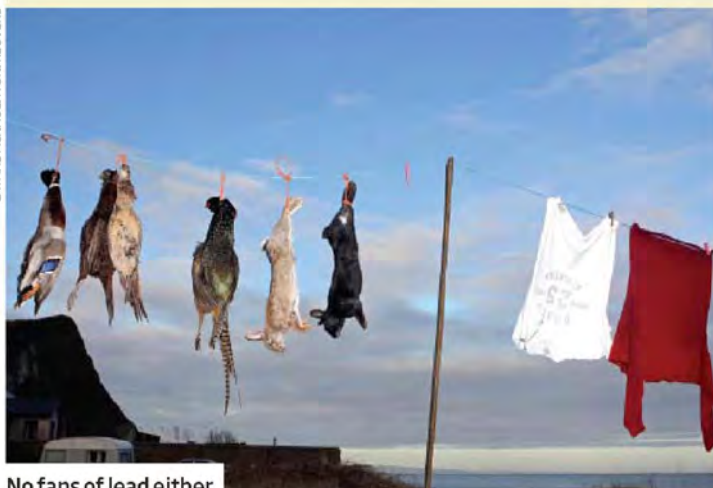
Subsequent analysis of the deboned, pulverised meat revealed that just over three meals of woodcock in a week would take

a 70-kilogram person over the lead-threshold set by United Nations bodies for most farmed animals. Red grouse, partridge and pheasant hit the limit with about 10 meals per week. Wood pigeon and mallard fans can rest easier, unless they eat 24 to 30 servings per week (*PLoS ONE*, DOI: 10.1371/journal.pone.0010315).

The X-rays suggest the blame lies with small unnoticed pieces of shot. "People all over the world consume birds killed with lead shotgun pellets, so the work has wide implications," says Grainger Hunt of the Peregrine Fund in McArthur, California.

A recent report by the European Food Safety Authority found that harmful effects emerge well below the UN's limits on lead consumption.

CATHAL MCNAUGHTON/REUTERS



No fans of lead either

60 SECONDS

Large as named

The biggest telescope on Earth will be built on Cerro Armazones in Chile's Atacama desert. The European Extremely Large Telescope will have a primary mirror 42 metres across for peering at exoplanets and stars up to 59 million light years away. The mountain was chosen in part for its clear nights and dry climate.

Carbon respite

Soil microbes were expected to churn out increasing amounts of carbon dioxide in a warmer world, but a computer model now suggests the bugs will eventually overheat and their metabolism slow down (*Nature Geoscience*, DOI: 10.1038/ngeo846).

Tree fall

The US lost more than 120,000 square kilometres of forest between 2000 and 2005, a greater percentage than any of the other seven most heavily forested nations on Earth: Canada, Russia, China, Brazil, Indonesia and the Democratic Republic of the Congo. Globally, 3 per cent of the world's forest disappeared (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.0912668107).

Electric moon

Lunar craters contain hazardous electrical pockets. When the solar wind flows over a crater rim, more electrons pour down than heavier positively charged ions, creating a region of negative charge, finds a study in the *Journal of Geophysical Research* (DOI: 10.1029/2009JE003464). Astronauts should avoid electrostatic discharges.

China lifts HIV ban

China has lifted its decades-old travel ban on foreigners with HIV, ahead of the opening of the Shanghai Expo trade fair. In January, the US dropped a similar ban, but according to UNAIDS, 51 countries and territories still impose travel restrictions on HIV-positive tourists.

Greenhouses on the Red Planet

The creation of a human outpost on Mars is still some way off, but that hasn't stopped us planning the garden



No home-like place, yet

Rowan Hooper

AT KENNEDY Space Center last week, President Barack Obama announced the intention to send humans to Mars by the mid-2030s. If all goes to plan, NASA will kick off an era of space exploration not seen since the Apollo moon programme in the 1960s.

If getting to Mars is a big step, ultimately staying there will be a giant leap. But already, experiments conducted in space and in simulated Martian conditions on Earth have yielded micro-organisms that will eventually help turn Martian rocks into soil, generate oxygen for us to breathe, purify water and recycle waste. Think of these

microbial colonies as the first gardens on Mars.

Karen Olsson-Francis at the Planetary and Space Sciences Research Institute of the Open University in Milton Keynes, UK, is part of a team that subjects terrestrial organisms to extreme stresses. The group has conducted experiments on the International Space Station (ISS) and as part of the Biopan VI mission run by the European Space Agency (ESA).

Biopan was a capsule loaded with – among others – samples of rocks from the sea cliffs at Beeron the south-west coast of England. It was carried by a Soyuz rocket into low Earth orbit in 2007. Once there, the capsule exposed its contents to the vacuum of space. The Beer rocks are home

to a broad spectrum of microbes, including photosynthesising cyanobacteria. “We thought it would be fun to send Beer into space,” says Olsson-Francis.

By the time the Biopan samples were recovered, they had endured

“If these microbes were on Mars, they could help to condition the rock for higher-order plant life”

10 days of space exposure, though the sun's lethal UV radiation had mostly been filtered out. The team discovered a cyanobacterium new to science that had survived the ride (*Applied and Environmental Microbiology*, DOI: 10.1128/aem.02547-09). The experiments were not designed with space

gardens in mind, but their findings are relevant. The high levels of UV radiation on Mars essentially sterilise anything left on the surface, so space gardens would need the protection of greenhouses (see diagram). “The experiments demonstrated that we can use low Earth orbit to select for resistant organisms that could potentially be used in space applications,” says Olsson-Francis.

Rocks placed into orbit also provide support for the lithopanspermia hypothesis – the idea that living cells can be transported through space in meteorites. Meteor impacts onto a life-bearing planet may throw rocky debris containing living micro-organisms into space, and

In this section

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if those organisms can survive the vacuum of space then they can start to grow again if they ever find themselves landing on a barren planet with otherwise suitable conditions.

The organisms in the planned Martian gardens will, of course, be transported by spacecraft. Nevertheless, astronauts will need them to be tough enough to survive in a compact, dormant state – as seeds and spores, for instance – and able to tolerate equipment failure and exposure to unshielded extremes.

Cyanobacteria photosynthesise, so they are good candidates for use in long-term space missions or on crewed outposts. That's because colonists will need organisms that are "primary producers", which are able to directly use the energy of sunlight to grow. For this reason, cyanobacteria are part of the self-contained recycling system being designed by ESA. The MELiSSA loop, or Micro-Ecological Life Support System Alternative, recycles human waste into water, oxygen and nutrients that astronauts and Martian colonists can use. Cyanobacteria are used to make the protein-rich food supplement spirulina, which ESA has named as one of its nine essential crops to grow on Mars.

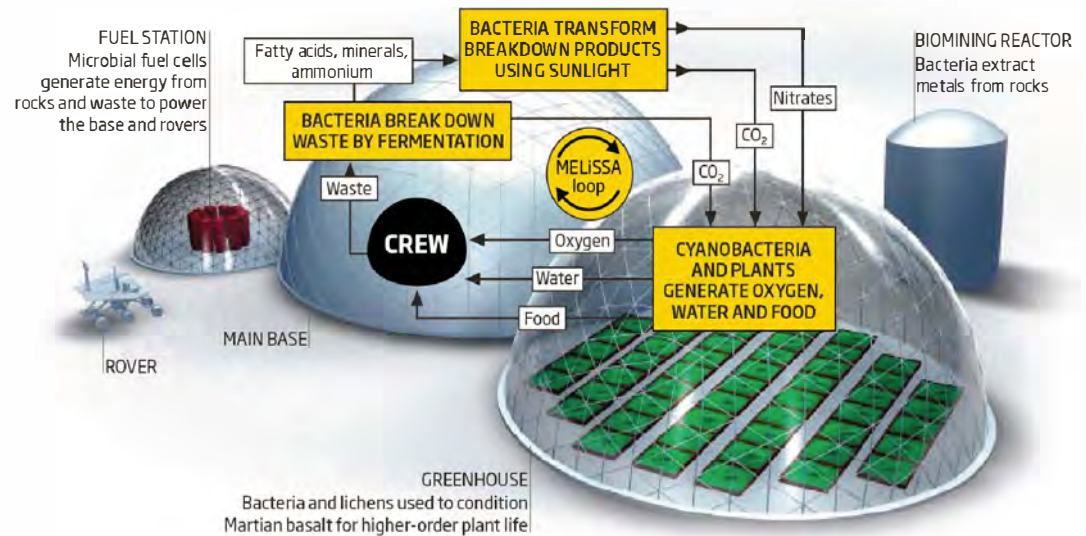
As non-terrestrial locations for gardens go, Mars isn't too bad. On the Martian equator in midsummer, the temperature can reach 20°C, and the atmosphere is 95 percent carbon dioxide, which is fabulous news for photosynthesisers. But there's one fundamental garden ingredient missing: soil.

The first Mars gardener could just slop fertiliser onto pulverised Martian rocks; experiments using rocks from Antarctica have shown that plants can grow in this way. In the longer term, though, we need a way of turning the volcanic basalt that makes up most of the Martian surface into a plant-supporting structure.

Basalt-eating bacteria could

Bug-based life support

The first inhabited outpost on Mars will likely depend on microbes for its essential functions. The MELiSSA loop life-support system will use a range of them to convert crew waste into nutrients, purify water, generate oxygen and produce food



be the answer, suggests Paul Wilkinson, also at the Open University. He is hunting inside Icelandic basalts for organisms capable of surviving on a diet of Martian rocks. "The [terrestrial] rocks are positively teeming with microbial life," he says. "If these microbes were on Mars and capable of surviving and growing, they would go some

way to conditioning the rock for higher-order plant life."

Wilkinson, who presented his results in April at the Astrobiology Society of Britain meeting at Royal Holloway, University of London, used genetic profiling to identify some of the organisms in the Icelandic rocks. He also managed to grow them in media rich in heavy metals such as copper,

nickel, zinc and chromium. This suggests space gardeners will be able to call on bacteria tolerant of the iron prevalent in the rust-hued rocks of the Red Planet.

The real kings of rock processing, though, are the lichens, says Wilkinson. Happily, rock-colonising lichens were also among the organisms that survived exposure to space in the Biopan experiment. What's more, a team led by Jean-Pierre de Vera at the Institute of Planetary Research in Berlin, Germany, has subjected lichens to conditions similar to those found on some parts of Mars – but without the lethal levels of UV radiation. The lichens were able to photosynthesise (*Astrobiology*, DOI: 10.1089/ast.2009.0362).

None of this is to say that astrobiologists are seriously talking about terraforming Mars, not in the immediate future at least. But, piece by piece, the elements of a starter kit for the first colonists are coming together. Housed in a pressurised greenhouse and populated by vats of micro-organisms that will supply oxygen and food, and transform Martian rocks into fertile soil, the first alien garden is not as far off as it appears. ■

BEWARE THE SUN AND PROTECT THE LOCALS

When it comes to gardens, Earth's red neighbour has way too much of a bad thing: ultraviolet radiation. With no ozone layer, Mars cannot screen the lethal amounts of UV emitted by the sun. Two schemes can overcome this.

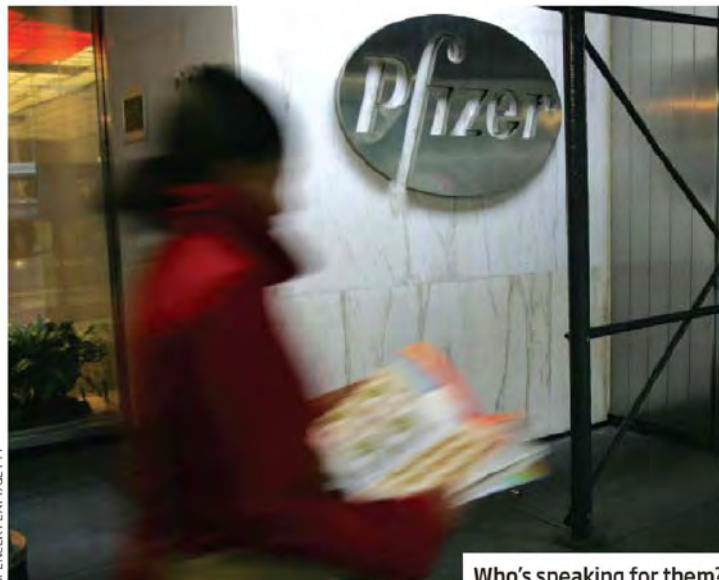
In one scenario, Mars is terraformed to make it more Earth-like. This could involve putting potent greenhouse gases like CFCs into the atmosphere to warm it up, and also making a UV screen, perhaps from ozone, says Lewis Dartnell of University College London. This is a long-term planet-sized engineering scheme, and is not something scientists are even considering at the moment. Much more manageable, then, would be biosphere-based greenhouse gardens.

Any scheme will involve

exporting life to Mars. This would immediately bring into play planetary protection guidelines that aim to prevent other planets from being contaminated with terrestrial life.

The international Committee on Space Research (COSPAR), which provides guidelines for space agencies, classifies a trip to the Martian surface as a category IV mission. This means it considers that Mars may already host life which could be contaminated by Earth life. COSPAR's rules mean that spacecraft landing on Mars must be virtually sterile, carrying no more than 300 spores of *Bacillus* bacteria per square metre. In reality, the Mars rovers and Polar Lander missions have probably already contaminated Mars with terrestrial life.

Pfizer's payments to censured doctors



Who's speaking for them?

Peter Aldhous and Jim Giles

THEY are billed as "healthcare professionals who spend years building expertise in their fields". Using materials grounded in science, they educate their peers in the risks and benefits of drugs.

This is how Pfizer, the pharmaceuticals giant, describes the experts it hires to lead forums in which doctors are lectured on the use of its products.

Yet *New Scientist* has found that some of Pfizer's experts have been disciplined for deficiencies in patient care, while others have been reprimanded for how they conducted drug research trials.

The findings add to controversy surrounding the pharmaceutical industry's efforts to market drugs by influencing prescribing. Doctors paid to educate their peers are a particular worry, argues Sidney Wolfe of consumer advocacy group Public Citizen in Washington DC. "They are doing things that may be influencing your doctor and you have no way of knowing about it," he says. "It's made worse by the fact that some

of them have been disciplined."

Many drug firms sponsor educational events for doctors. The talks may include research results, advice on identifying patients suitable for treatment and guidance on prescribing.

New Scientist matched doctors licensed to practice in the four most populous US states – California, Texas, New York and Florida – against Pfizer's records of payments to doctors and medical researchers in the second half of 2009. These were published in March as a condition of Pfizer's \$2.3-billion settlement with the US government over charges of illegal drug marketing.

Our search revealed 26 doctors paid to lecture on the company's drugs whose records include disciplinary actions related to problems with patient care or drug prescribing. Some were under probation from their state medical boards as they gave talks.

Further cross-referencing against US Food and Drug Administration (FDA) records revealed another four who have received warning letters over

problems with how they conducted drug research. The speaking fees were between \$800 and \$22,500.

In the four largest states, roughly 1 in 50 of Pfizer's experts had disciplinary records for problems with patient care or prescribing. Yet campaigners for patients' rights say that it could be close to zero, if drug companies checked databases provided by most US states. "If it's Pfizer's position that these are respected thought-leaders, they should have clean records," says Elizabeth Woeckner of Citizens for Responsible Care and Research in Philadelphia, Pennsylvania.

Censured Pfizer speakers approached by *New Scientist* deny that their records make them unsuitable to educate peers. Joseph Altieri of Vero Beach, Florida, and Mark Kosins of San Clemente, California – who both lectured about Pfizer's antipsychotic drug Geodon while under probation – argue that their disciplinary actions have no bearing on their talks because they concerned other drugs. Thomas Gazda of Scottsdale, Arizona, who was reprimanded by the FDA over a Geodon trial, points out that he has extensive clinical experience outside of research trials. "One learns from mistakes," he says.

At least one other drug firm has employed doctors disciplined

"Some doctors were under probation from their state medical boards as they gave talks for Pfizer"

over patient care. Of the 26 we found speaking on Pfizer's behalf, four were also paid to speak for GlaxoSmithKline in 2009.

Pfizer says that it already excludes those who are debarred from US government healthcare schemes. "We are continually refining our review process to ensure we are selecting the most appropriate healthcare providers to partner with to educate the medical community," says spokeswoman Kristen Neese. ■ **Additional reporting by Brad Stenger.**

Decaying beauty spied for first time by LHC

BEAUTY may be rare and fleeting, but the Large Hadron Collider (LHC) has already found it.

The LHC started work on 30 March, and within a week one of its four large detectors had found evidence of a beauty quark – also known, less poetically, as a bottom quark. This should be the first of many such quarks that LHCb, the LHC's beauty experiment, will observe, and shows the detector is working properly.

The first recorded particle was a meson composed of an anti-beauty quark – the beauty quark's antiparticle – and an up quark, which is one of the two common quarks that make up protons and neutrons. While up quarks can last for billions of years, the large beauty quark swiftly decays into lower-energy particles in about 1.5×10^{-12} seconds, or a billionth of the blink of an eye.

After travelling only 2 millimetres in the detector, the beauty quark decayed to a lighter quark – still paired with the original up quark – and the extra energy was carried off in the form of electron-like particles called muons.

"It's a very rare event; it's like a needle in a haystack," says Andreas Schopper, a spokesman for LHCb. "In these 10 million data or so we find this one event."

Beauty quarks could take us back to the first moments of the universe. They form in high-energy explosions, so the big bang must have created quite a few. By examining the quarks' decay, LHC researchers hope to find clues as to what happened to the universe's antimatter: the big bang should have created antimatter alongside matter, but there is little sign of it today.

"While precision measurements will need many millions of beauty particles, as with kisses, the first is always very special," says Jürgen Schukraft, spokesperson for the LHC's ALICE experiment, which studies heavy ions. Kate McAlpine ■

Jungle funerals: how chimps mourn their dead

IN A forest clearing in south-east Guinea, a mother chimpanzee gently puts down her baby to crack open a nut. There's something wrong with the apparently mundane scene, though: the baby is dead, and has been for weeks.

The 1-year-old infant, Jimato, died of flu when an epidemic struck a chimp community in the district of Bossou in 2003. The virus also killed 2-and-a-half-year-old Veve, and both corpses were carried by their mothers for weeks (see photo). The events were observed by Dora Biro of the University of Oxford and her colleagues, who have just published their account.

Five years later, in Blair Drummond Safari and Adventure Park in Stirling, UK, a group of chimps was seen to "mourn" the death of a 50-year-old female called Pansy. After she died, her daughter stayed beside her throughout the night. Later, members of the group cleaned the corpse and avoided the place where Pansy had died (*Current*

Biology, vol 20, p R349).

James Anderson, a psychologist at the University of Stirling who studied the episode, says Pansy's group of apes showed signs of "rituals" to cope with death – although he says different behaviour has been seen around adult deaths in the wild.

The events in Bossou, on the other hand, suggest that a period of continued contact after the death of an infant may be

"Chimps may not only understand the concept of death but have ways of coping with it"

important for a mother chimp to adjust psychologically to her loss, Anderson says.

Other primates have been seen carrying infant corpses around, but rarely for more than a few days before they were snatched by males or wet conditions caused them to fall apart. The Bossou corpses, on the other hand, were



Not ready to let go

mummified by dry-season conditions, and carried for 68 and 19 days respectively before they were abandoned (*Current Biology*, vol 20, p R351).

In many ways, their mothers treated the corpses as though they were still alive: they groomed them, swatted flies away and made high-pitched screams of distress

when they accidentally dropped the bodies. But there were telltale signs – occasional flinching, for instance – showing that they knew the infants were dead.

The two studies "make a strong case that chimps not only understand the concept of death but also have ways of coping with it," says Anderson. **Shanta Barley** ■

Female sharks are doing it for themselves

CAN'T find a mate? Try parthenogenesis. The type of asexual reproduction may be part of an extreme survival strategy for sharks.

In parthenogenesis, females' eggs start dividing without being fertilised. This produces daughters that are genetically similar to the mother. It was first observed in a captive hammerhead shark in 2001, but this was an isolated incident, and the shark pup died after three days, making it difficult to say much about its evolutionary significance.

Kevin Feldheim at the Field Museum in Chicago, and an international team of colleagues,



No father required

have now shown that the incident was not exceptional and sharks born from a virgin mother can survive for many years (*Journal of Heredity*, vol 101, p 374).

The team were inspired by the 2001 birth to keep eggs produced by a captive white-spotted bamboo

shark at the Belle Isle Aquarium of the Detroit Zoological Institute. The female had never encountered a male during her adult life and biologists had assumed the eggs were infertile. To their surprise seven incubated eggs produced two pups that survived five years before they were

transferred to another facility. Genetic analysis confirmed that they were parthenogens.

"This suggests that parthenogenesis is a viable shark survival strategy," says Paulo Prodöhl of Queen's University Belfast, UK, who is investigating a possible case of virgin birth in the whitetip reef shark.

Modern sharks have been on Earth for several hundred million years. One theory is that switching from sexual reproduction to virgin birth might have helped these ancient creatures survive so long. Prodöhl suggests virgin birth could have been a safeguard mechanism. Several shark species live in single-sex groups and he says parthenogenesis may have ensured that isolated populations of females could survive without males. **Shaoni Bhattacharya** ■

INSIGHT

DNA dilemma: settlement highlights wider issues posed by gene research

A UNIVERSITY has agreed to pay 41 members of a Native American tribe \$700,000 after using DNA for purposes it was not donated for. The settlement ends a dispute between the Havasupai people and geneticists at Arizona State University in Tempe. It also highlights a dilemma facing much modern genetics research.

Scientists who work with human subjects must obtain informed consent, making sure the participants understand and agree to the purposes of the research and the risks it might entail. This process does not always sit well with the demands of genetics research. Direct physical harm is unlikely, but the potential for privacy violation is great. DNA can also turn out to reveal so much about disease risk, ancestry and other aspects of biology that researchers often find themselves itching to use people's DNA to answer questions that could not have been predicted at the outset.

Such curiosity is what got Arizona State University into trouble with the Havasupai. The disputed DNA was collected in the early 1990s to shed light on the high rates of

diabetes among the Havasupai, but researchers went on to use it to probe their ancestry, which angered tribe members.

Since then, "things have really progressed", says Bartha Maria Knoppers, director of the Centre of Genomics and Policy at McGill University in Montreal, Canada. Nowadays, if researchers want to use samples to study a condition not

Havasupai people visited Tempe to say prayers over disputed blood



JIM WILSON/THE NEW YORK TIMES/REDOX/EYEVIEW

initially specified, they must get permission from the participants – something that did not happen with the Havasupai's DNA. Another option is to obtain a waiver that usually requires all the data to be anonymised.

These approaches are not ideal for either researchers or volunteers. Participants can be difficult to track down, and once the link between DNA data and the donor has been broken it becomes impossible to collect extra information, such as a disease's progression. Matthias Wjst at the Institute for Genetic Medicine in Bolzano, Italy, says that researchers could do much more to keep study participants abreast of how their

DNA is being used, perhaps by making better use of social networking tools.

The Personal Genome Project (PGP), an effort to sequence the complete genomes of 100,000 volunteers, takes a radically different approach: it requires participants to consent to their DNA being used for just about anything – and posted online along with their medical history, allowing anyone to use it. PGP's bioethicist, Jeantine Lunshof, says this "open consent" approach is the only honest way to collect DNA. "We need to tell people that there is an uncertain future."

Others are more cautious. "It's an intriguing model, but I think it's totally un-generalisable," says Ellen Clayton at Vanderbilt University in Nashville, Tennessee. Researchers ought to focus on improving ways of protecting genetic data, not removing them, she says. "Without the trust of the public this isn't going to work."

Dan Vorhaus, a biotechnology lawyer who advises PGP, agrees its approach isn't for everyone. He suggests that some researchers asking for open consent could limit who can access participants' DNA, decreasing the chances of misuse. "I don't think it's the case that we need to abandon all attempts at privacy," he says. **Ewen Callaway** ■

Gene silencing prevents first human disease

THE discovery over a decade ago that snippets of RNA can be used as gene silencers in worms garnered a Nobel prize in 2006. Now, for the first time, RNA interference (RNAi) has proved to be effective against a human disease – a common respiratory virus.

Under RNAi, short strands of RNA are added to cells to destroy any native RNA molecules with a complementary sequence of letters. Since genes use RNA molecules to make proteins, these snippets effectively "silence"

genes that carry the same sequence. In animals, RNAi has shown promise, but progress in people has been slow.

John DeVincenzo studies paediatric infectious disease at the University of Tennessee Health Science Center in Memphis. He and his colleagues tested the ability of short interfering RNA (siRNA) to inhibit a virus of the respiratory tract, where cells are exceptionally willing to take up RNA snippets.

Eighty-five healthy adults were given a nasal spray containing either a placebo or siRNA designed to silence one of the genes of respiratory syncytial virus (RSV), which is the leading cause of infant hospitalisation in the US but fairly

harmless in healthy adults. They were to use the spray daily for five days. On day two, all the volunteers were infected with live RSV. By day 11, just 44 per cent of those who received the RNAi nasal spray had RSV infections, compared with 71 per cent of the placebo group.

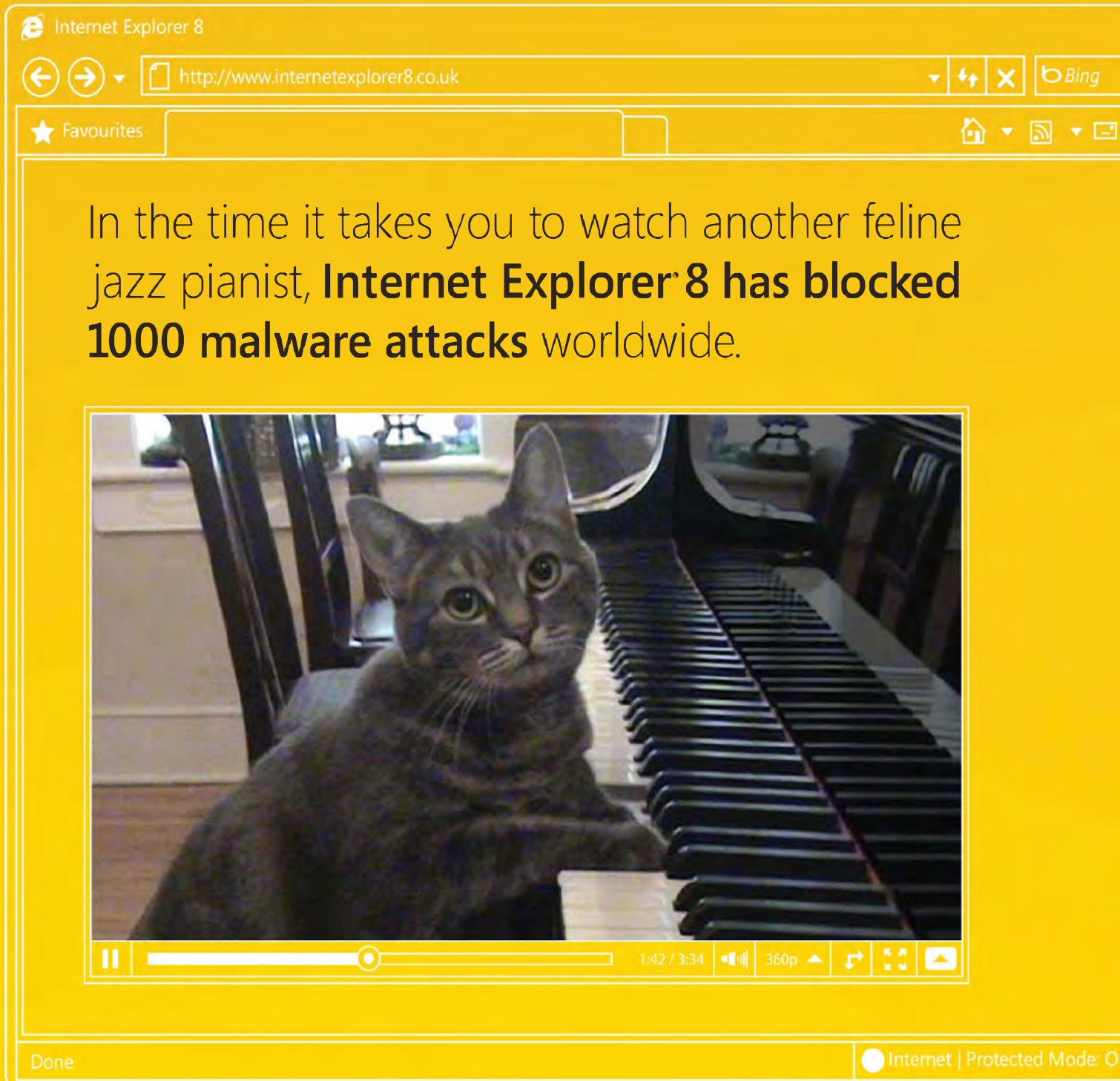
RNAi can trigger an immune response, which might have helped keep infections at bay. But blood samples showed that the risk of RSV infection did not depend on levels of immune molecules, suggesting that

"RNA interference has proved to be effective against a common respiratory virus"

RNAi's protective effect was due to the silencing of genes (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.0912186107).

The team is now testing the therapy in lung-transplant patients, who take immune-suppressing drugs that can make RSV infections deadly. DeVincenzo also hopes to test the therapy in infants soon.

For non-respiratory diseases, however, other ways of getting RNA into the target cells are needed. "Delivery has always been the big issue for RNAi," says John Rossi, a molecular geneticist at City of Hope medical centre in Duarte, California, who is testing RNAi's potential to fight HIV. Bob Holmes ■



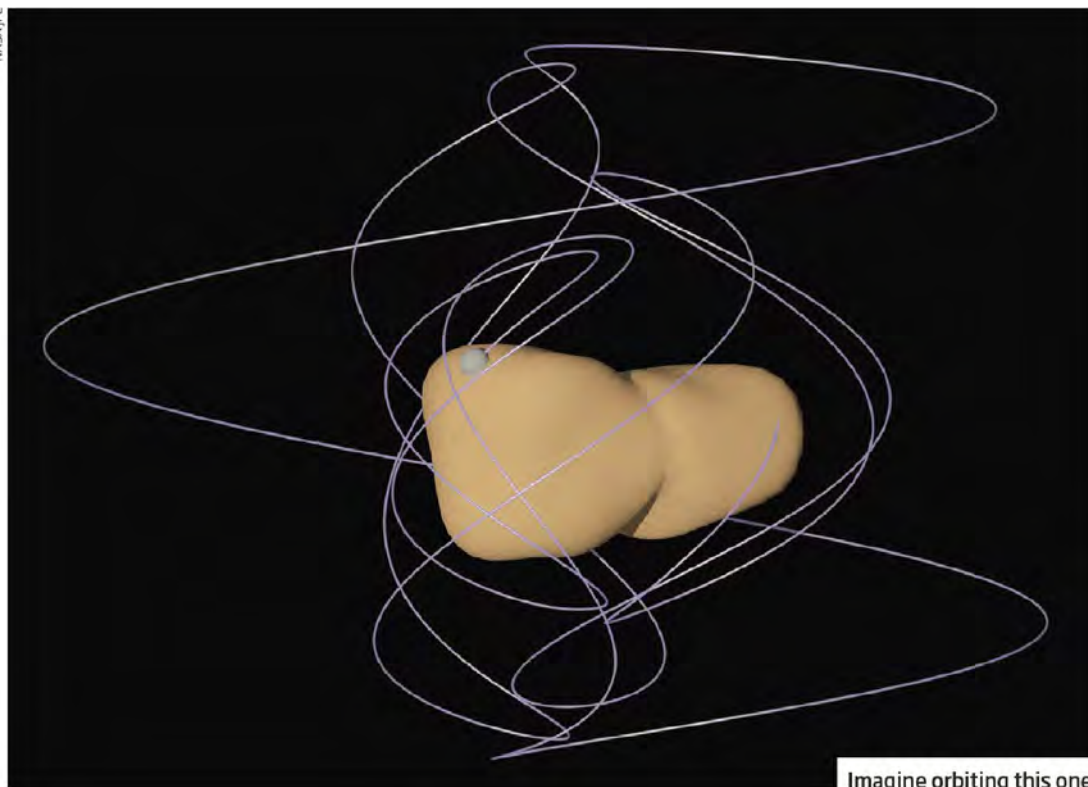
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Imagine orbiting this one

Wanted: attractive asteroid for visit

David Shiga

DECIDING to send astronauts to an asteroid is all very well, but now NASA will have to find the few space rocks that are suitable to visit, and work out how to rendezvous safely.

Last month, US president Barack Obama announced the next destination for NASA astronauts would be an asteroid, as early as 2025. The goal would be to gain experience of safely sending humans far from Earth, as a stepping stone towards longer journeys to Mars. Studying the interior of an asteroid up close could also prove important if we ever need to deflect one. Yet achieving the goal will mean overcoming daunting challenges.

Before landing on an asteroid, a spacecraft must enter its orbit, rather than simply whizzing by. That means matching the object's

speed and direction of motion, which in most cases would require burning too much rocket fuel to be practical. The only way round this would be if the asteroid's motion happened to be very similar to Earth's at the time of its closest approach.

Even if a space rock passes that test, few have close approaches to Earth in the right time frame, in 2025 or the following few years, points out Martin Elvis of the

Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, who was to speak on the subject this week at a meeting of the American Astronomical Society's Division on Dynamical Astronomy in Boston.

A 2009 study led by Paul Abell of NASA's Johnson Space Center in Houston, Texas, found only seven asteroids that could be visited between 2025 and 2030, from a list of more than 1200 near-Earth objects (*Meteoritics and Planetary Science*, vol 44, p 1825). New discoveries since that study – which only included asteroids known in 2006 – has increased that number to 42, but many of these could be rejected

when further criteria are applied.

The rotation rate of most asteroids is unknown, but any fast-spinning objects will be off limits because they would be difficult for astronauts to hang onto. Combine that with potential mission delays, and it becomes clear that many more candidates are required, Elvis says. "I think people have not appreciated how many you need," he says. "NASA will need to survey huge numbers of asteroids to sift out the limited number of really good ones."

Abell is optimistic that telescopes like the Pan-STARRS observatory that recently opened in Hawaii will expand the list of candidates. "There could be many, many targets to go to," he says.

However, ground-based telescopes are hampered because asteroids in orbits similar to Earth's are often hidden by the glare of the sun, Elvis says. He advocates launching a space telescope to orbit the sun near Venus, from which it could look outward to see asteroids near Earth's orbit – an idea that has long been discussed by astronomers but never funded.

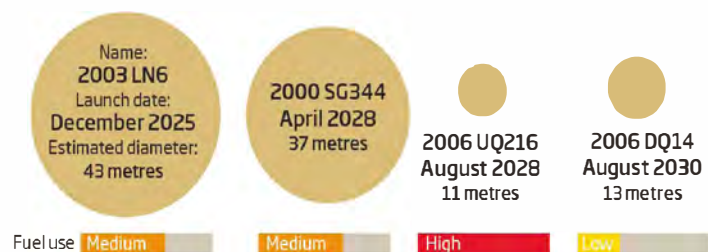
"Any fast-spinning objects will be off limits because they would be difficult for astronauts to hang onto"

Even if enough suitable targets can be found, there are more problems to overcome. Small, irregularly shaped asteroids have lumpy gravity fields, so an orbiting spacecraft would follow a chaotic trajectory, making navigation much trickier than around Earth or the moon, says Daniel Scheeres of the University of Colorado in Boulder, who has simulated such orbits (see picture).

The surfaces of some asteroids may also be unstable, so astronauts could accidentally set off a landslide, Scheeres says, adding that it would be wise to send robots before humans. "We don't have the sort of data that you might want before you send an astronaut," he says. ■

Which space rock?

Each of these asteroids would take five to six months to reach, but the mission launch date and amount of fuel needed to land on them varies



Cellular 'battery' is new source of stroke defence

GENE hunters looking for the causes of strokes and other common diseases may have been looking in the wrong place. It seems that common mutations in the DNA of mitochondria, tiny structures that form the energy powerhouses of cells, may protect people against strokes, and play a role in Parkinson's and other complex diseases.

Until now mitochondrial DNA has only been associated with a few, rare disorders: catastrophic mutations can cause diseases such as MELAS, which results in muscle weakness and seizures. But recent studies have hinted that less problematic – but far more common – mitochondrial mutations might also be implicated in diseases with no obvious link to

energy demand, including strokes.

Mitochondrial DNA varies from person to person, but humans can generally be divided into broad "haplogroups" on the basis of the combinations of mutations they possess. Patrick Chinnery at the University of Newcastle, UK, and his colleagues assigned haplogroups to 950 people who'd had strokes, 340 people with heart disease symptoms, and 2939 healthy volunteers, all of whom live in Oxfordshire, UK.

They found that among those people who'd had strokes, half as many belonged to haplogroup "K" as would be expected in the general population. The researchers conclude that K – which accounts for around 9 per cent of people of European

ancestry – decreases the risk of stroke by 50 per cent compared with the other haplogroups. This makes it one of the best predictors of stroke risk identified so far – on a par with aggressively lowering blood pressure (*The Lancet Neurology*, DOI: 10.1016/S1474-4422(10)70083-1).

Belonging to the other haplogroups did not alter the risk of stroke and haplogroup K's protective effect didn't extend to heart disease.

"This could explain why genome-wide association studies have failed to identify new stroke genes"

The result could help explain why genome-wide association studies – which only look at nuclear DNA – have so far failed to identify new genes associated with stroke, says Chinnery. "Our findings indicate the importance of mitochondrial DNA

as a genetic risk factor," he adds.

It is not clear how mitochondrial mutations offer stroke protection but Chinnery speculates that those found in haplogroup K might produce fewer reactive oxygen species, which are known to contribute to the blood vessel damage that leads to strokes.

The next step is to examine whether different groups within haplogroup K are better protected against strokes than others, and to work out what the protective mechanism is.

Other recent studies suggest a link between specific mitochondrial haplogroups and other complex disorders, including diabetes, Parkinson's and Alzheimer's, and the rate at which people with HIV develop AIDS. Some have even linked a haplogroup particularly prevalent among centenarians to longevity (*PLoS One*, DOI: 10.1371/journal.pone.0006423). Linda Geddes ■



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Energy drinks give your muscles an instant boost

IF YOU spit out an energy drink after taking a sip, it could still boost your strength. This pre-digestive effect is immediate and seems due to a newly discovered neural pathway that links taste buds to muscles.

Nicholas Gant at the University of Auckland in New Zealand previously showed that mouth-rinsing and then spitting out a carbohydrate solution immediately improved performance at sprinting and cycling – even though it takes at least 10 minutes for carbohydrates to be digested and utilised by muscles.

This time, Gant's team had 16 participants tire out their

biceps by flexing them for 11 minutes before rinsing their mouths with either a carbohydrate drink or a non-caloric, taste-matched one. One second after rinsing, the team applied transcranial magnetic stimulation to the participants' scalps, which aided the detection of activity in the motor cortex, a brain area known to send signals to biceps.

The team found that the volunteers who swilled with carbohydrates were able to flex with more force immediately afterwards, and had a 30 per cent stronger neural response compared with those given placebo. Gant says it's likely that taste receptors detect carbohydrates, resulting in a signal to fatigued muscles "that help is on the way" so they continue working hard (*Brain Research*, DOI: 10.1016/j.brainres.2010.04.004).

Fetuses have their own immunity

FETUSES aren't as defenceless as they seem – they may be armed to fight off viruses long before birth.

It was thought that fetal immune cells were too immature to be useful and that fetuses and newborns relied on antibodies provided by their mothers. Now David Vermijlen at the Institute for Medical Immunology in Brussels, Belgium, and his colleagues have shown that

fetuses just 21 weeks old may be capable of fending off infections using their own immune cells. This could lead to new vaccines for newborns and unborn babies.

Vermijlen's team analysed cord blood from 19 newborns infected with cytomegalovirus (CMV) – which can cause serious symptoms in infected infants and give fetuses brain damage – and 22 uninfected newborns. The

team found that the number of gamma delta T-cells was higher in the CMV-infected babies, and that a greater proportion of these immune cells were activated.

When the team compared the types of immune cells activated in the fetus with those in the mother, there were clear differences, suggesting that fetuses generate an independent immune response to CMV (*Journal of Experimental Medicine*, DOI: 10.1084/jem.20090348).

Cosmic rays may 'sterilise' galaxies

WHERE are all the missing galaxies that should be orbiting the Milky Way? Cosmic rays may have "sterilised" them so that they cannot form new stars and so are now too dim to see.

Standard theories of dark matter and galactic evolution predict that a few thousand dwarf galaxies should be spiralling around our galaxy, but a mere 35 have been found. Many are very faint, though, suggesting others might not be missing but instead are unseen blobs of dark matter.

Now, Markus Wadepuhl and Volker Springel of the Max Planck Institute for Astrophysics in Garching, Germany, say cosmic rays from sparse supernovae inside these small galaxies pelt the surrounding gas, which then has trouble collapsing into stars due to the rays' high energies. Their computer simulations of galaxy formation are the most detailed yet (arxiv.org/abs/1004.3217).

Look for Mars life with laughing gas

TRACE amounts of laughing gas, or nitrous oxide, in Mars's atmosphere could aid the search for life on the Red Planet.

Mandy Joye of the University of Georgia in Athens, US, and colleagues found that the nitrite-rich water of hypersaline Don Juan pond in Antarctica reacts with minerals in volcanic rock to produce nitrous oxide (*Nature Geoscience*, DOI: 10.1038/ngeo0847).

Joye speculates that a similar reaction could produce the gas on Mars. Since the reaction produces nitrous oxide with a specific isotopic signature, Joye says: "This could be an easy way to 'sniff' around the surface of Mars looking for pockets of subsurface brine that might be hotspots for extreme microbial life."

It's raining males, if you're a buffalo

EAT red meat if you want a boy baby, fish and vegetables for a girl... Myths about how women can influence the sex of their baby abound, but for African buffalo, such effects are more science than fiction, and the main driver is the pitter-patter of tiny raindrops.

During wet periods, about 55 per cent of conceptions are male, but this falls to 45 per cent in dry seasons, says Pim van Hooft of Wageningen University in the Netherlands. He analysed data from more than 3000 buffalo culled over 20 years in South Africa's Kruger National Park.

Van Hooft found that some males carry a "sex-ratio distorter" gene which ensures that more males are conceived in the wet season, when food is abundant, making the fathers fitter and their sperm quality higher. Other would-be fathers carry a "sex-ratio suppressor" which does the opposite, producing a slight boost in female offspring conceived in the barren dry season.

Carriers of the "distorter" gene mate almost exclusively in the wet season, while the opposite is true of the "suppressor" carriers, which breed largely in the dry season. The system ensures that the population has fitter males: the physique and high sperm quality of wet-season fathers are passed on to the more abundant males of the next generation, says van Hooft.



FRIEDRICH VON HORSTEN/ALAMY

Killing cancer stem cells is a game of whack-a-mole

TO KILL a tumour, go after its neighbours: it seems to be the tumour-free tissue surrounding colon tumours that fosters the cancer's most pernicious cells.

One theory says that tumour cells can be divided into two types: ordinary ones and cancer stem cells, which can divide indefinitely and go on to form any kind of tumour cell, driving the growth of tumours. "Not all tumour cells are created equal," says Louis Vermeulen, a biologist at the University of Amsterdam in the Netherlands. Now

Vermeulen's team has found that all colon cancer cells may have the potential to revert to stem cells and that whether they do depends on their environment.

The team found that connective-tissue cells adjacent to colon cancer stem cells secrete growth factors that activate a molecular pathway in other cells that is vital to maintaining stem-cell-like qualities. Only cancer cells that received these growth factors switched on this pathway, and only they could seed new tumours when injected into mice. What's

more, when ordinary colon cancer cells were implanted near connective tissue in other mice, they transformed into cancer stem cells (*Nature Cell Biology*, DOI: 10.1038/ncb2048).

This suggests that treatments that merely attack cancer stem cells may not be enough – and could end up like a game of whack-a-mole. "Maybe you should attack this process, not its result," says Vermeulen. Stopping cancer stem cells communicating with the neighbouring tissue may be more effective.

Seven dwarfs killed off marine life

SEVEN small undersea "volcanoes" that once spewed asphalt into the Pacific Ocean have been mapped off the coast of California. They could be the cause of a prehistoric marine dead zone thought to exist in the area.

David Valentine and colleagues at the University of California, Santa Barbara, surveyed the sea floor and discovered the mounds, the largest of which rises 20 metres above the seabed, made from tar. Some were still releasing methane. It is the first time that asphalt "volcanoes" have been identified in the area. Valentine says they formed as sticky hydrocarbons seeped from the seabed around 40,000 years ago (*Nature Geoscience*, DOI: 10.1038/ngeo848).

Methane would also have been released at a rate that greatly exceeds today's output, with devastating consequences for the local ecosystem. The gas would have attracted bacteria that metabolise methane and deplete oxygen. That fits with analysis of sea-floor sediments, which suggests that a dead zone of around 600 square kilometres formed here around 40,000 years ago.



FLUP/NICKLUM/INDEN/FLPA

What type of killer whale was Willy?

AND then there were three: long-held assumptions that all killer whales belong to the same species have been blown apart by a DNA analysis of 139 orcas. It reveals that there are at least three separate species.

"These have all radiated from one another quite recently, from 150,000 to 700,000 years ago," says Phillip Morin of the Southwest Fisheries Science Center in La Jolla, California (*Genome Research*, DOI: 10.1101/gr.102954.109). The three new species differ in appearance, hunting habits and diet.

Ross Sea killer whales from the

Antarctic are about two-thirds the size of most orcas, eat only fish and have the smallest eye streak of all. Pack-ice killer whales also live in the Antarctic but have the largest eye patch and hunt seals. Both are greyer than the north-east Pacific transient killer whales living off Alaska, which feed on marine mammals, including dolphins.

The fact that the species have such different diets could explain the difficulties some aquaria have had getting their captive orcas to eat fish. Morin says he has no idea which species Willy, of *Free Willy* fame, belonged to.

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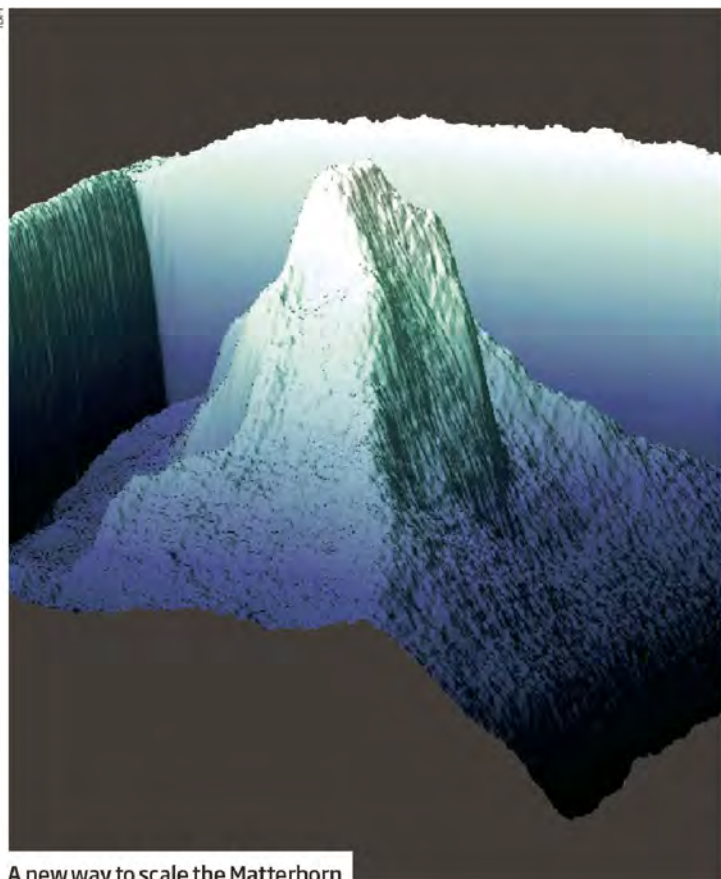
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A new way to scale the Matterhorn

Nanosculptors grow ambition

IT CERTAINLY turns making a mountain out of a molehill on its head. IBM researchers have sculpted a 1:180 billion scale model of the Matterhorn, the 4478-metre alp on the border of Germany and Italy.

Armin Knoll and colleagues at IBM Research in Zurich, Switzerland, carved the minute mountain, measuring 25 nanometres from base to peak, using a technique called Millipede that was developed for high-density computer storage.

IBM unveiled Millipede - a form of computer memory that promises to store hundreds of gigabytes of data per square centimetre by punching nanoscale holes in a polymer sheet - in 2002.

Now Knoll's team has found that it is possible to evaporate material from a surface by heating Millipede's punching needle to 330 °C. "We use

heat instead of force to carve," says Knoll. "No other method can produce 3D objects with such precision."

The microscopic Matterhorn was carved from a glassy organic material whose molecules are held together by hydrogen bonds that can be broken by flashes of heat

"We use heat, not force, to carve. No other method can produce 3D objects with such precision"

from the Millipede needle.

Knoll's team suggest that potential applications of the technique include the ability to make tiny lenses for ever-smaller silicon chips. The lenses would allow for optical connections on chips that are too small for current-carrying electronic wires to work efficiently.

Keeping athletes at peak hydration

TRACK athletes in Ireland preparing for the 2012 Olympics have been testing a device designed to improve performance by optimising their hydration levels during training.

Dehydration causes tiredness and cramping. Readings taken after training are unreliable, so Fernando Benito Lopez of Dublin City University has developed a device that assesses hydration levels while athletes are training. An absorbent pad strapped to the athlete's body draws sweat through a narrow channel containing pH sensors. Readings sent wirelessly to the coach reveal the sodium content of the athlete's sweat and therefore their hydration level. Training can then be fine-tuned accordingly.

Details will be presented at next month's Lab-on-a-Chip European Congress in Dublin.

2

milligrams per cubic metre. The maximum safe concentration of volcanic ash, according to the UK Civil Aviation Authority

Safer repairs for brain blood vessels

REPAIRING weakened blood vessels in the brain may soon be less hazardous thanks to a device that protects damaged areas.

When a weakness develops in the wall of a blood vessel, the pressure of the blood can cause it to balloon out, forming what is called an aneurysm. At least 2 per cent of people in the UK and US are thought to have aneurysms in the brain, putting them at risk of a haemorrhage.

They are treated either by surgery to clip the base of the aneurysm or by inserting platinum coils into the cavity.

The coils promote the formation of a clot in the cavity to relieve pressure on the weakened part of the blood vessel. A metal mesh tube, or stent, is sometimes used to bridge the weakened section of blood vessel and keep the coils in place. However, there is still a risk of them escaping, with potentially serious consequences.

Engineer Zhong You and colleagues at the University of Oxford have created a new flow-diverting stent with leaf-shaped sections that unfurl to deflect blood flow away from weak points. The devices, which remove the need for coils, can be individually tailored for each patient.

The team plans to begin testing its design in animals this year.



"I don't know how this could be weaponisation of space"

Gary Payton of the US air force dismisses concerns that the X-37B spaceplane launched last week is a weapon, saying it will be used for research. The craft is like a pilotless, scaled-down space shuttle but details of its capabilities and first mission are classified (AOL News, 22 April)

Smartphone chips make a better brain

To put computers with brain-like flexibility to work we have to build them from readily available components like the processor in your pocket

Paul Marks

IF YOU have a smart phone, you probably have a slice of Steve Furber's brain in your pocket. By the time you read this, his 1-billion-neuron silicon brain will be in production at a microchip plant in Taiwan.

Computer engineers have long wanted to copy the compact power of biological brains. But the best mimics so far have been impractical, being simulations running on supercomputers.

Furber, a computer scientist at the University of Manchester, UK, says that if we want to use computers with even a fraction of a brain's flexibility, we need to start with affordable, practical, low-power components.

"We're using bog-standard, off-the-shelf processors of fairly modest performance," he says.

Furber won't come close to copying every property of real neurons, says Henry Markram, head of Blue Brain. This is IBM's attempt to simulate a brain with unsurpassed accuracy on a Blue Gene supercomputer at the Swiss Institute for Technology, Lausanne. "It's a worthy aim, but brain-inspired chips can only produce brain-like functions," he says.

That's good enough for Furber, who wants to start teaching his brain-like computer about the world as soon as possible. His first goal is to teach it how to control a robotic arm, before working towards a design to control a humanoid. A robot controller with even a dash of brain-like properties should be much better

at tasks like image recognition, navigation and decision-making, says Furber.

"Robots offer a natural, sensory environment for testing brain-like computers," says Furber. "You can instantly tell if it is being useful."

Called Spinnaker – for Spiking Neural Network Architecture – the brain is based on a processor created in 1987 by Furber and colleagues at Acorn Computers in



Cambridge, UK, makers of the seminal BBC Microcomputer.

Although the chip was made for a follow-up computer that flopped, the ARM design at its heart lived on, becoming the most common “embedded” processor in devices like e-book readers and smartphones.

But coaxing any computer into behaving like a brain is tough. Both real neurons and computer circuits communicate using electrical signals, but in biology the “wires” carrying them do not have fixed roles as in electronics. The importance of a particular neural connection, or synapse, varies as the network learns by balancing the influence of the different signals being received. This synaptic “weighting” must be dynamic in a silicon brain, too.

The chips under construction in Taiwan contain 20 ARM processor cores, each modelling 1000 neurons. With 20,000

because the basic nature of individual neurons means that they work together in an emergent, bottom-up way.

Spinnaker cannot mimic that property, so it relies on a miniature controller to direct spike traffic, similar to one of the routers in the internet’s backbone. “We can route to more than 4 billion neurons,” says Furber, “many more than we need.”

While the Manchester team await the arrival of their chips, they have built a cut-down version with just 50 neurons and have put the prototype through its paces in the lab. They have created a virtual environment in which the silicon brain controls a Pac-Man-like program that learns to hunt for a virtual doughnut.

“It shows that our four years designing the system haven’t been wasted,” says Furber. He hopes to have a 10,000-processor version working later this year.

As they attempt to coax brain-like behaviour from phone chips, others are working with hardware which may have greater potential.

The Defense Advanced Research Projects Agency, the Pentagon’s research arm, is funding a project called Synapse. Wei Lu of the University of Michigan at Ann Arbor, is working on a way of providing synaptic weights with memristors, first made in 2008 (*New Scientist*, 3 May 2008, p 26).

Handily, their most basic nature is brain-like: at any one moment a memristor’s resistance depends on the last voltage placed across it. This rudimentary “memory” means that simple networks of memristors form weighted connections like those of neurons. This memory remains without drawing power, unlike the memory chips needed in Spinnaker. “Memristors are pretty neat,” says Lu.

Their downside is that they are untested, though. “Synapse is an extremely ambitious project,” says Furber. “But ambition is what drives this field. No one knows the right way to go.” ■

“To coordinate its ‘neurons’ the chip mimics the way real neurons communicate using ‘spikes’ in voltage”

neurons per chip, 50,000 chips will be needed to reach the target of 1 billion neurons.

A memory chip next to each processor stores the changing synaptic weights as simple numbers that represent the importance of a given connection at any moment. Initially, those will be loaded from a PC, but as the system gets bigger and smarter, says Furber, “the only computer able to compute them will be the machine itself”.

Another brain-like behaviour his chips need to master is to communicate coordinated “spikes” of voltage. A computer has no trouble matching the speed at which individual neurons spike – about 10 times per second – but neurons work in very much larger, parallel groups than silicon logic gates.

In a brain there is no top-down control to coordinate their actions

INSIGHT

New code blurs the boundary between your computer and the web



WOULDN'T it be nice to have just one, all-powerful program on your computer? No cluttered desktop, just one icon that opens a window capable of any task imaginable.

In fact, you probably use that omnipotent program often: it's your web browser. Over the last few weeks, some of the largest digital companies around have added their support to a new version of the code behind the web that will enable tomorrow's websites to usurp today's conventionally installed programs.

The technology creating the buzz is a new version of the HyperText Markup Language (HTML) used to make all web pages. Like its predecessors, HTML5 will be effectively invisible to most people, but it has the potential to dramatically change computing.

Advanced web services, such as Google's online office suite and Adobe's online version of Photoshop, already ape conventional software. But such web applications still don't feel quite “right”, because current HTML ring-fences the web from the rest of a computer.

HTML5 is designed in part to dissolve that barrier. For example, last week Google used the still-unfinished format to let users drag files into its web-mail service as they would across their computer desktop. The firm also plans to use HTML5 to make

With its iPad, Apple is embracing HTML5 – the future of web code

its online office suite function offline, by storing some data locally and seamlessly synchronising new changes when a connection becomes available.

The launch of Apple's iPad has also boosted HTML5's profile. Eyebrows were raised when the firm declared that its device would never support Adobe's Flash plug-in, widely used to deliver online video. But suggestions that this would prevent iPad users from fully experiencing the web are looking shaky. Apple has instead embraced HTML5, which can provide video without the need for third-party plug-ins like Flash. Many big producers of web content, including Flickr and Reuters, are responding to Apple's move by beginning to serve their video up in this way.

The new format should also speed the development of new kinds of websites for presenting magazines and newspapers on tablet computers.

So far, so good, but the consortium of web-programmers and academics working on HTML5 don't expect it to be finished before 2020. With so many of its features already finding favour with web producers, though, don't be surprised if an all-purpose window arrives on your desktop sooner than that. **MacGregor Campbell** ■

Steer space junk out of Earth's orbit with a laser

WITH Earth's orbit cluttered with dead satellites, discarded rocket boosters and other space junk, ways to prevent the accumulation of such debris are desperately needed.

How about using a tractor beam to simply steer future junk aside, says space-flight engineer John Sinko of Nagoya University, Japan.

Sinko's idea is based on an experimental type of spacecraft engine called a laser thruster. Inside these motors, laser pulses fired into a mass of solid propellant cause a jet of material to be released, pushing the craft in the opposite direction.

Sinko realised that the laser did not necessarily have to be on the same craft. "These on-board motors

needed to use a beam to tug one towards the laser (see diagram).

Combining those designs could allow full control in any direction, says Sinko. He imagines spacecraft being fitted with remotely operated thrusters before launch, so that once they reach the end of their lives it is simple to alter their orbit or even shove them into the atmosphere to burn up - even if they have lost all power (*Journal of Propulsion and Power*, DOI: 10.2514/1.46037).

Tractor beams could be fired from up to 100 kilometres away, says Sinko, either from a spacecraft in orbit or a mirror in space redirecting a beam from Earth.

"It's an interesting idea that could work in principle," says Richard Holdaway, director of space science technology at the Rutherford Appleton Laboratory in Didcot, UK. Keeping a laser beam accurately trained on a distant motor would be a challenge, he adds, "but perhaps not an insurmountable one".

Sinko hopes to test one of his tractor beams on a 10-kilogram satellite within a few years. He is not alone in trying to develop such technology: a team at the Research Institute for Complex Testing of Optoelectronic Devices and Systems in Sosnovy Bor, Russia, is working on similar ideas. Paul Marks ■

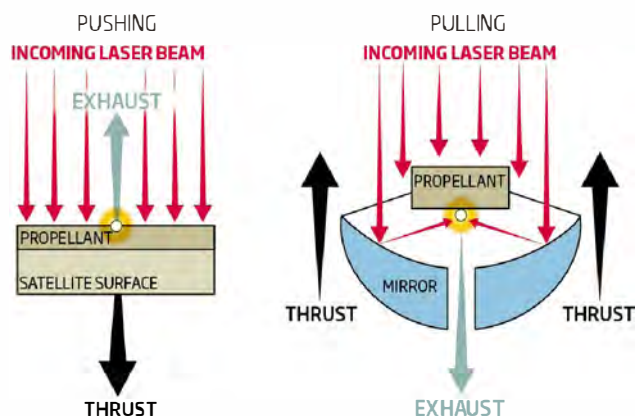
"A spacecraft could fire a low-power laser beam at another craft to steer it from a distance"

could also be targeted remotely by lasers for tractor beaming," he says.

He has designed a series of laser thrusters that can be activated in this way. A spacecraft fitted with a laser would fire a low-power beam at a thruster fitted on another craft to attract, repel or steer it in another direction. Pushing a spacecraft away is a relatively simple matter, but more complex designs using mirrors are

Making space in space

Satellites fitted with laser thrusters could be controlled remotely with low-power lasers to manoeuvre them out of Earth's orbit



So real it hurts

Survival of the fittest makes for more lifelike animations

MONSTERS and aliens that move more realistically than ever before are coming soon to a screen near you. It's all down to an animation technique first used to "evolve" the most lifelike interaction between human characters and their surroundings through trial and error.

NaturalMotion of Oxford, UK, whose technique was used in the films *Troy* and *Poseidon*, has now shown that artificial evolution can equally be applied to non-human body shapes - for instance, bipedal monsters.

"It's equivalent to me waking up in a child's body and being able to balance and look natural straight away," says Torsten Reil, the firm's CEO.

State-of-the-art animation for non-human film characters usually involves filming real actors wearing motion-capture sensors. Then artwork of a monster, say, is mapped onto the footage and made to move using these sensors as a guide.

Computer games use this technique but it is not ideal because a number of set sequences must be applied in almost all situations.

The team at NaturalMotion took a different approach. They began with 100 identical virtual skeletons, complete with simulated muscles and motor nerves. Then they attributed random values to the strength of connections between key motor nerves in each individual and made them perform a task, such as walking.

Those that walked furthest without falling were labelled the "most fit" and used to spawn the next generation. By running this process over several generations, they evolved algorithms capable of generating natural-looking movement in any situation, says Reil.

These skills will be on show in NaturalMotion's *Backbreaker* American football game, which is due for release in June. Reil's team have now applied their algorithms to radically different body shapes.

"We can add additional joints - we might give a leg two knees," says Reil. "And recently I've been looking at how a three-legged stool walks and balances. It makes you realise why biology doesn't go for three legs." Colin Barras ■

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A sprinkling of doubt

Excess dietary salt is a killer and you should take any evidence to the contrary with a large pinch of the stuff, say **Franco Cappuccio** and **Simon Capewell**

SALT hidden in food kills millions of people worldwide. Reducing dietary salt is therefore important for public health; it is also one of the cheapest and easiest ways to save lives. So why are efforts to cut dietary salt being met with fierce resistance?

First the facts. Decreasing salt intake substantially reduces blood pressure, thus lowering the risk of heart attacks and strokes. An analysis of all the available evidence, published in 2007, suggested that reducing salt intake around the world by 15 per cent could prevent almost 9 million deaths by 2015. That is on par with the public health benefits of reducing cholesterol and stopping smoking (*The Lancet*, vol 370, p 2044).

Other analyses have concluded that cutting daily salt intake by 5 grams could reduce strokes by 23 per cent and cardiovascular disease by 14 per cent (*BMJ*, vol 339, p b4567; *Journal of Human Hypertension*, vol 23, p 363).

The benefits of salt reduction may also extend further. Links have repeatedly been reported between high salt intake and chronic kidney damage, stomach cancer and osteoporosis.

There is no doubt that our salt intake is excessive. A typical British adult consumes roughly 8.6 grams of salt per day. Americans consume even more, about 10 g, which is almost twice the recommended limit in the US. It is also over six times what the body actually needs.

According to US national dietary guidelines, adults should eat no more than 6 g of salt a day.



The World Health Organization recommends 5 g. Even this is in excess of bodily needs. The physiological "adequate intake" for an adult is only about 1.5 g.

US guidelines are being updated and the 2010 version is widely expected to recommend a lower salt intake. New UK recommendations, from the National Institute for Health and Clinical Excellence, are also awaited with interest.

This excess intake is not a matter of personal choice. Only about 15 per cent of the salt in our diets comes from our own salt shakers; the rest is added to foods before they are sold. Salt is added to make food more palatable, to

increase the water content of meat products and to increase thirst. All generate profit for the food and drink industry.

This hidden salt means it is important to read labels and buy foods that are low in salt. That, however, is not enough. It is fine for people with the education, income and time to read and understand labels and the energy to modify their behaviour. But real life is rather different for many of us. Hence the need for public health interventions.

"Excess intake of salt is not a personal choice. Most of the salt in our diets is added to food before it is sold"

Most people agree that even in free-market economies, governments have a duty of care. This is especially true for children, who are particularly vulnerable to high salt intake.

This is the ethical justification for public health interventions in salt consumption. Governments legislate to make public spaces smoke-free, and they mandate cholera-free drinking water. They should also aim to progressively reduce the salt hidden in food.

In the US, the New York City Health Department is doing exactly that. It is coordinating the National Salt Reduction Initiative, a coalition of cities, states and health organisations working to help food manufacturers and restaurants voluntarily reduce salt. Fifteen state health departments are already signed up. The goal is to reduce Americans' salt intake by 20 per cent over five years. An authoritative analysis suggests that this may save tens of thousands of lives each year and avoid billions of dollars in healthcare costs (*The New England Journal of Medicine*, vol 362, p 650).

It can be done. Since 2004, the UK Food Standards Agency has been working with the food industry to reduce salt through clearer labelling and progressive reduction of salt so that consumers neither notice nor mind. As a direct result, average UK salt intake has fallen from 9.5 g to 8.6 g per day.

Other countries, notably Japan, Portugal and Finland, have done much better, reducing average

salt intake by 5 g or more per day via a combination of regulation, labelling, public education and collaboration with industry.

Earlier this month the US Institute of Medicine recommended government intervention to reduce salt intake. However, the food industry is fighting a bitter rearguard action against any such move. The salt industry's annual turnover is several billion dollars and it has no plans to downsize. Thus, in advance of the new US guidelines, articles have appeared in *The New York Times* and elsewhere claiming that the evidence for reducing salt is not clear-cut.

This controversy is fake. The evidence for salt reduction is clear and consistent. Most of the "contradictory research" comes from a very small number of scientists, most of whom are linked to the salt industry. However, it takes skill to spot misinformation and subterfuge. And so the confusion is successfully promulgated.

It is a familiar story. The tobacco industry spent decades denying that smoking caused fatal diseases. Their very successful strategies included accusations of scientific conspiracies, selective use of scientific evidence, and paying scientists to produce evidence to contradict the public health experts and confuse the public. In general, the food industry is more ethical, but it is far from squeaky clean.

Lives can be saved by cutting salt. How many depends on whether politicians choose to accept the evidence, or cave in to industry pressure instead. ■

Franco Cappuccio is director of the European Centre of Excellence in Hypertension and Cardio-Metabolic Research and head of the World Health Organization Collaborating Centre for Nutrition, both based at the University of Warwick, UK. Simon Capewell is professor of clinical epidemiology at the University of Liverpool, UK

One minute with... Jerry Zucker

The film director and producer talks about his bid to improve the way movies portray science

How well do you think movies have represented science?

I think it is a mixed bag. Sometimes it has been great, sometimes I cringe. In some ways Hollywood has done science a real disservice, since the scientist is frequently played as a crazed megalomaniac out to create life at any cost. Then you have a movie like *The Core*, which was full of science babble. On the other hand you have *The X-Files*, in which one of the lead characters is a female scientist, as a result of which more women started choosing science as a career.

You founded the Science and Entertainment Exchange in 2008. What's the idea behind it?

It came out of a conversation with the president of the National Academy of Sciences, who wanted to see if we could use our ties with Hollywood to communicate more and better information about science. The NAS thought the best way to get the word out was through documentaries, but that would be ineffective unless you're Michael Moore. We thought it would be better if we could act as a resource for the movie community, to interest them in science and help them with science-related issues.

How do film-makers use your organisation?

If someone wants to know the facts, we can connect them to the people who can tell them. It's also a brainstorming resource. We hold small gatherings of entertainment people and scientists, such as physicist Brian Greene and neurologist Stanley Prusiner, to explore ideas. For example, if you're working on a science fiction script about sending astronauts to another galaxy, scientists can provide more interesting theories about how it might be done than screenwriters.

What are your aims?

We're looking to cultivate an appreciation and a love of science. There are plenty of medical dramas that have doctors on set for accuracy – they stretch the limits quite a bit, but they make people watch the shows and they make medicine seem like a good profession. In a sense we want



PROFILE

Jerry Zucker's films include *Airplane!* and *Ghost*. With his wife he started the Science and Entertainment Exchange, which recently worked on *Iron Man 2*, out this week.

to do the same with science. It is a little harder, as science is about solving problems rather than fast-paced action. But the more we can get the entertainment community fascinated by science, the more we'll get positive messages about science out there.

Which movies have you helped out with?

This year we've helped with *Iron Man 2* and *Tron Legacy*, the sequel to the 1982 sci-fi film *Tron*. We're working on others, such as a script being developed by Roland Emmerich, who wrote *The Day After Tomorrow*, which has a strong genetics and bioweapons focus.

Are there any similarities between what scientists and film-makers do?

They're both creative, require a certain imagination and both are problem-solving enterprises. When you're writing a screenplay you have to figure out how all the pieces are going to fit together. In general I have noticed that scientists and film-makers hit it off. They're fascinated by one another.

Interview by Michael Bond

The affairs of tides

From Peter Fraenkel,
Marine Current Turbines
Hans van Haren correctly points out that tidal flow is not likely to meet all our energy needs, but his suggestion that it is therefore not worth trying to exploit this energy source is wrong (3 April, p 20).

No single resource can ever provide all our energy. "Only" 20 per cent of our electricity needs would be a very substantial contribution to replacing fossil fuel, equivalent to the world's installed hydroelectric capacity.

He is also wrong when he says there are only 20 suitable sites for extracting tidal stream energy around the world. There are more than that number of sites around the UK alone.

We have the world's first commercial-scale tidal turbine in Strangford narrows in Northern Ireland. It is subject to a pioneering independent environmental impact monitoring programme, and the operating licence specifies that it will be shut down if it causes any significant environmental damage. Killing

fish would clearly be within that category.

Perhaps van Haren could explain in what ways extracting a fraction of the energy in a tide race using slowly rotating turbine rotors can cause environmental damage. No explanation is needed of why failure to develop clean sources of energy will cause disastrous environmental damage—further acidification of the sea in particular.
Bristol, UK

Green economists

From John Maddison

Your catalogue of efforts to reduce the wholesale rape and pillage of our precious planet was fascinating (13 March, p 34). However, you make no mention of the motivation behind these disparate initiatives and I would love to know more.

Economists traditionally insist that effects on the planet are "externalities", which is to say that they will be ignored by business unless they are incorporated into prices via taxes. Could it be that economists have got yet another thing wildly

wrong, and if so, what are the driving forces of these endeavours?

*Mansfield Woodhouse,
Nottinghamshire, UK*

After the flood

From Mike Waghorne

Your interview with Joel Morgan, environment minister of the Seychelles, helped me understand something that had been puzzling me about the Copenhagen climate change summit last December (27 March, p 25). Why were Tuvalu and other small, low-lying island states treated with such hostility by the big players when they insisted on strong, binding measures against their countries disappearing?

If these island states wholly or partially disappear, then the hundreds of thousands of square kilometres of exclusive economic zones around their myriad islands will also disappear. Where these countries used to be, huge areas of shallow ocean would become freely exploitable for seabed minerals. All their fishing grounds would also be available.

It won't be other small island states that exploit these new opportunities, but we know who can and will.

Esquibien, Finistère, France

Road rationality

From John Hastings

Nic Fleming's article on semi-autonomous vehicles was far more rational than most of us are when it comes to our cars (3 April, p 34).

Presumably a semi-autonomous vehicle would be programmed to keep to the legal speed limit. But how many of us want to do that consistently? Those who oppose speed cameras on irrational grounds will surely be just as irrational when it comes to automated speed control.

And do drivers really want to

travel in convoy? There are clearly some drivers who simply want to be ahead of the vehicle in front, and will do whatever it takes to get there.

In all this technical development, what psychological studies have been carried out by the car-makers to determine the acceptability of automated systems? And how will motorists be persuaded to adopt them?
Whittlesey, Cambridgeshire, UK



From Peter Wicks

I was surprised to be reminded of a *Beezer* comic from the 1960s by Nic Fleming's article on driverless cars. In a story called "The Year of Bedlam", a driver would habitually take his car under manual control from his house down to the road, where he handed over control to a series of beacons alongside the road. There was no fail-safe written into the system, though, so when the electrics went down it failed, resulting in urban carnage and devastation.

One hopes developers of hands-off driving systems will take note.
Bulford, Wiltshire, UK

Cause or correlation?

From Mark Nelson

Jared Diamond and James Robinson argue that "natural experiments are not inferior, second-class science" (27 March, p 28). I disagree: natural experiments are not experiments at all but observational studies.

In the case of the historical

Enigma Number 1593

Three squares

ADRIAN SOMERFIELD

On three identical square cards I wrote 3×3 magic squares (where the sums of each row, column and major diagonal are equal) using the numbers 1 to 9 on the first, 10 to 18 on the second and 19 to 27 on the third. I formed them into a sandwich

in some order. I then found that I could push a pin through the cards so that it passed through three multiples of three. Furthermore, writing the three numbers in order along the pin gave a five-figure perfect square. One number on the middle card was sandwiched between two perfect squares on the other cards. Which number?

WIN £15 will be awarded to the sender of the first correct answer opened on Wednesday 2 June. The Editor's decision is final. Please send entries to Enigma 1593, New Scientist, Lacon House, 84 Theobald's Road, London WC1X 8NS, or to enigma@newscientist.com (please include your postal address).

Answer to 1587 Deja vu: The number is 9

The winner Dean Witter III of Woodside, California, US

epidemiological study discussed, John Snow thought the cholera outbreak in London was due to a water-borne disease. To find out, he compared the health of people who drank water from the well closest to the cholera outbreak with that of men who worked at the brewery, and who drank only beer. He turned out to be right, but that does not mean it was these observations that clinched it.

There are many possible explanations for differences in the disease rates in the two groups. For example, the brewery employees were all male and had different socio-economic status (through employment, alcohol intake and so on) to the population who drank from the well.

In medicine there are numerous examples of observational studies giving the wrong answer. For instance, observational studies repeatedly showed cardioprotection for women on hormone replacement therapy. Controlled trials have since shown this to be false, and that there is actually a small adverse cardiac risk.

Hobart, Tasmania, Australia

Fat offset

From Robert Bryan

Peter Aldhous reports that test subjects who make green choices subsequently exhibit a greater tendency to lie and that people who improve their homes' energy efficiency thereafter use their heating more (27 March, p 11).



Is this a general facet of human nature that also exhibits itself in dietary choices? Does ordering a skinny latte result in a greater propensity to buy a slice of cake or a doughnut?

The prevalence of low-fat products could, therefore, cause weight gain, by giving one a licence to indulge in a fatty treat. I doubt that the fat in milk has a significant effect on a person's waistline, but I'm pretty sure cakes and doughnuts do.

Nicholls, ACT, Australia

Anty literature

From Karen Tansley

E. O. Wilson says, of his new novel *Anthill*: "This is the first time anyone has written about the lives of ants from their point of view" (10 April, p 38).

Wilson seems unfamiliar with the works of the French science-fiction writer, Bernard Werber. In the 1990s, Werber wrote the trilogy *Les Fourmis* (The Ants), about the lives of ants from their point of view. His books have been translated into 30 languages, including English.

Issaquah, Washington, UK

Accidental origins

From Tim Walshaw

Bob Holmes reports on evolutionary biologist Mark Pagel's theory that speciation is best explained as a consequence of single accidental events rather than by the gradual changes caused by natural selection (13 March, p 30).

This resonates with Nassim Taleb's suggestion in his book *The Black Swan: The impact of the highly improbable* (reviewed 7 April 2007, p 52) that the structure of modern society is due to the impact of sudden extreme events, from the cause of the first world war to the creation of the internet. Taleb also suggests that the Gaussian normal curve, the

recognisable bell-shaped graph used to represent normal distribution, should be replaced by fractal representations that work on the basis of power law distributions of events, which is a far better statistical measure for both science and economics.

Canberra, ACT, Australia

Key to safety

From Ian Duguid

Nic Fleming's article on the safety issues arising from the increasing computerisation of cars (27 March, p 20) put me in mind of a safety solution based on a close call I once had.

Driving at about 80 kilometres per hour in a snowstorm, I became suddenly aware that the throttle pedal was no longer working and I couldn't slow down. My options were to force the gear lever into neutral, which would cause the engine to over-rev and perhaps disintegrate, to attempt to use the brakes (if they were working) to stall the car, or to switch off the ignition.

I chose the last option, and managed to coast the car to a halt on the hard shoulder, where I discovered that snow had packed itself behind the throttle lever, preventing it from closing.

Clearly, any of my options would be preferable to the high-speed crashes mentioned in your article. It seems to me that a hard-wired ignition switch is the cheapest and most practical fail-safe for cars that increasingly rely on complicated computer hardware and software.

Worthing, West Sussex, UK

Plant a dead donkey

From Sam Little

I was pleased upon reading Linda Geddes's piece on changes in vegetation around animal graves (10 April, p 18) to see another example of folklore being vindicated by science. In the part



of rural Somerset in the UK where I grew up, nobody would dream of planting an asparagus patch without first inserting a dead donkey into the underlying soil. The patience shown in waiting for the long-lived animal to die, along with the determination required to dig a hole large enough to park a donkey in, was unfailingly rewarded with much improved yields.

Presumably, these flourishing fields would be observable from the air with the right spectroscopic kit.

Hale, Cheshire, UK

For the record

■ RNA-based viruses replicate in the host cell's cytoplasm. The mimivirus, on which we reported, joins the poxviruses as the only DNA-based viruses to do so (10 April, p 10).

■ The research we reported in our article on carnivorous plants and heavy metals was carried out by Iain Green and Christopher Moody (10 April, p 7).

■ Steve Haake is a sports scientist at Sheffield Hallam University, UK (3 April, p 15).

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The cooperative wrestler

Austrian economist **Ernst Fehr** tells **Mark Buchanan** why global economics could benefit from a touch of compassion and why a good wrestler never gives up

FROM outside economist Ernst Fehr's office at the University of Zurich in Switzerland you would have no idea that he had been tipped to win a Nobel economics prize. For one thing, the name on the door looks as if it has been dashed off on the cheapest of departmental printers.

But Fehr himself seems to fit the bill. Smiling broadly, he extends a hand, eager to talk about his experiences, whether favourable, amusing or confounding. Ironically, he says, it was one of the latter that led to his current success. In reality, it all started with failure.

Twenty years ago, Fehr had a seemingly sensible idea – that a deep-seated human preference for fairness might play an important role in economics. He thought it might explain why companies – even in countries without a minimum wage – don't offer jobs paying wages far below the standard, despite research showing plenty of unemployed people would willingly take the work. It doesn't happen, he suggested, because companies know that workers hired at a lower wage feel they are being cheated, causing them to grow disgruntled and work less hard.

Fehr wrote a paper on the idea that fairness matters, which was promptly rejected by every prestigious economic journal he sent it to on the grounds that people only care about how much they get for themselves, not how that compares to what others might receive. "Most economists would be deeply unhappy if paid

less than what they consider to be fair, so I thought I had a convincing answer," Fehr says. "But I found out that in theoretical economics, fairness just doesn't count."

However, as a former Austrian national wrestling champion, Fehr doesn't give up easily. Over the past decade, he has pursued his ideas on human fairness far past their relevance to employment, and he is now experiencing something of a reversal of fortune. His work is overturning 50 years of economic wisdom about motivation, showing that most economists have overlooked one of the most important factors determining economic outcomes: our values about fairness. "We've moved past the doubt stage," he says. "There are now fewer serious critics."

At the University of Zurich, Fehr heads up the Institute for Empirical Research in Economics. The institute owes much of its reputation to the radical theme of Fehr's work, which aims to use lab experiments to provide an empirical basis for economic theories of behaviour. It is one part experimental psychology, one part economics, and one part searching tirelessly for ever more students to use as behavioural guinea pigs. "I don't think we'll ever run out of students," Fehr says, pondering the numbers. "But we do have to work hard to find them."

That wasn't a problem for economists of the past, who eschewed empirical work for the elegance of pure theory. Traditionally, economic theory assumes that people care only about themselves, pursuing their own self-interest. Even when people cooperate, the theory goes, this is really only pursuing their own interests by harnessing others' efforts. That may seem cynical, but it is a mainstay of economic thinking that has taken painstaking research by Fehr and his colleagues to refute.

Suppose, for example, you approach a stranger on the street and hand them \$20.

"Hard-headed thinking played a fundamental role in the recent economic crisis... it's a biased way of perceiving the world"

PROFILE

Ernst Fehr is a professor in microeconomics and experimental economics and director of the Institute for Empirical Research in Economics at the University of Zurich, Switzerland. He has won many prizes for his work on neuroeconomics, including the "Swiss Nobel", the Marcel Benoist prize in 2008



Photography: Jos Schmid



You tell them they can keep the money or give some to an unknown person. Whatever they choose to do, they will never meet that person, nor will anyone learn of their decision. Will the stranger keep it all or give some away? If you think like a “hard-headed” economist, you’ll assume that everyone short of the late Mother Teresa would pocket the lot. But when Fehr and his colleagues did this a few years ago they found that a significant proportion of people gave away close to 50 per cent of the money.

These and a host of similar results represent “the most important work on the human sense of justice in many decades”, according to evolutionary biologist Robert Trivers of Rutgers, the State University of New Jersey in New Brunswick. Fehr has won awards for it around the world. In February of this year, he gave the prestigious Clarendon lectures in economics at the University of Oxford.

None of this, apparently, has gone to his head, as he gently corrects my own slightly mangled interpretations of his work, and shares his bemusement over the emotional, sometimes almost hysterical reaction his work seems to provoke. “Our latest experience was just amazing,” he says,

referring to a paper he published in *Nature* in January (vol 463, p 356).


In that paper, he and his co-authors showed that testosterone, despite its reputation as a promoter of aggressive behaviour, actually made people more cooperative when playing economic games. They used female volunteers since previous studies have indicated that women are more likely than men to show behavioural changes if given very low doses of the hormone. “In the end we had six referees. Some had legitimate points, but one was really irrational and emotional,” Fehr says. “The referee suggested that maybe we had done a more general study and then decided only to report the effects in women, basically accusing us of being dishonest.”

Such responses, Fehr suspects, arise from a deep-seated resistance in many people to the idea that something as apparently complex and unique to humans as our social instincts could find a relatively simple basis in chemical changes in brain activity. In other work, he has shown that broken promises show up as enhanced brain activity reflecting emotional conflict, and do so well before a person actually makes the final decision to break a promise.

Fehr’s most recent work focuses on so-called neuroeconomics, which explores the roots of our social instincts and emotions. That our precious moral values may ultimately be biologically based upsets some people, Fehr admits, but science is science. “I’m quite happy with whatever I find,” he says. “You have to accept what the data tell you.”

In the wake of the worst financial crisis in nearly a century, that may be good advice to economic science itself. At a conference on compassion in economics in Zurich last month, people from the fields of economics, psychology, philosophy and religion gathered to discuss the extent to which the crisis was enabled and even amplified by traditional thinking in economics. According to Fehr this is exactly what has steered us down the wrong path. “I think this kind of thinking played a fundamental role in the recent crisis,” he says, “as this notion that people are strictly self-interested has been the dominant mindset for decades. Almost everyone in business, finance or government studies some economics along the way and this is what they think is the norm. It’s a biased way of perceiving the world.”

The paradox is that it’s the economists’ supposedly “hard-headed” thinking that has turned out to be profoundly naive. Getting that message out is now one of Fehr’s most urgent aims. ■



IN AN ideal world, elections should be two things: free and fair. Every adult, with a few sensible exceptions, should be able to vote for a candidate of their choice, and each single vote should be worth the same.

Ensuring a free vote is a matter for the law. Making elections fair is more a matter for mathematicians. They have been studying voting systems for hundreds of years, looking for sources of bias that distort the value of individual votes, and ways to avoid them. Along the way, they have turned up many paradoxes and surprises. What they have not

Electoral dysfunction

Think your vote counts for nothing? There may be fairer ways to do things – but don't bank on it, says mathematician Ian Stewart

done is come up with the answer. With good reason: it probably doesn't exist.

The many democratic electoral systems in use around the world attempt to strike a balance between mathematical fairness and political considerations such as accountability and the need for strong, stable government. Take or "plurality" voting, which used for national elections in the US, Canada, India – and the UK, which goes to the polls next week. Its principle is simple: each electoral division elects one representative, the candidate who gained the most votes.

This system scores well on stability and accountability, but in terms of mathematical fairness it is a dud. Votes for anyone other than the winning candidate are disregarded. If more than two parties with substantial support contest a constituency, as is typical in Canada, India and the UK, a candidate does not have to get anything like 50 per cent of the votes to win, so a majority of votes are "lost".

Dividing a nation or city into bite-sized chunks for an election is itself a fraught business (see "Borderline case", right) that invites other distortions, too. A party can win outright by being only marginally ahead of its competitors in most electoral divisions. In the UK general election in 2005, the ruling Labour party won 55 per cent of the seats on just 35 per cent of the total votes. If a candidate or party is slightly ahead in a bare majority of electoral divisions but a long way behind in others, they can win even if a competitor gets more votes overall – as happened most notoriously in recent history in the US presidential election of 2000, when George W. Bush narrowly defeated Al Gore.

The anomalies of a plurality voting system can be more subtle, though, as mathematician Donald Saari at the University of California, Irvine, showed. Suppose 15 people are asked to rank their liking for milk (M), beer (B), or wine (W). Six rank them M-W-B, five B-W-M, and four W-B-M. In a plurality system where only first preferences count, the outcome is simple: milk wins with 40 per cent of the vote, followed by beer, with wine trailing in last. So do voters actually prefer milk? Not a bit of it. Nine voters prefer beer to milk, and nine prefer wine to milk – clear majorities in both cases. Meanwhile, 10 people prefer wine to beer. By pairing off all these preferences, we see the truly preferred order to be W-B-M – the exact reverse of what the voting system

produced. In fact Saari showed that given a set of voter preferences you can design a system that produces any result you desire.

In the example above, simple plurality voting produced an anomalous outcome because the alcohol drinkers stuck together: wine and beer drinkers both nominated the other as their second preference and gave milk a big thumbs-down. Similar things happen in politics when two parties appeal to the same kind of voters, splitting their votes between them and allowing a third party unpopular with the majority to win the election.

Can we avoid that kind of unfairness while keeping the advantages of a system? Only to an extent. One possibility is a second "run-off" election between the two top-ranked candidates, as happens in France and in many presidential elections elsewhere. But there is no guarantee that the two candidates with the widest potential support even make the run-off. In the 2002 French presidential election, for example, so many left-wing candidates stood in the first round that all of them were eliminated, leaving two right-wing candidates, Jacques Chirac and Jean-Marie Le Pen, to contest the run-off.

Order, order

Another strategy allows voters to place candidates in order of preference, with a 1, 2, 3 and so on. After the first-preference votes have been counted, the candidate with the lowest score is eliminated and the votes reapportioned to the next-choice candidates on those ballot papers. This process goes on until one candidate has the support of over 50 per cent of the voters. This system, called the instant run-off or alternative or preferential vote, is used in elections to the Australian House of Representatives, as well as in several US cities. It has also been suggested for the UK.

Preferential voting comes closer to being fair than plurality voting, but it does not eliminate ordering paradoxes. The Marquis de Condorcet, a French mathematician, noted this as early as 1785. Suppose we have three candidates, A, B and C, and three voters who rank them A-B-C, B-C-A and C-A-B. Voters prefer A to B by 2 to 1. But B is preferred to C and C preferred to A by the same margin of 2 to 1. To quote the Dodo in *Alice in Wonderland*: "Everybody has won and all must have prizes."

One type of voting system avoids such circular paradoxes entirely: proportional representation. Here a party is awarded a number of parliamentary seats in direct proportion to the number of people who

BORDERLINE CASE

In first-past-the-post or "plurality" systems, borders matter. To ensure that each vote has roughly the same weight, each constituency should have roughly the same number of voters. Threading boundaries between and through centres of population on the pretext of ensuring fairness is also a great way to cheat for your own benefit – a practice known as gerrymandering, after a 19th-century governor of Massachusetts, Elbridge Gerry, who created an electoral division whose shape reminded a local newspaper editor of a salamander.

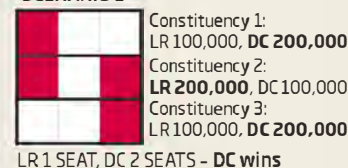
Suppose a city controlled by the Liberal Republican (LR) party has a voting population of 900,000 divided into three constituencies. Polls show that at the next election LR is heading for defeat – 400,000 people intend to vote for it but the 500,000 others will opt for the Democratic Conservative (DC) party. If the boundaries were to keep the proportions the same, each constituency would contain roughly 130,000 LR voters and 170,000 DC voters, and DC would take all three seats – the usual inequity of a plurality voting system.

In reality, voters inclined to vote for one party or the other will probably clump together in the same neighbourhoods of the city, so LR might well retain one seat. However, it could be all too easy for LR to redraw the boundaries to reverse the result and secure itself a majority – as the following two dividing strategies show.

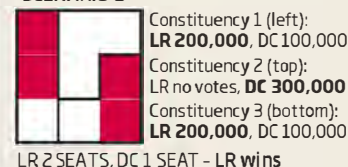
Each square represents 100,000 voters

■ Liberal Republicans (LR): Total votes 400,000
□ Democratic Conservatives (DC): Total votes 500,000

SCENARIO 1

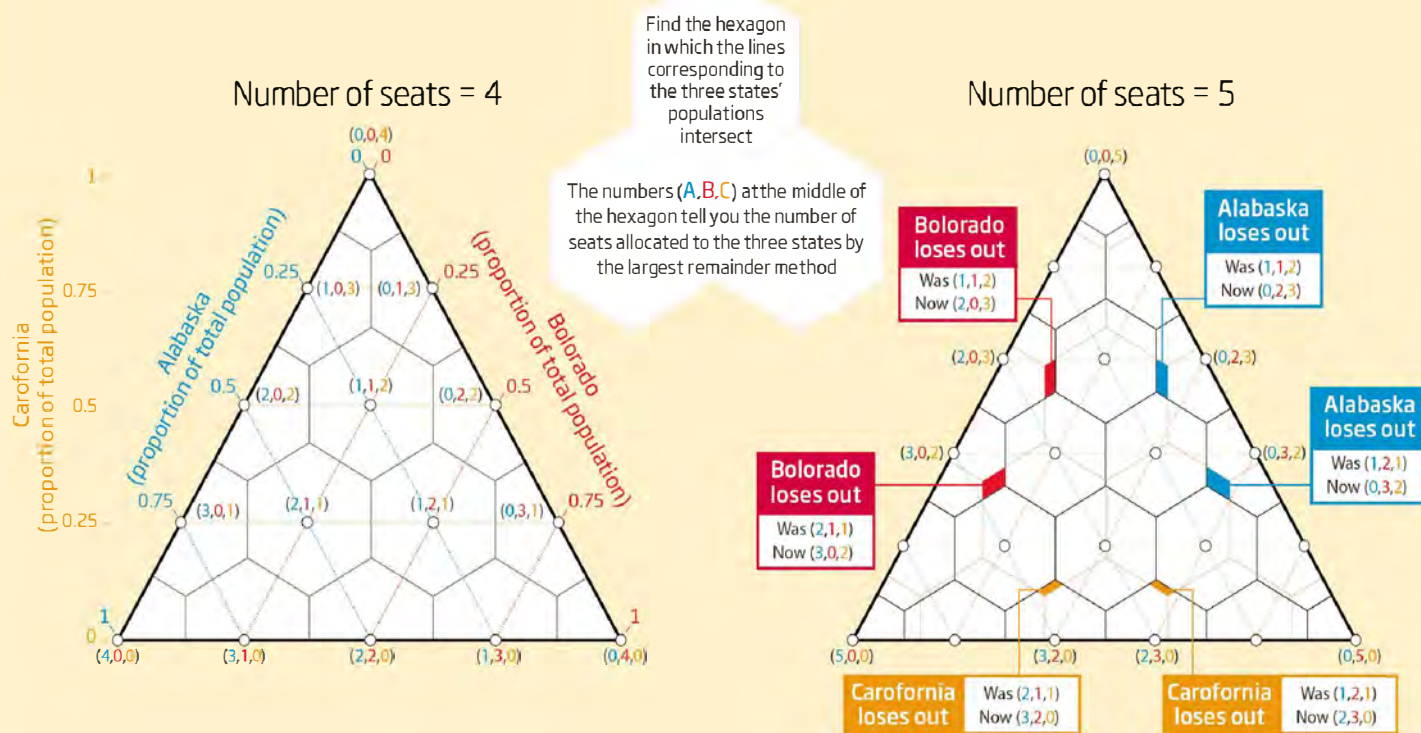


SCENARIO 2



PROPORTIONAL PARADOX

A state can lose representation if the number of seats in a national parliament increases, even if its population stays the same



Although elections to the US House of Representatives use a first-past-the-post voting system, the constitution requires that seats be "apportioned among the several states according to their respective numbers" - that is, divided up proportionally. In 1880, the chief clerk of the US Census Bureau, Charles Seaton, discovered that Alabama would get eight seats in a 299-seat House, but only seven in a 300-seat House.

This "Alabama paradox" was caused by an algorithm known as the largest remainder method, which was used to round the number of seats a state would receive under strict proportionality to a whole number.

Suppose for simplicity's sake that a nation of 39 million voters has a parliament with four seats - giving a quota of 9.75 million voters per seat. The seats must, however, be shared among three states, Alabama, Bolorado and Carofoonia, with voting populations of 21, 13 and 5 million, respectively. Dividing these numbers by the quota gives each state's fair proportion of seats. Rounded down to an integer, this number of seats is given to the states. Any seats left over go to the state or states with the highest remainders.

| | Alabama | Bolorado | Carofoonia |
|----------------------|---------|----------|------------|
| Fair proportion | 2.15 | 1.33 | 0.51 |
| Rounded-down integer | 2 | 1 | 0 |
| Remainder | 0.15 | 0.33 | 0.51 |
| Extra seats | 0 | 0 | 1 |
| Total seats | 2 | 1 | 1 |

The rounded-down integers allocate three seats. The fourth goes to Carofoonia, the state with the largest remainder.

Suppose now the number of seats increases from four to five. The quota is 39 million divided by 5, or 7.8 million, and so our table becomes:

| | Alabama | Bolorado | Carofoonia |
|----------------------|---------|----------|------------|
| Fair proportion | 2.69 | 1.67 | 0.64 |
| Rounded-down integer | 2 | 1 | 0 |
| Remainder | 0.69 | 0.67 | 0.64 |
| Extra seats | 1 | 1 | 0 |
| Total seats | 3 | 2 | 0 |

The rounded-down integers account for three seats as before. The two spare go to Alabama and

Bolorado, which have the two largest remainders, and Carofoonia loses its only seat. (The US Constitution stipulates that each state must have at least one representative, which would protect Carofoonia in this case - the size of the House would have to be increased by one seat.)

The precise conditions that lead to the Alabama paradox are mathematically complex. For three states they can be portrayed graphically, as above. The left-hand diagram shows the populations (as a fraction of the country's total) and fair proportions of three states in the case of four seats; the right-hand side superimposes the diagram for five seats. The Alabama paradox occurs for the shaded population combinations: our example lies in the leftmost orange-shaded region.

Such quirks mean that seats in proportional systems are now generally apportioned using algorithms known as divisor methods. These work by dividing voting populations by a common factor so that when the fair proportions are rounded to a whole number they add up to the number of available seats. But this method is not foolproof: it sometimes gives a constituency more seats than the whole number closest to its fair proportion.

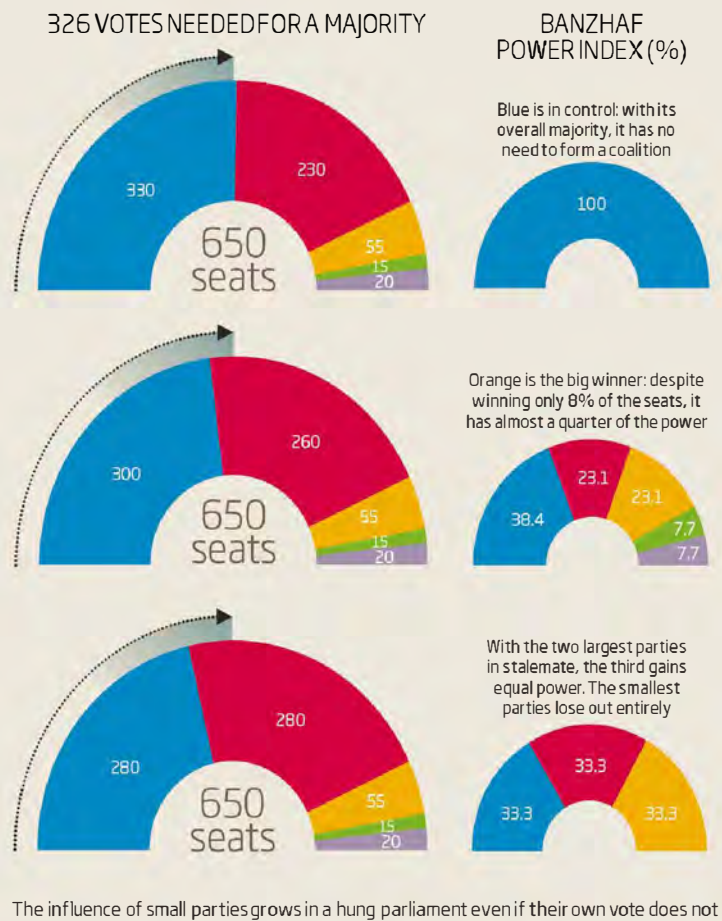
POWER IN THE BALANCE

One criticism of proportional voting systems is that they make it less likely that one party wins a majority of the seats available, thus increasing the power of smaller parties as "king-makers" who can swing the balance between rival parties as they see fit. The same can happen in a plurality system if the electoral arithmetic delivers a hung parliament, in which no party has an overall majority - as might happen in the UK after its election next week.

Where does the power reside in such situations? One way to quantify that question is the Banzhaf power index. First, list all combinations of parties that could form a majority coalition, and in all of those coalitions count how many times a party is a "swing" partner that could destroy the majority if it dropped out. Dividing this number by the total number of swing partners in all possible majority coalitions gives a party's power index.

For example, imagine a parliament of six seats in which party A has three seats, party B has two and party C has one. There are three ways to make a coalition with a majority of at least four votes: AB, AC and ABC. In the first two instances, both partners are swing partners. In the third instance, only A is - if either B or C dropped out, the remaining coalition would still have a majority. Among the total of five swing partners in the three coalitions, A crops up three times and B and C once each. So A has a power index of $3 \div 5$, or 0.6, or 60 per cent - more than the 50 per cent of the seats it holds - and B and C are each "worth" just 20 per cent.

In a realistic situation, the calculations are more involved. The diagram on the right shows how the power shifts dramatically when there is no majority in a hypothetical parliament of 650 seats in which five voting blocs are represented.



voted for it. Such a system is undoubtedly fairer in a mathematical sense than either plurality or preferential voting, but it has political drawbacks. It implies large, multi-representative constituencies; the best shot at truly proportional representation comes with just one constituency, the system used in Israel. But large constituencies weaken the link between voters and their representatives. Candidates are often chosen from a centrally determined list, so voters have little or no control over who represents them. What's more, proportional systems tend to produce coalitions of two or more parties, potentially leading to unstable and ineffectual government - although plurality systems are not immune to such problems, either (see "Power in the balance", above).

Proportional representation has its own mathematical wrinkles. There is no way, for example, to allocate a whole number of seats in exact proportion to a larger population. This can lead to an odd situation in which increasing the total number of seats available reduces the representation of an individual constituency, even if its population stays the

same (see "Proportional paradox", left).

Such imperfections led the American economist Kenneth Arrow to list in 1963 the general attributes of an idealised fair voting system. He suggested that voters should be able to express a complete set of their preferences; no single voter should be allowed to dictate the outcome of the election; if every voter prefers one candidate to another, the final ranking should reflect that; and if a voter prefers one candidate to a second, introducing a third candidate should not reverse that preference.

All very sensible. There's just one problem: Arrow and others went on to prove that no conceivable voting system could satisfy all four conditions. In particular, there will always be the possibility that one voter, simply by changing their vote, can change the overall preference of the whole electorate.

So we are left to make the best of a bad job. Some less fair systems produce governments with enough power to actually do things, though most voters may disapprove; some fairer systems spread power so thinly that any attempt at government descends into partisan infighting. Crunching the numbers can help,

but deciding which is the lesser of the two evils is ultimately a matter not for mathematics, but for human judgement. ■

Ian Stewart is based at the University of Warwick in the UK. His latest book is *Professor Stewart's Hoard of Mathematical Treasures* (Profile)

THE UK'S NEXT PRIME MINISTER

Psychologists Rob Jenkins and Tony McCarthy from the University of Glasgow, and Richard Wiseman of the University of Hertfordshire, have run a subliminal online experiment with *New Scientist* to predict the outcome of the UK general election next week. And the result is:

Conservatives 290

Labour 247

Liberal Democrats 70

Were they right? They explain their method - and its success or failure - in the 15 May issue of *New Scientist*.



Autism has long been defined in terms of its drawbacks. Now it is time to look at the benefits, argues David Wolman

The autie advantage

MICHELLE Dawson can't handle crowded bus journeys, and she struggles to order a cup of coffee in a restaurant because contact with strangers makes her feel panicky. Yet over the past few years, Dawson has been making a name for herself as a researcher at the Rivière-des-Prairies hospital, part of the University of Montreal in Canada.

Dawson's field of research is the cognitive abilities of people with autism – people such as herself. She is one of a cadre of scientists who say that current definitions of this condition rely on findings that are outdated, if not downright misleading, and that the nature of autism has been fundamentally misunderstood for the past 70 years.

Medical textbooks tell us that autism is a developmental disability diagnosed by a classic “triad of impairments”: in communication, imagination and social interaction. While the condition varies in severity, about three-quarters of people with autism are classed, in the official language of psychiatrists, as mentally retarded.

Over the past decade or so, a growing autistic pride movement has been pushing the idea that people with autism aren't disabled, they just think differently to “neurotypicals”. Now, research by Dawson and others has carried this concept a step further. They say that auties, as some people with autism call themselves, don't merely think differently: in certain ways they think better. Call it the autie advantage.

How can a group of people who are generally seen as disabled actually have cognitive advantages? For a start, research is challenging the original studies that apparently demonstrated the low IQ of people with autism. Other studies are revealing the breadth of their cognitive strengths, ranging

from attention to detail and sensitivity to musical pitch to better memory.

More recently, brain imaging is elucidating what neurological differences might lie behind these strengths. Entrepreneurs have even started trying to harness autistic people's talents (see “Nice work if you can get it”, page 34). “Scientists working in autism always reported abilities as anecdotes, but they were rarely the focus of research,” says Isabelle Soulières, a neuropsychologist at Harvard Medical School in Boston, who works with Dawson. “Now they're beginning to develop interest in those strengths to help us understand autism.”

The fact that some people with autism have certain talents is hardly a revelation. Leo Kanner, the psychiatrist who first described autism in the early 1940s, noted that some of his patients had what he termed “islets of ability”, in areas such as memory, drawing and puzzles. But Kanner's emphasis, like that of most people since, was on autism's drawbacks.

Today it is recognised that autism varies widely in terms of which traits are present and how prominently they manifest themselves. The cause remains mysterious, although evidence is pointing towards many genes playing a role, possibly in concert with factors affecting development in the womb.

A single, elegant explanation capturing all that is different about the autistic mind has so

far proved elusive, but several ideas have been put forward that attempt to explain the most notable traits. Perhaps one of the best known is the idea that autistic people lack theory of mind – the understanding that other people can have different beliefs to yourself, or to reality. This account would explain why many autistic people do not tell lies and cannot comprehend those told by others, although the supporting evidence behind this theory has come under fire lately.

Verbal cues

People with autism are also said to have weak central coherence – the ability to synthesise an array of information, such as verbal and gestural cues in conversation. In other words, sometimes they can't see the wood for the trees.

The idea of the autistic savant, with prodigious, sometimes jaw-dropping, talents has taken hold in popular culture. Yet savants are the exception, not the rule. The usual figure cited is that about 1 in 10 people with autism have some kind of savant-like ability. That includes many individuals with esoteric skills that are of little use in everyday life – like being able to instantly reckon the day of the week for any past or future date.

The reality is that children with autism generally take longer to hit milestones such as talking and becoming toilet-trained, and as adults commonly struggle to fit into society. Only 15 per cent of autistic adults have a paying job in the UK, according to government figures. The mainstream medical view of autism is that it represents a form of developmental brain damage. But what if that view is missing something?

The first way in which Dawson challenged ►

“The flip side of an inability to see the wood for the trees is being very, very good at seeing trees”

NICE WORK IF YOU CAN GET IT

Thorkil Sonne, founder of the IT firm Specialisterne in Copenhagen, Denmark, has led private-sector efforts to capitalise on autistic strengths, such as memory and attention to detail. His company employs 48 people, 38 of whom have autism.

After receiving training, employees work as IT consultants to other firms. Sonne, a former IT consultant himself, founded the company in 2004, soon after his son was diagnosed with autism. "I am just a father who reacted in despair by establishing a company tailored to meet the working conditions of people

with autism," he says.

Specialisterne is no charity, though. The company turns a healthy profit - £120,000 in 2008 - and branches will soon open in the UK, Iceland and Germany. In Chicago, a non-profit start-up called Aspirotech is based on Sonne's model.

Michelle Dawson, an autistic cognition researcher at the University of Montreal, Canada, who has the condition herself, is hopeful that such enterprises will improve public attitudes and career opportunities for people with autism. Yet she cautions against pigeonholing people: "Asking what kind of job is good

for an autistic is like asking what kind of job is good for a woman," she says.

Sonne says it is not his intention to stereotype autistic people as data-entry drones. The IT connection is because that's where his experience lay, but he's already ramping up the operation to cater to individual preferences and talents. He recently established an education programme for adolescents with autism, and hired a music and art teacher. Sonne says: "Our ambition is to work out a model in which people who struggle with traditional expectations of social skills can excel."

Take, for example, a 2004 study where autistic and non-autistic people did sentence comprehension tests while lying in a brain scanner (*Brain*, vol 127, p 1811). The autistic volunteers showed less synchronicity between the different language areas of the brain as they performed the task. The authors speculate that this could explain some of the language problems seen in autism. Yet according to the results section, the autistic group did better at this particular comprehension task than the control group. "The researchers use the higher performance in one area to speculate about deficit elsewhere," says Dawson.

Attention to detail

Evidence for autistic advantages is also coming in from new studies. One strength derives from an aspect of autism that has long been seen as one of its chief deficits: weak central coherence. The flip side of an inability to see the wood for the trees is being very, very good at seeing trees.

Psychologists investigate the ability to aggregate or tease apart information by showing volunteers drawings of objects such as a house, and asking them to identify the shapes embedded within it, like triangles and rectangles. Numerous studies have shown that people with autism can do these tasks faster and more accurately. And that's not just with pictures; autistic people also do it with music, in tasks such as identifying individual notes within chords.

Maretha de Jonge, a child psychiatrist at the University Medical Centre in Utrecht, the Netherlands, who has done such studies, explains that "weak" in the context of central coherence doesn't have to mean inferior in daily life. "Weakness in integration is sometimes an asset," she says. It can be useful to filter out external stimuli if you are writing an email in a noisy coffee shop, for example, or are searching for a camouflaged insect in a rainforest. Recasting weak central coherence as attention to detail and resistance to distraction suggests a mode of thought that could have advantages.

Other autistic strengths are harder to paint as disabilities in anyway. For example, Pamela Heaton of Goldsmiths, University of London, has shown that people with autism have better musical pitch recognition.

On the visual side, a few autistic savants who are immensely talented artists are well known, but recent studies suggest superior visuospatial skills may be more common in



ULRIK JANTZEN/DAS BUREAU

the mainstream view was to address the association between autism and low IQ. In 2007, Dawson and Laurent Mottron, head of the autism research programme at the University of Montreal, published a study showing that an autistic person's IQ score depends on which kind of test is used. With the most common test, the Weschsler Intelligence Scale, three-quarters of people with autism score 70 or lower, which classifies them as mentally retarded, as defined by the World Health Organization's *International Classification of Diseases*. But when the team administered a different, yet equally valid, IQ test known as the Raven's Progressive Matrices, which places less weight on social knowledge, most people with autism scored at a level that lifted them out of this range

Thorkil Sonne (centre) trains his employees, most of whom are autistic, for jobs in IT

(*Psychological Science*, vol 18, p 657).

Dawson believes her personal connection to this field of inquiry gives her unique insights. Recently, she began wondering if autistic strengths might already have surfaced in research settings, only to be buried in a literature dominated by the view of autistic people as damaged goods. "No one had ever thought to ask: What cognitive strengths have been reported in the literature?" she says.

After reviewing thousands of papers and re-examining the data, Dawson says she has found dozens that include empirical evidence of autistic strengths that are cloaked by a preoccupation with deficits.

Temple Grandin says her autism has contributed to her achievements as a livestock scientist



JAMES DUNCAN DAVIDSON/TED

autism than previously supposed. Autistic people are better at three-dimensional drawing, for example, and tasks such as assembling designs out of blocks printed with different patterns (*Journal of Autism and Developmental Disorders*, vol 39, p 1039).

Brain scans indicate that this may be because people with autism recruit more firepower from the brain's visual areas when doing such tasks. They may even use their visual areas for other thought processes. Mottron's team found that people with autism were completing the reasoning tasks in the Raven's IQ test by using what is usually regarded as the visual part of the brain, along with more typical intelligence networks (*Human Brain Mapping*, vol 30, p 4082).

Many researchers note that people with autism seem hypersensitive to sights and sounds. In 2007, based partly on this finding, Kamila Markram and Henry Markram and Tania Rinaldi of the Swiss Federal Institute of Technology in Lausanne set out a theory of autism dubbed the "intense world syndrome" (*Frontiers in Neuroscience*, vol 1, p 77). According to this, autism is caused by a hyperactive brain that makes everyday sensory experiences overwhelming.

One of their planks of evidence is autopsy findings of structural differences in the brain's cortex, or outer layer. People with autism have smaller minicolumns – clusters of around 100 neurons that some researchers think act as the brain's basic processing units – but they also have more of them. While some have linked this trait to superior functioning, the Lausanne team still framed their theory as explaining autism's disabilities and deficits.

Mottron's team has published an alternative theory of autism that they believe more fully and accurately incorporates autistic strengths.

Their "enhanced perceptual function model" suggests autistic brains are wired differently, but not necessarily because they are damaged (*Journal of Autism and Developmental Disorders*, vol 36, p 27). "These findings open a new educational perspective on autism that can be compared to sign language for deaf people," says Mottron.

While Henry Markram maintains that autism involves a "core neuropathology", he told *New Scientist* that the intense world idea and Mottron's theory are "aligned in most aspects". "Of course the brain is different, but to say whether the brain is damaged or not depends on what you mean by damaged."

What other cognitive abilities make up the autistic advantage? More rational decision-making seems to be one – people with autism are less susceptible to subjective or emotional

factors such as how a question is worded (*New Scientist*, 18 October 2008, p 16). Still, until the idea of the autie advantage gains ground, the full range of autistic strengths will remain unknown.

Yet the idea seems to be taking root. When speaking at the TED conference in Long Beach, California, in February, professor of animal science Temple Grandin, who has autism, was cheered after quipping that Silicon Valley wouldn't exist without the condition. She also claimed the tech-heavy crowd was probably stacked with "autism genetics".

Galling message

Perhaps it will prove impossible to draw all-encompassing conclusions about the advantages and disadvantages of a condition described as a spectrum. Autism includes brilliant engineers, music prodigies who can't unload a dishwasher, maths savants who can't speak, and other combinations of talent and disability.

It is important to note, however, that the concept of the autie advantage has not been universally welcomed. A number of researchers, as well as parents of autistic people, are leery of too much emphasis on autistic strengths. They fear it could lead society to underestimate some people's impairments and the difficulties they face.

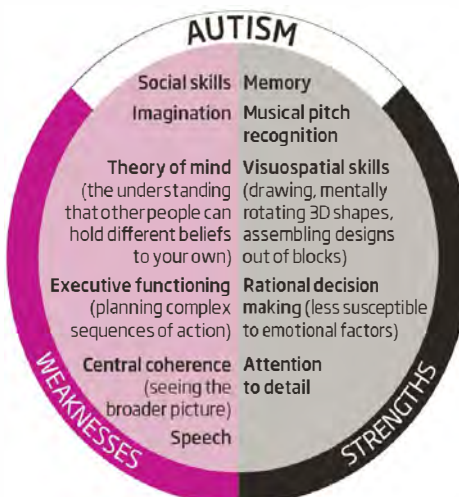
That outcome could threaten funding for badly needed social services and therapy programmes. As one researcher who did not want to be identified put it: "Michelle Dawson's first-hand experience is valuable. But her experience doesn't necessarily map onto other people's."

For a parent struggling with a child who cannot feed or use the toilet themselves it must be galling to hear that the condition may be advantageous. Yet other parents may be equally fed up of hearing uniformly negative messages about their children's potential. Perhaps only by considering the advantages of autism as well as its disadvantages can those affected reap better opportunities in life.

As far as Dawson is concerned, what matters most is evidence. Last year, at an autism conference, she presented a poster on her work. "When people looked at my results, they said, 'It's so good to see something positive!' I said that I don't see it as positive or negative. I see it as accurate." ■

Pros and cons

Many people with autism have cognitive strengths as well as weaknesses



David Wolman is a science writer in Portland, Oregon. His book *Righting the Mother Tongue* is available from HarperCollins/Smithsonian Books

Nearly every creature in the animal kingdom prefers using one paw over the other for certain tasks. But why did such an odd trait ever evolve, asks left-hander Nora Schultz

Southpaws

HANDICRAFTS were never my strong point at school. For each project I attempted, I'd struggle with tools and techniques that didn't suit a left-hander like me, which often made me wonder why humans are wired to prefer using one side of the body over the other. Apart from a few wrist aches, though, my handedness hasn't been too much of a burden. Contrast this with the bad luck of a toad that fails to jump away from a snake approaching from its right, just because its right eye is much worse at spotting the danger than its left. Clearly, such asymmetry can have fatal consequences.

All the more perplexing, then, that creatures across the animal kingdom – including mammals, birds, fish and invertebrates – prefer to use one paw, eye or even antenna for certain tasks, even though they may then be let down in crucial situations by their weaker side.

The cause of this trait, called lateralisation, is fairly simple: one side of the brain, which generally controls the opposite side of the body, is more dominant than the other when processing certain tasks. Why would animal brains ever have evolved a characteristic that seems to put them in harm's way? Armed with a spate of ingenious cognitive tests, a group of animal psychologists think they've finally found the answer, in the shape of some previously overlooked benefits to a lopsided brain-body connection.

Not before time. Up until the not-too-distant past, it had been broadly assumed that handedness was a uniquely human trait that evolved as a by-product of our amazing capacity for language. "This unique skill depends predominantly on the left hemisphere, so everybody thought language and lateralisation were tied up," explains Richard Andrew of the University of Sussex, UK.

This notion rapidly fell apart as researchers starting spotting evidence of lateralisation in all sorts of animals. Back in the 1970s, Lesley Rogers, now at the University of New England in Armidale, New South Wales, Australia, was studying memory and learning in chicks. She had been injecting cycloheximide into the chicks' brains to stop them learning how to spot grains of food among distracting pebbles, but found the chemical only worked when applied to the left hemisphere. That strongly suggested that the right side of a chick's brain played little or no role in learning such behaviours – compelling evidence that the different sides of the animal's brain perform different tasks (*Pharmacology, Biochemistry and Behavior*, vol 10, p 679). "Injecting it on the right side had absolutely no effect. And that was the initial discovery of lateralisation in the chick, at a time when everybody thought it was unique in humans," she says.

Similar evidence appeared in songbirds and rats around the same time, and since then, researchers have built up an impressive catalogue of animal lateralisation. Sometimes it's as simple as a preference for a single paw or foot – primates, cats and even parrots fall into this category. In other cases, lateralisation appears in more general patterns of behaviour.

The left side of most vertebrate brains seems to process and control feeding, for example. Since the left hemisphere processes input from the right side of the body, that means animals as diverse as fish, toads and birds are more likely to attack prey or food items if they view them with their right eye. Even humpback whales prefer to use the right side of their jaws to scrape up sand eels from the ocean floor. Some more exotic recent examples of animal lateralisation include elephants with marked preferences for which

Like humans, many primates are either right or left-handed

direction they swing their trunk for feeding or sand spraying, and honeybees whose right antenna is more sensitive to odours.

There are no hard-and-fast rules, however. Many fish, for example, consistently turn in the same direction when faced with a predator, apparently so that they can use a specific eye and brain hemisphere to deal with the situation, but a study of 16 different species found that the preferred direction varied between species, no matter how closely related they were (*Laterality*, vol 5, p 269). Similarly, parrots can be left-footed, right-footed or ambidextrous. The side preference can even differ within a species according to





gender: tomcats tend to fish tuna out of a jar with their left paw, while females prefer their right paw.

Despite such diversity, we can't rule out the possibility that lateralisation was passed down from a single common ancestor. Lateralisation is caused by the way the brain is organised, with certain regions predisposed to handle certain aspects of cognition. Generally, only one side of the brain will contain the region that handles a given aspect of cognition. So a preference for a particular side therefore depends on which of these regions are typically involved in the task. Since there might be multiple ways of performing a task,

each using different regions of the brain, a preference for one side may just be a symptom of the chosen cognitive strategy. "Different individuals or species may be using different cognitive approaches to deal with similar problems and this affects which side of the brain has the upper hand," says Giorgio Vallortigara at the University of Trento in Italy. In that case, the brain organisation underlying lateralisation may still have arisen in early ancestors, even if specific side preferences have shifted over the years.

What, then, ultimately determines the direction and level of lateralisation in an individual? Genetics will certainly play a

"Animals as diverse as fish, toads and birds are more likely to attack prey viewed with their right eye"



IS YOUR PET A SOUTHPAW?

Try these tests to see if your furry, feathered or scaly friends prefer to use their left or right appendages for certain tasks - and what this reveals about their behaviour.

Dogs: See if Fido wags his tail to his left or right. If he's like most dogs, furious wagging to the right means he is relaxed and ready to approach whatever he sees; if he wags to the left he might prefer to withdraw.

Cats and rodents: Give your cat, rat or hamster a jar with a tasty treat and see which paw they use to try and extract it. If your pet is a cat, expect toms to use their left paws and the females to use their right.

Parrots and other dextrous birds: This is an easy one. "Anything they are interested in they will pick up with their dominant foot," says Culum Brown at Macquarie University in Sydney, Australia. Watch out for odd combinations of lateralised behaviours too. Unlike most birds which view the objects they hold with the eye on the same side, the Australian galah manages to pull off a cross-over number, using the eye on the opposite side.

Fish: Place an unfamiliar object in the centre of your fish tank and

record if your fish go around it clockwise or anticlockwise, indicating their eye preference. Be aware, though that the preferred eye might change depending on whether the object is disturbing or attractive and whether your fish are bold or shy (*Animal Behaviour*, vol 74, p 231).

Reptiles and amphibians: Move a food morsel into your pet's field of view from either the left or right side and watch which direction elicits more or quicker catches. For most species tested so far, the right side appears to be the favourite.

Horses: Chances are that your horse has already been trained to be handled from the left side. Recent research suggests that horses prefer to use their left eye for assessment and evaluation of their surroundings regardless of such training. Yet horses are also likely to react more strongly to alarming sights they see with the left eye too, which leads Lesley Rogers and Nicole Austin at the University of New England in Armidale, New South Wales, Australia, to propose that it might be worth exploring if they should actually be trained from the right instead.

Tomcats generally prefer using their left paw to fish for food



part, but environmental factors can have an impact too. Rogers, for example, has found that a chick's bias depends on whether its egg was exposed to light before hatching - if they are kept in the dark during incubation, neither hemisphere becomes particularly dominant.

Fortunately, this observation allowed Rogers to test the possible advantages of a brain bias in 2004, by hatching broods with either strong or weak lateralisation. She had the notion that a lateralised brain, with each hemisphere processing input from a different eye, might help chicks to do two tasks simultaneously - watching out for predators with one eye while searching for food with the other. So she studied the behaviour of the two groups of chicks presented with a smattering of grains among small pebbles under the threatening silhouette of a fake predator bird flying overhead.

As expected, the chicks incubated in the light looked for grains mainly with their right eye, while using the left eye to check out the predator. The chicks incubated in the dark, however, had trouble deciding where to look. They had no preferred eye for foraging or checking on the predator and became so distracted by the challenge of multitasking that they actually became less likely to detect the predator. And their ability to spot the grain declined over the course of the experiment (*Proceedings of the Royal Society B*, vol 271, p S420).

Parallel processors

Similar results probably hold true for many other animals. Angelo Bisazza at the University of Padua in Italy, for example, has studied goldbelly topminnows with different levels of brain lateralisation. With the threat of a predator looming over them, the strongly lateralised fish caught tasty brine shrimp twice as fast as weakly lateralised ones.

Assigning different jobs to different brain halves may be especially advantageous for animals such as birds and fish, whose eyes are placed on the side of their heads so that there is little overlap between the two visual fields. Processing input from each side separately, with different tasks in mind, would seem a natural way to distribute their resources. "So functional left-right asymmetries are much more relevant in everyday behaviour for a fish or a bird than, for example, for a primate with frontal eyes," says Bisazza.

Nevertheless, there are many other cases of lateralisation that can't be explained this way.

KENNETH BENGTSSON/NATURALBILD/CORBIS



PAUL NICKLEWINGS

Most fish in a species turn the same way when facing danger

What about animals that prefer to use a specific paw or foot for almost all tasks, for example? This led Maria Magat and Culum Brown at Macquarie University in Sydney, Australia, to wonder if there were a more general cognitive advantage that might apply to any lateralised animal. To investigate, they turned to parrots, which, like humans, can be either strongly right or left-footed or totally ambidextrous.

The parrots were given the intellectually demanding task of raising a tempting snack dangling on a string up to their beaks, using a coordinated combination of their claws and beak to pull the string. The results, published last year, showed that the parrots with the strongest foot preferences solved the problem far more quickly than their ambidextrous peers (*Proceedings of the Royal Society B*, vol 276, p 4155).

Why lateralisation would lead to this general cognitive advantage is not clear, though multitasking is probably still involved. Lateralisation allows the brain to channel information from multiple sources and process different parts of complex tasks in different hemispheres so that each can be processed separately at a quicker rate. One side of the brain, for example, may process well-established, routine “housekeeping” tasks while the other side detects and processes unexpected stimuli and challenges.

Yet in all these cases, it is the strength of lateralisation, rather than the direction, that confers the benefits, raising another puzzling question: why do most animals within a species prefer the same side, making their behaviour extremely predictable to predators, prey and competitors alike? And why are there always a few oddballs, like me, who are wired differently from the rest of the population?

Vallortigara and his colleague Stefano Ghirlanda at Stockholm University in Sweden, have found an answer in game theory. They have constructed mathematical models which show that every animal gets the best deal in a group that’s made up of many individuals with the same lateralisation, plus a small proportion of outsiders like myself.

They considered a group of individuals constantly faced with the threat of predators—fish swimming in a sea with sharks, for example. In these situations, you might think that there would be safety in numbers—your risk of being caught reduces as you surround yourself with ever more potential victims. So it would make sense for each individual fish to stay in sync with the crowd, turning together in the face of a predator.

Conversely, however, Vallortigara supposed that as long as most fish do exactly this, it might pay for a very small proportion of group members to escape the other way. They would benefit by running off in the direction that the predator is not expecting. However, this advantage only holds as long as this alternative strategy remains rare and

“Human left-handers are more likely to survive potentially fatal hand-to-hand fights”

unpredictable. The team’s models showed that the most stable grouping in the face of various evolutionary pressures is one where a large majority are lateralised in one direction, accompanied by a small minority of individuals that buck the trend (*Proceedings of the Royal Society B*, vol 271, p 853).

Surprise attacks

Similar trade-offs between majority and minority preferences may exist within a population too, explaining the varied patterns of lateralisation in many species. Numerous studies have found, for example, that both cooperative behaviours such as courtship displays or parent-offspring interactions and aggression among peers tend to be lateralised across populations in creatures as diverse as lizards, wading birds, Siamese fighting fish and primates. Here, the balance between left and right preferences would depend on two competing factors—in this case, the benefit of being able to react in kind during cooperation, and conversely, the ability to go against expectations in antagonistic interactions and launch an attack from an unexpected quarter (*Philosophical Transactions of the Royal Society B*, vol 364, p 861).

Perhaps this can partly explain the existence of left-handers in human societies. Numerous studies have found that left-handers have an advantage in many sports involving a direct opponent, such as tennis or boxing, and the advantages may run to more serious encounters: many sports are forms of ritualised combat, after all. Charlotte Faurie and Michel Raymond at the University of Montpellier in France compared eight unindustrialised indigenous societies and found that those with the highest number of homicides also had the most left-handed people, suggesting that lefties really are more likely to survive hand-to-hand fights (*Proceedings of the Royal Society B*, vol 272, p 25).

All this is good news for me, a left-hander in a right-handed world. I survived the complex cognitive challenges of higher education thanks to my highly lateralised brain, and with a good set of left-handed appliances, I don’t even get wrist ache anymore. Fair enough, my drawing and needlework still leave a lot to be desired, but I take comfort in the knowledge that should anyone tease me about it, I might just be able to pull off a surprise attack with my left hand. ■

Nora Schultz is a writer based in Berlin



GORDON WIERSE

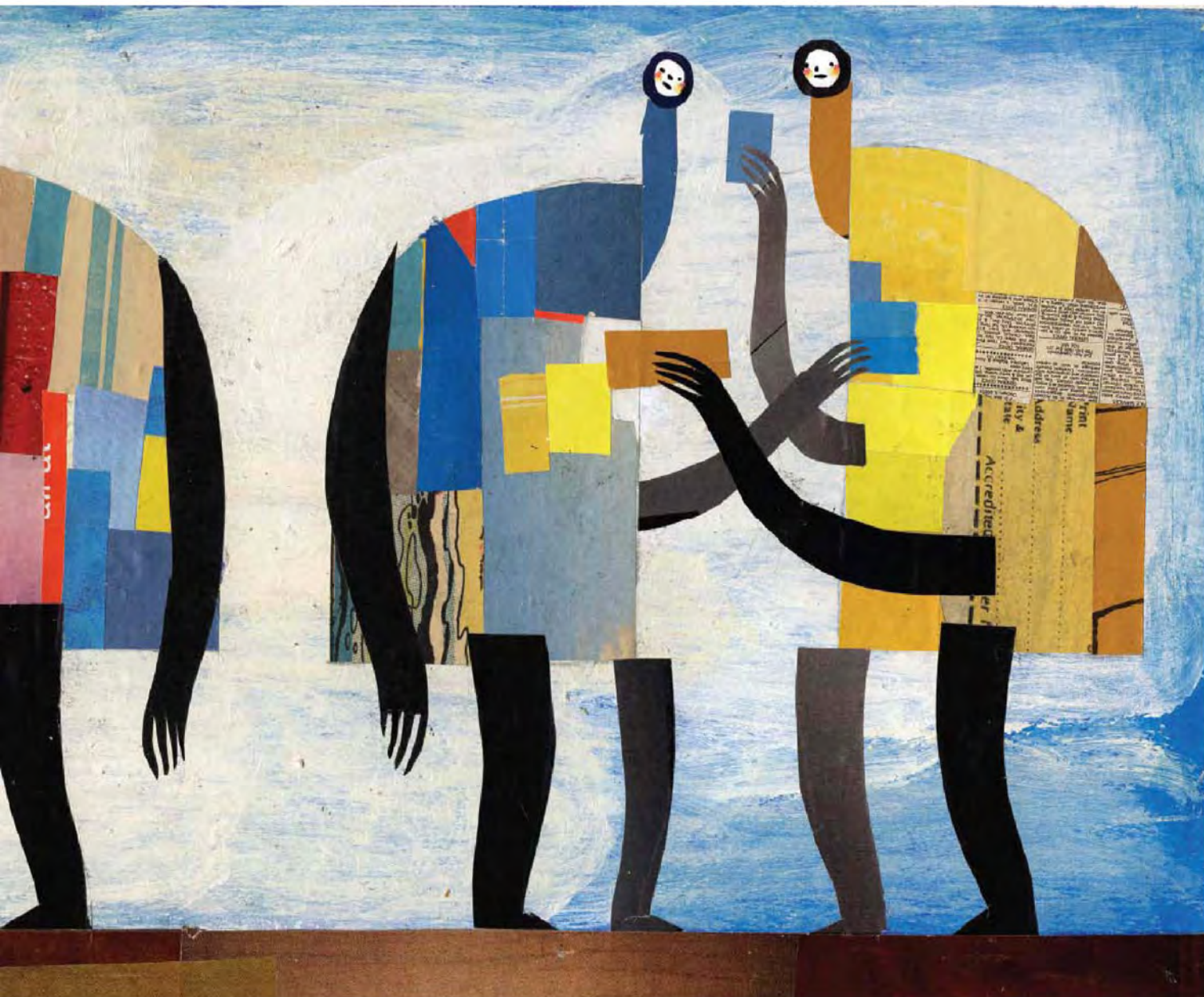
You are what you copy

Forget free thinking, a talent for imitation is what really makes us smart.
Mairi Macleod reports

YOUR plane crashes and you find yourself stranded in the middle of a vast jungle. How would you work out which fruits are safe to eat and where to find clean water? You could muddle along on your own for a while, but you would probably end up sick and very hungry. Far better to find some friendly locals and learn how they do things.

Learning from others is something we do all the time, not just in extremis. We are more reliant on so-called "social learning" than any other animal – it is thought to be at the core of culture and tradition and is credited with our successful colonisation of the planet. Yet no one knows exactly how social learning works. Obviously, copying others allows us to acquire useful knowledge without having to bear the costs of working everything out for ourselves. But there is a catch. If societies are to adapt to changing conditions, there must be innovation too – people cannot blindly copy everything because the information may be wrong, outdated or unavailable.

This problem has occupied Kevin Laland of



the University of St Andrews, UK, for some time. "Individuals ought to be selective with respect to when they rely on social learning and from whom they learn," he says. "Natural selection ought to have fashioned specific adaptive learning strategies." But what are these strategies? If social learning is such a powerful force in our species' success, surely we need to know when, where and why it happens. Yet previous attempts to answer these questions have only scratched the surface. Laland realised that if he was going to get anywhere he would have to come up with an original approach.

Until then, only a tiny fraction of the possible learning strategies had been investigated. The most thoroughly researched was the "conformist transmission model" – the idea that a person is more likely to copy traits that are common in the population than those that are rare. An alternative is "copy an expert", which seems like a reasonable rule to follow when buying a new computer or shares on the stock market, for example. "Copy the

most successful" also makes intuitive sense, although in our celebrity-oriented world there is a chance it might backfire – George Clooney may endorse a certain brand of coffee, but does he really know any more about beverages than the next person?

Let battle commence

Laland wanted to consider a much broader range of strategies and, crucially, to find out which ones work best. He realised he could not do that with a traditional experiment, so he hit on the idea of holding a tournament. His inspiration came from a series of open competitions held in the 1970s to examine why cooperation evolved. These tournaments, based around the prisoner's dilemma, which involves deciding when to cooperate and when to defect, were a shot in the arm for research into cooperation. Laland hoped a tournament could be just as successful for social learning. "We thought if we were to advertise this idea widely we could attract all kinds of people into

the field," he says. So, teaming up with several other experts in social learning, Laland secured enough funding from the European Union to pay for the project, including a €10,000 prize for the tournament winner.

Their competition was going to be a game of survival, taking place in a computer-generated world. Virtual agents would have the potential to acquire 100 possible behaviours, each with a different associated pay-off that would change over the course of the game. The pay-off represents the benefit an individual gains by performing a particular behaviour, its changing value reflecting the fact that information can become outdated as the environment changes.

Entrants to the tournament would start with 100 agents each, which would accumulate a repertoire of behaviours over their lifetime through learning. At every round of the game, each agent would have three options: innovation, in which they randomly acquired a new behaviour by individual learning; observation, in which

they acquired a new behaviour by social learning; or exploitation, in which they used a previously learned behaviour and so gained its pay-off. The entrants had to devise a strategy that their agents would use to decide between these options. The challenge was to create the strategy that generated the most successful or “fittest” agents – a criterion measured by dividing an agent’s accumulated pay-off value by the number of rounds it had survived. Furthermore, in each round, every agent would have a 1 in 50 chance of dying. The deceased would then be replaced by an “offspring” of another agent. Agents were chosen to “reproduce” with a probability proportional to their mean lifetime payoff. So the better a strategy’s performance, the bigger the share of the population its agents were likely to have. By this simulated version of natural selection, the entrant with the most successful strategy would have the most agents at the end of the game.

There were two phases to the tournament. The first was a round robin where all strategies played each other for 10,000 rounds in pairwise contests. The strategy with the most agents at the end was the winner. Then, in the second phase, the 10 highest scoring strategies were thrown in together to see who would win overall. They battled it out in a variety of simulated environments, differing in such parameters as the number of agents a potential learner was able to observe, the likelihood that an agent using social learning would pick up the wrong information, and the way in which pay-offs associated with behaviours changed over time. The aim here was to test how robust the strategies were in different learning environments because in the real world the costs and benefits of social learning versus individual learning may vary.

And the winner is...

The competition, held last year, turned out to be an irresistible challenge to many, with over 100 entries submitted from a variety of academic disciplines, ranging from philosophy to computer science, and even some school pupils. In fact, two teenagers from Westminster School in London beat most of the academics to come tenth overall.

Last month, Laland and colleagues published their findings in *Science*, DOI: 10.1126/science.1184719. So what did they discover? It seems a successful strategy rests primarily on the amount of social learning involved, with the most successful agents spending almost all their learning time observing rather than

innovating. However, avoiding spending too much time learning either socially or individually was just as important. “Between a tenth and a fifth of their life seemed to be the optimal range,” says fellow organiser Luke Rendell, also from St Andrews University. “If they did more learning than that it seemed that life was just passing them by.”

Successful strategies were also good at spacing out learning throughout the agents’ lives. The winning strategy, Discount Machine, submitted by PhD students Daniel Cownden and Timothy Lillicrap from Queen’s University in Ontario, Canada, stood out because it did just this. It seems packing all your learning into the early part of your life is not a great idea – we need to keep updating our knowledge as we go along.

Lillicrap points out that the questions their strategy addressed resemble those posed in real life. “We face similar trade-offs all the time – for example, how much education should I get before I join the workforce?” To answer such a question we need to consider various factors such as how much more do I expect to earn with this training? How long is



it going to take? What’s the likelihood that my training will become irrelevant? How long will I be in the workforce? “Our strategy takes those things into account,” he says.

Another attribute of the most successful strategies is that they are parasitic. This is the essence of social learning – somebody has to do the hard graft to find out how to do things before other people can copy them, so it only pays to learn socially when there are some innovators around. Indeed, in contests where Discount Machine agents were able to invade the entire population, they actually ended up with a lower average pay-off than they did in contests where the conditions allowed some agents with more innovative strategies to survive, so providing new behaviours to copy.

This also has real-world implications. Could it be that we don’t all use the same optimal social learning strategy? “It’s quite clear that you would expect social learning to evolve and



“The most successful agents spent almost all their learning time observing rather than innovating”



Copy an expert: gymnast Zhao Chaoyue, age 8, leads morning exercises at her school

be favoured," says Laland. But if everyone relied heavily on it then there would be a decrease in the population's fitness and subsequent advantages for individuals who are more inclined to learn for themselves.

General observation certainly suggests that people vary considerably in their propensity to copy others or find stuff out for themselves. Personality traits such as creativity and curiosity are clearly linked to the ability and willingness to carry out successful individual learning, and these traits vary widely.

There also seems to be a gender difference. Kimmo Eriksson of Malardalen University in Sweden, one of the tournament's designers, and Pontus Strimling of Stockholm University discovered this when they carried out a game called explore and collect, in which paired players tried to get the highest possible score among a number of undisclosed options by either uncovering the relative ranks of options for themselves or choosing options already favoured by the other player (*Journal of Evolutionary Psychology*, vol 7, p 309). "We found that women tend to invest more in individual learning than men, in the sense that they spend more effort on trying out a greater number of unknown options," says Eriksson.

As well as highlighting the variability in our individual approaches to social learning, the tournament has also shed light on an apparent paradox. Laland and others have found that

"Social learning is widespread in nature. So what's so special about copying in humans?"

social learning is widespread in nature, even being used by invertebrates. So what's so special about copying in humans?

Firstly, says Laland, the competition reveals that social learning does not require much brainpower. "You don't need any clever copying rules. You can just copy anyone at random," he says. "Other individuals are doing the filtering for you. They will have tried out a number of behaviours and they will tend to perform the ones which are reaping the highest rewards." That explains why even insects can benefit from social learning. "But," he adds, "to become the winner of the tournament you really have to do something a bit more sophisticated than that." You have to weigh up the relative costs and benefits of sticking with the behaviour that you have, versus inventing a new behaviour, versus copying others. That requires assessing how quickly the environment is changing, as this

gives you an idea of how quickly information will become outdated. Discount Machine was very good at doing just that – in variable environments it placed a higher value on more recently acquired information and discounted older information more readily.

It is in this ability that humans seem to have the edge over other animals. That's not to say we are alone in making these sorts of calculations, though. For example, Laland and his colleagues have found that sticklebacks can do it. First they taught individual fish to expect more food at site A than site B. Then they switched the food around, but the only clue to the deception was that there were now more fish feeding at B than A. It turns out that the longer it has been since the fish checked the sites out for itself, the more it will rely on social information to tell it which site has the most food (*Proceedings of the Royal Society B*, vol 271, p 957).

While this is impressive, humans have a unique talent that allows us to take account of passing time and changing circumstances far more effectively: language. "You can simply talk about what might happen," says Rendell. Or you can use language to imagine yourself in a different place or time. Rendell suspects this may be what has enabled us to take full advantage of social learning, leading to the huge gap between human culture and the behaviour of other animals.

The tournament has undoubtedly provided several insights into social learning. According to Rob Boyd of the University of California, Los Angeles, a pioneer of social learning research and another of the tournament's designers, its big advantage over previous approaches is the level of realism. It entails "much more environmental complexity and more cognitive complexity in the organisms", he says. Nevertheless, there is room for improvement. Rendell points out that the simulations cannot track particular individuals through time, and that it doesn't include formal teaching, a vital part of learning in the real world. "We want to explore additional complexities with some more tournaments in the future," he says.

Before they do that, however, the team has another intriguing idea to pursue. "We want to go out and try to explore this in the real world," says Rendell. "We plan to set up an experimental version of this tournament where we get people to play it themselves and see what they actually do." ■

Mairi Macleod is a science writer based in Edinburgh, UK

In search of an impossible sound

Modern life has cast us adrift upon a sea of noise. Are there any islands of quiet left?

In Pursuit of Silence: Listening for meaning in a world of noise by George Prochnik, Doubleday, \$26
Zero Decibels: The quest for absolute silence by George Michael Foy, Scribner, \$24
The Unwanted Sound of Everything We Want: A book about noise by Garret Keizer, Public Affairs, \$27.95
 Reviewed by Deborah Blum



TICK. Tock. Tick. I would do a much better job reviewing books if the clock in my office didn't thumpout the seconds like a

crazed drummer. The dog's tail whacks the floor. The floor creaks. How does anyone expect me to write in the midst of this racket?

It doesn't surprise me that many of my fellow writers share my fantasies of a golden bubble of silence. Why else do we have writer's retreats, tucked into sheltering forests or beside pastoral streams (where, frankly, the water gurgles damn noisily)?

Three new books embrace this silence-is-golden theme. George Prochnik's *In Pursuit of Silence* and George Michael Foy's *Zero Decibels* focus on hunting for the perfect hush. In *The Unwanted Sound of Everything We Want*, Garret Keizer takes another route, critically surveying the cacophony of our industrial world.

Keizer's is probably the most realistic approach because—as becomes obvious—books about silence inevitably turn into books about noise. As both Prochnik and

The whispering voice of your better nature may be audible now



TAMMY HARRATT/CORBIS

Foy quickly discover, quiet is an elusive goal in our surround-sound environment. (Must my husband have the television blaring at this moment?)

Foy becomes so obsessed with the constant roar of life around him that he begins to think of the sound as something almost alive, the rumbling exhale of a great creature, “the monster-breath”. He buys an audiometer, which measures noise in decibels. Zero decibels refers to the tiniest sound audible to healthy human ears, an infinitesimal notch above silence. The sound of your own breath in a quiet room is about 30 dB; the

we may eventually hear the voice of our better selves.

Foy’s book is edgier, jazzier. He has an elegant way with description – lakes are “the colour of Parker ink” and rocks rise from the ground “like the back of a surfacing whale”. But his perspective is darker. When he visits the famously taciturn Lakota Indians, for instance, he finds them not so much beautifully silent but culturally crushed, left with nothing to say.

Keizer, on the other hand, likes the idea of a joyful noise. He watches two young boys poised to roar off on all-terrain vehicles and feels a leap of happiness. “I wanted them and their noise to exist forever.” But the occasional tribute to rowdy children aside, he is no noise lover either.

For Keizer, the real noise is the noise of industry, and noise pollution and industrial pollution walk arm in arm. “The history of noise in this book is in many ways an implicit history of fossil fuels,” he notes. Industrialisation has left us with a decibel-blasted lifestyle that doctors link to depression and rage. People have killed their neighbours for refusing to turn off the stereo.

And that’s what really ties these three books together. It’s not just any noise that makes us crazy, it’s *our* noise – our amplified sound systems, our revving engines, the whole exasperating, jangling loudness of modern life.

So, these writers agree, if there is no perfect quiet, it wouldn’t hurt us all to turn it down a little, respect our neighbours’ need for occasional peace and find a little ourselves. And now, if you’ll excuse me, I’m taking the battery out of the clock and asking my husband to turn down that movie. Otherwise I don’t know how anyone expects me to finish this review. ■

Deborah Blum is the author of *The Poisoner’s Handbook: Murder and the birth of forensic medicine in Jazz Age New York* (Penguin, 2010)

“Industrialisation has left us in a decibel-blasted lifestyle that doctors link to depression and rage”

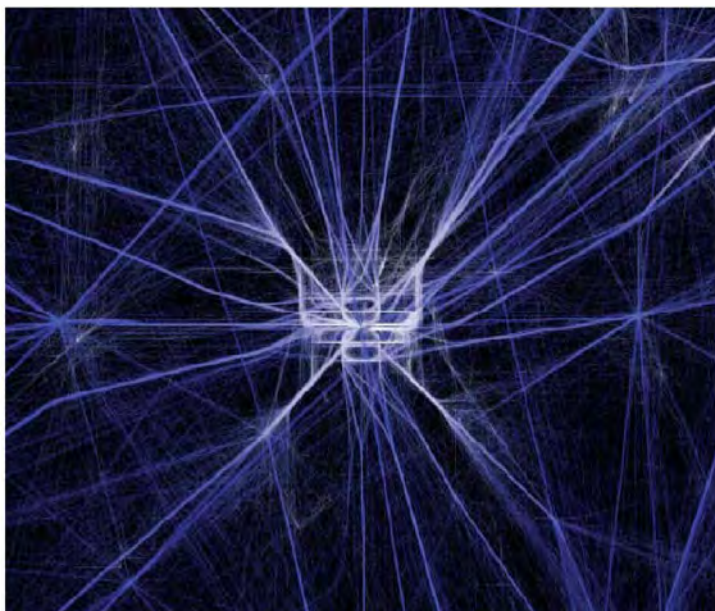
hum of a refrigerator averages above 50. Subway trains register in the 90s. The scale refers to the pressure of sound waves on the ears, with rising numbers indicating a logarithmic increase. On the decibel scale, Foy notes, a jet engine at 120 dB generates a trillion times more sound-wave pressure than one of those fleeting whispers at 0 dB.

Foy obsessively measures the sounds of daily life as he searches for his zero-decibel moment. Eventually, he resorts to spending time in a sensory deprivation tank. Prochnik also tries sensory deprivation, and discovers that with no distraction he can hear the sound of saliva swooshing in his mouth. In further pursuit of quiet, Prochnik goes on to investigate noise-control regulations and soundproofing technologies.

My favourite part of Prochnik’s journey is the time he spends at a Trappist monastery in Iowa, tucked away in a landscape of gentle hills and small farms. It allows him to ponder the idea that “some things we cannot put into words are yet resoundingly real”, and captures the author’s belief that if we can find a way to listen

Fits and bursts

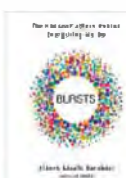
Even so-called spontaneous behaviour is predictable, thanks to our “bursty” nature



AARON KOBLEN

Bursts: The hidden pattern behind everything we do by Albert-László Barabási, Dutton, \$26.95

Reviewed by Jessica Hamzelou



DO YOU think your spontaneous, free-spirited take on life makes your behaviour random and unpredictable?

Albert-László Barabási takes a different view. Human behaviour, he argues, is predictable due to its “bursty” nature – long periods of low activity interspersed with bursts of high activity. By tracking our past behaviour, Barabási thinks we might be able to predict our future actions.

Bursts opens with the story of Hasan Elahi, an American artist whose work takes him around the globe. Elahi’s erratic travel patterns set him apart from the crowd, making him an outlier and attracting the attention of the US Department of Homeland Security. Elahi is the first of many

people we are introduced to who take us on “Einsteinian jumps through time and space”. One minute Barabási is describing a gun seller who marks his dollar bills so that their movement can be tracked throughout the US, the next we are following Einstein’s pattern of letter-writing.

As well as these specific examples, Barabási shows how bursty behaviour can be found everywhere, from online browsing to visits to the doctor. The reasons behind these bursts of activity may vary, but they don’t make us any less predictable, he says.

Barabási concludes that we are all simultaneously bursty and quite regular; apparently random but deeply predictable. He foresees a future in which a “Vast Machine” follows our every move, cataloguing human behaviour. Perhaps the large amount of data this would collect will enable us to predict the future, but at what price? ■

Catching the bug

Responding swiftly to a pandemic requires collaboration and openness on a global scale, as **Catherine de Lange** discovers

WHEN news broke in the spring of 2009 of a new strain of flu in Mexico and California, it appeared to take the world by surprise. Yet across the globe several groups of scientists were primed and ready to react. As the flu spread and people began to die of it, these researchers worked together to identify the strain and produced vaccines in double quick time. How did they do it?

Peter Palese, chair of the department of microbiology at the Mount Sinai School of Medicine in New York, keeps around 4000 strains of influenza in the freezer for just such an occasion. When a new strain arises, his lab will compare it with previous viruses and use animal models to work out how the microbe is transmitted. You need to be tenacious in these

Reacting quickly to an outbreak can make the difference between life and death



NICOLA D'ON OFRIOLI/ANZENBERGER/EYEVINE

initial stages, says Palese, until you understand how dangerous the pathogen is. This means research has to take place in high-containment facilities, which can make work cumbersome and slow the process down. Palese's lab, one of a small number of centres of excellence funded by the US National Institutes of Health, forms part of a group of specialised laboratories around the world which come together to analyse emerging pandemics. Others, such as the National Institute for Medical Research (NIMR) in London, and the Center for Disease Control in Atlanta, will work in parallel with them to isolate the new virus as a first step to producing a vaccine. Good communication at this stage is crucial, says John McCauley, director of the World Health Organization's Influenza Centre at the NIMR, and regular teleconferences between specialist labs to coordinate their efforts are set up by the WHO.

The next stage is to move towards the production of a virus that can be used as a vaccine. It's at this point that pharma companies are invited in on the discussions, with the aim of finding a way to mass-produce the vaccine. "All the information is given as soon as possible because everyone is pulling in the same direction," says McCauley.

"There is a group of influenza manufacturers that get together routinely during this strain selection and early vaccine manufacturing time frame," explains George Kemble, vice-president of R&D and general manager of MedImmune Vaccines in California. They share information, typically discussing how the various candidate strains are behaving, whether they are growing well and what other candidates might grow better. "Certainly we all compete with each other, but

"The work of a relatively small group of scientists can help save the lives of so many people"

in these early stages there is a lot of very good, open communication among the different agencies and companies to ensure they are making as much vaccine as they can," he says. Collaboration takes place internationally, although there will be some differences in vaccine development between countries depending on national policy – for example, over whether certain substances are licensed for use as components of a vaccine.

Can scientists get involved in policy decisions too? Yes, says Gary Nabel, director of the National Institute of Allergy and Infectious Diseases' Vaccine Research Center in Bethesda,

Maryland, which works to understand how new viruses arise and find ways to respond better next time around. "Scientists within government make decisions on how government funds should be expended, and on which vaccines and what kinds of preventative measures should be used," he says. A good place for aspiring science policy-makers to start is the Center for Infectious Disease Research and Policy at the University of Minnesota, Minneapolis, which has a team dedicated to studying influenza.

REAP THE REWARDS

If you are passionate about developing a vaccine, you will need to be committed: it is a tough challenge. Last year researchers were working through the night "doing whatever they could to ensure that we could make the H1N1 vaccine in a timely manner", says Kemble. Despite the long hours, this can be the most rewarding aspect of creating a vaccine. "These people were putting their heart and soul into this because they knew that if they came up with a vaccine they would be helping their friends, family and people they didn't even know," he says. "It was a very tiring but fulfilling time to be in the business."

To work in emergency pandemic response, a qualification in immunology or microbiology is the obvious academic background to have, although Palese believes a rigorous grounding in any biomedical science will be helpful too. Nabel goes one step further: "I would be surprised if you could find any discipline of science that couldn't be somehow matched to a pressing need in vaccinology." His advice is to think about the scope of the problems involved, then see which areas best fit your interests.

Once you are working in the field, it is important to remain open-minded and flexible, says Kemble. The nature of infectious disease is constantly changing, so researchers need to be able to adapt. "There are a lot of folk who come in with one discipline and find themselves working on something completely different a few years down the line because it fired up their passion," he says. And although working in a crisis environment can be difficult, the benefits of success can be far-reaching. "A stunning thought is that the work of a relatively small group of scientists can save the lives of so many people," says Kemble. "You take basic knowledge and you relate it to problems that really have a huge impact on people's lives." ■

Catherine de Lange is a freelance writer based in London

Call of duty



If developing vaccines isn't for you, then you might prefer to tell everyone about them instead. Karen Robinson, director of public relations at MedImmune Vaccines in California, explains what a job in communications entails.

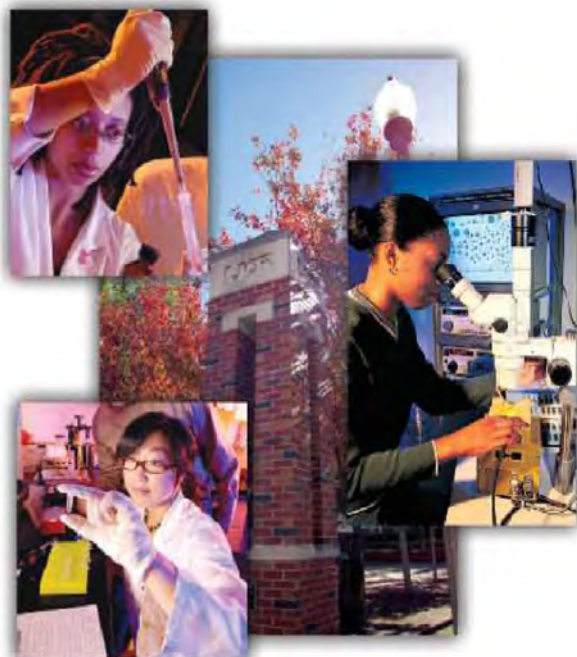
"It was a very frightening time for many people. Nobody knew what the pandemic was going to do or how it was going to behave," says Robinson, recalling the uncertainty surrounding the H1N1 outbreak a year ago. Following the first infections in Mexico, the virus seemed to be spreading fast and the stories about it even faster. For communications specialists like Robinson, who were at the centre of the media storm, it was a once-in-a-career event, one that put all their capabilities to the test. "Coming into work that Monday, it just kicked into high gear. It was pretty much non-stop, hectic activity for the next eight months," she says.

MedImmune adopted a novel approach to vaccine development, working on a live nasal spray vaccine – which also proved to be the first H1N1 vaccine made available to the public in the US – when other manufacturers were developing injectable vaccines based on deactivated virus. As a result, there was a lot of media interest in the company's work. Robinson not only had to keep the media up to speed with MedImmune's progress, she also had to monitor the ensuing coverage, prepare scientists and spokespeople for public meetings and be the first port of call for the press. "It was a constantly changing landscape," she says.

Connecting the media with top scientists is exciting, says Robinson. To do that well, it's important to understand the science involved, although a science background isn't a prerequisite as researchers are usually only too happy to explain their work. "It's rewarding to have a level of scientific education straight from some great minds."

A key challenge for anyone wanting to join a communications team is to convey a sense of balance. For example, while many companies were having trouble harvesting their vaccine, MedImmune was achieving a high yield, but its production was limited by the number of sprayers they could secure. "As much as we had a great story to tell, we needed to make sure that balance came through as well," says Robinson.

UAB THE UNIVERSITY OF ALABAMA AT BIRMINGHAM



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Interested applicants should forward curriculum vitae, statement of interests, and the names and contact information for three references to:

**Mark A. Rubin, MD, Vice Chair for Experimental Pathology
Department of Pathology and Laboratory Medicine
Weill Cornell Medical College, 1300 York Ave., C-410A
New York, New York 10065
email: rubinma@med.cornell.edu.**

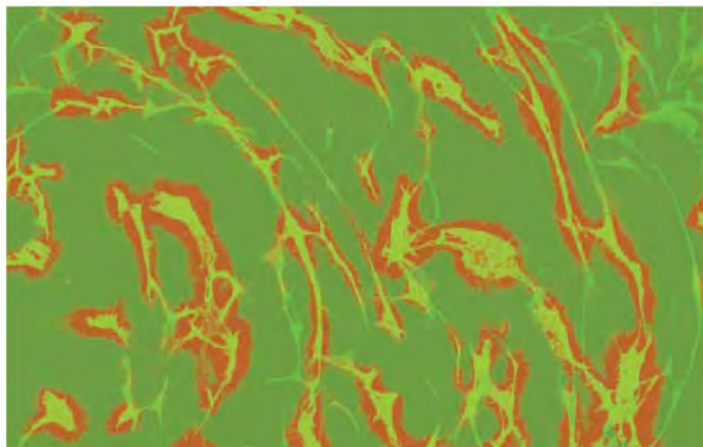
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To apply, go to <http://employment.unl.edu> and search for requisition number 090685. Complete the faculty academic administrative information form. Attach a letter of application; curriculum vitae; and the contact information for three professional references. Review of applications will begin **June 15, 2010**, and continue until the position has been filled or the search is closed.

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Dartmouth Medical School
NH - New Hampshire

Our goal is to recruit an established investigator and cancer/molecular biologist with expertise in the broadly defined area of molecular therapeutics with strengths in specific areas such as intracellular signaling, genome maintenance and stability, drug discovery and/or structural biology using modern experimental model system.

For more information visit
NewScientistJobs.com Job ID:
1400767762

Imaging Lab Scientist - Senior Scientist / Principal Scientist

Pfizer US
CT - Connecticut
Identify and develop in vitro assays utilizing the multiphoton microscope for various Neuroscience drug discovery programs. Lead efforts with internal partner lines to integrate confocal microscopy to enable data driven decisions.

For more information visit
NewScientistJobs.com Job ID:
1400761826

Liver Physiologist - CVMED Target Exploration

Pfizer US
CT - Connecticut
A Ph.D level position is available in the Cardiovascular, Metabolic, and Endocrine Diseases (CVMED) group for a biologist with a background in hepatic lipid metabolism and/or insulin sensitivity.

For more information visit
NewScientistJobs.com Job ID:
1400767693

Oncology Research Associate, Cephalon, Inc., Westchester, PA

Cephalon
PA - Pennsylvania
This is an experienced tumor biologist with experience in Drug Discovery and basic research for an emerging Oncology company where full use and application of standard principles, theories, and techniques are used to solve specific problems, interpret data, interpret data, and perform complex as well as routine work with a significant degree of independence shown.

For more information visit
NewScientistJobs.com Job ID:
1400763559

Ph.D. scientist - Bacterial geneticist/bacterial physiologist

Novartis Institutes for BioMedical Research (US)
MA - Massachusetts
The Infectious Diseases department is looking for a Ph.D scientist to lead an antimicrobial discovery group in novel compound/target identification and mechanism of action studies while utilizing new approaches to antimicrobial screening.

For more information visit
NewScientistJobs.com Job ID:
1400760460

Postdoctoral Fellow, Structural and Functional Study of Immunoreceptors

National Institute of Allergy & Infectious Diseases (NIAID),
National Institute of Health (NIH)
MD - Maryland
A postdoctoral position is available in structural immunology at the National Institute of Allergy and Infectious Diseases (NIAID) to study the structure and function of immune receptors and their ligand recognition using X-ray crystallography and immunological techniques.

For more information visit
NewScientistJobs.com Job ID:
1400767772

Postdoctoral Position - Molecular Genetics, Structure Function Proton-Coupled Folate/Antifolate Transporter - New York

Albert Einstein College of Medicine
NY - New York
A postdoctoral position is available for studies on the structure-function, molecular genetics, and biological/pharmacological properties of the proton-coupled folate transporter (PCFT) recently cloned by this laboratory (Cell 127:917, 2006) and the mutations that are the basis for the autosomal recessive disorder, hereditary folate

malabsorption.

For more information visit
NewScientistJobs.com Job ID:
1400767740

POSTDOCTORAL POSITION

University of Tennessee
Memphis Health Science Center
TN - Tennessee

Postdoctoral position available to study physiological functions and pathological alterations in ion channels and local and global calcium signals in arterial smooth muscle cells. Projects include studying IP3 receptors, TRP channels, voltage-dependent Ca2+ channels, and mitochondria.

For more information visit
NewScientistJobs.com Job ID:
1400767685

POSTDOCTORAL POSITION

FOX CHASE CANCER CENTER
PA - Pennsylvania

We are recruiting a new faculty member who will complement and strengthen our ongoing programs in Epigenetics and Progenitor/Stem Cell Biology (EPC). We seek to fill a position at the Assistant Professor level, but consideration will also be given to established investigators.

For more information visit
NewScientistJobs.com Job ID:
1400767748

Postdoctoral/Research Associate Position In Tumor Virology

University of Pittsburgh Cancer Institute (UPCI)

PA - Pennsylvania

Current studies involve programmed frameshifting, tumorigenesis and innate immune evasion for KSHV and MCV (a new human polyomavirus), as well as searches for other new human tumor viruses.

For more information visit
NewScientistJobs.com Job ID:
1400767750

Principal Scientist/ Sr. Principal Scientist Engineered Immune Proteins, Group Head

Pfizer US

MA - Massachusetts

As a core member of the Engineered Immune Proteins group, this individual will work closely with RU project teams and Immune Protein screening scientists to develop a strategy to generate optimized immune protein therapeutic Candidates.

For more information visit
NewScientistJobs.com Job ID:
1400760450

Promotional Regulatory Affairs Reviewer (Assoc Dir / Sr Mgr); 2 Positions

AstraZeneca US

DE - Delaware

Responsible for review and approval of promotional material and marketing activities for all segments (HCP, Consumer, Managed Markets), media (print, broadcast, electronic), sales training, faculty training, study recruitment advertisement and Corporate Affairs communications.

For more information visit
NewScientistJobs.com Job ID:
1400767445

Regulatory Information & Documentation Management Specialist

Pioneer Hi-Bred

IA - Iowa

Compliance with agency regulations and corporate policies requires rigorous systems for lifecycle maintenance as well as to provide efficient global access to all regulatory records in support of submissions for the approval of biotechnology products.

For more information visit
NewScientistJobs.com Job ID:
1400764275

Research Assistant

Pioneer Hi-Bred

HI - Hawaii

Under direct supervision, performs tasks to assist scientific personnel in general or routine field and/or laboratory operations. Perform tasks according to accepted methods and training prescribed by the work group.

For more information visit
NewScientistJobs.com Job ID:
1400764280

Research Assoc

Genentech

CA - California

We are seeking a highly motivated and interactive research associate with versatile technical expertise to support a cancer target validation program in Molecular Biology Department.

For more information visit
NewScientistJobs.com Job ID:
1400764174

Research Associate, Cancer Bioinformatics and Computational Biology of Drug Response Biomarkers

University of Virginia

VA - Virginia

Postdoctoral position as a research associate is available immediately to work in the discovery and validation of drug response biomarkers in cancer. Candidates should have an outstanding record in graduate school. Excellent skills in oral and written English and the ability to work independently are required.

For more information visit
NewScientistJobs.com Job ID:
1400766151

Research Associate, Signal Transduction and Cell Biology of Tumor Metastasis

University of Virginia

VA - Virginia

Molecular, cellular, transgenic and functional genomic approaches are being employed to define the molecular mechanisms whereby the RhoGDI2, Ral and associated binding partners affect the metastatic phenotype.

For more information visit
NewScientistJobs.com Job ID:
1400766150

Research Scientist - Nanoelectronics and Nanophotonics

Sandia National Laboratories,
California

CA - California

Department staff members conduct a broad and coordinated array of experimental and theoretical research to identify and understand the fundamental physical mechanisms underlying the surface, interface, and transport

behavior of a variety of advanced materials.

For more information visit
NewScientistJobs.com Job ID:
1400766314

Scientist (Technology)

Genentech

CA - California

We are seeking a Scientist to support drug discovery and early development in the Small Molecule Pharmaceuticals group. The candidate will have broad responsibilities spanning from supporting drug discovery through clinical development Phase II.

For more information visit
NewScientistJobs.com Job ID:
1400764178

Senior Manager, Global CMC, Biologics

Pfizer US

MA - Massachusetts

The individual will provide input and expertise in the development and execution of Global Regulatory CMC strategies for lifecycle management of commercially marketed biopharmaceutical products.

For more information visit
NewScientistJobs.com Job ID:
1400761834

Senior Research Scientist in Parallel Chemistry-Laval, Qc, Can

BOEHRINGER INGELHEIM

(CANADA) Ltd.

QC - Quebec

The candidate will work in close collaboration with multidisciplinary drug discovery teams (molecular and structural biology, pharmacology, computational chemistry, structural research and drug discovery support) to identify novel therapeutic agents for the treatment of viral diseases.

For more information visit
NewScientistJobs.com Job ID:
1400765264

Sr Scientist (Technology) - In Vivo Pharmacology

Genentech

CA - California

Lead and manage implementation of in vivo pharmacology models for

cancer targets of interest, using translational and pharmacodynamic approaches to select lead drug candidates. Identify and validate biomarkers in a preclinical setting and determine relationship to target modulation and potential for clinical translation.

For more information visit
NewScientistJobs.com Job ID:
1400764183

Stem Cell Research Associate (BS/MS)

Novartis Institutes for BioMedical Research (US)
 MA - Massachusetts
 The group focuses on stem cell biology and regenerative medicine, with the aim of developing therapeutics as well as cell-based research tools. The candidate will be expected to perform experiments and evaluate data independently and contribute to experimental design.

For more information visit
NewScientistJobs.com Job ID:
1400768549

Tenure Track Position in Pharmacometrics

Department of Bioengineering and the School of Pharmacy at the University of Washington
 WA - Washington
 The primary appointment will reside in the Department of Bioengineering, School of Medicine, with a joint appointment in the Department of Pharmaceutics, School of Pharmacy. Applications are sought at all levels including Assistant, Associate or Full Professor. Ph.D., PharmD or M.D. degrees are required.

For more information visit
NewScientistJobs.com Job ID:
1400767760

CHEMISTRY

Senior Associate Scientist (R2) / Scientist (R3) - Sample QC

Pfizer US
 CT - Connecticut
 Provide concentration, identity, and purity determination by applying appropriate analytical methods using LC/MS/UV/ELSD on samples that go for plate-based screening.

Analyze and upload relevant data using local and enterprise data analysis tools and reporting results into the corporate database.

For more information visit
NewScientistJobs.com Job ID:
1400763967

Sr Research Assoc (Chemistry)

Genentech
 CA - California
 Discovering, developing and demonstrating process chemistry at the laboratory and kilo-lab scale for timely delivery of early and mid-phase small molecule development candidates in the growing GNE pipeline in accordance with cGMP, ICH and FDA regulations.

For more information visit
NewScientistJobs.com Job ID:
1400764200

CLINICAL

Agronomic Research Associate - Fargo, ND (001LA)

Monsanto
 ND - North Dakota
 The Agronomic Research Associate will work with a team executing field research projects including, corn, soybean, cotton and chemistry. This is a unique opportunity to work with leading edge technology and talented cross functional teams such as Breeding, Commercial and Discovery Traits and Chemistry.

For more information visit
NewScientistJobs.com Job ID:
1400763053

Assay Validation Research Associate (001HC)

Monsanto
 MO - Missouri
 The team has access to state of the art sequencing and molecular biology facilities and equipment, and is responsible for delivering genomic tools and assays to be applied in our high throughput genotyping laboratories.

For more information visit
NewScientistJobs.com Job ID:
1400767213

Director Clinical Research-Onglyza

AstraZeneca US
 DE - Delaware
 Clinical Research physicians are involved in the design, conduct, monitoring, data interpretation and reporting of clinical trials. These individuals must ensure that all clinical studies operate to the highest ethical and safety standards and in compliance with GCP and regulatory requirements.

For more information visit
NewScientistJobs.com Job ID:
1400767447

Director or Associate Director - Health Economics & Outcomes Research

AstraZeneca US
 DE - Delaware
 Role Holder will have responsibility to provide technical HE&OR expertise and support for drug projects. They will have responsibility to support and interact with Value Demonstration Directors in advising on, and undertaking where appropriate, innovative and evidence based Health Economic and/or Outcomes Research solutions to optimize the price and value proposition.

For more information visit
NewScientistJobs.com Job ID:
1400767440

Medical Director (MD)

Genentech
 CA - California
 Stays abreast of internal and external developments (scientific, clinical, commercial, competitive, legal, regulatory and like) as such developments may implicate or otherwise impact the product pipeline and portfolio within the assigned therapeutic area(s).

For more information visit
NewScientistJobs.com Job ID:
1400764202

Nurse Research Coordinator (205330)

Henry M Jackson Foundation
 TX - Texas
 The Henry M. Jackson Foundation (HJF) is seeking a Nurse Research Coordinator for the Military & Emergency Medicine Department/ Defense and Veterans Brain Injury Center (DVBIC) located at the

Brooke Army Medical Center (BAMC) in Fort Sam, Houston, TX.

For more information visit
NewScientistJobs.com Job ID:
1400763401

Protein Engineering/ Antibody Research Scientist

Novartis Institutes for BioMedical Research (US)
 MA - Massachusetts
 Novartis is expanding its biologics capabilities. As part of this commitment, the Novartis Institutes of Biomedical Research (NIBR) created the global Biologics Center to enhance the growth of its biopharmaceutical pipeline.

For more information visit
NewScientistJobs.com Job ID:
1400767283

Protein Mass Spectrometry Research Associate

Novartis Institutes for BioMedical Research (US)
 MA - Massachusetts
 Analytical Sciences collaborates across all platforms to comprehensively characterize molecules ranging from traditional small molecules to novel biotherapeutics and their effects in biological systems. A core function is also to apply new technologies to benefit the Novartis research community.

For more information visit
NewScientistJobs.com Job ID:
1400766333

Research Scientist

Pioneer Hi-Bred
 IA - Iowa
 Design, prototype, evaluate, implement and optimize novel algorithms, models and methods that investigate and address complex genetic problems with strategic and economic importance to Pioneer's product development goals.

For more information visit
NewScientistJobs.com Job ID:
1400764293

Research Scientist - RNAi Therapeutics

Novartis Institutes for

BioMedical Research (US) MA - Massachusetts

The primary research goal of this unit is the development of drug delivery technologies for therapeutic siRNA applications. This position will be part of a multidisciplinary team focused on using a variety of approaches to advance our mechanistic understanding of RNAi pathways and aid in the delivery of therapeutic siRNA.

For more information visit
NewScientistJobs.com Job ID:
1400767834

Senior Director Clinical Research- Neuroscience Therapy Area

AstraZeneca US
DE - Delaware

The role of Senior Director Clinical Research provides medical input into the development and/or commercialization of AZ compounds by using detailed disease area knowledge to integrate knowledge into design of drug registration programs and diligence reviews of licensing candidates.

For more information visit
NewScientistJobs.com Job ID:
1400767433

Senior Research Associate

Pioneer Hi-Bred
IA - Iowa

Works closely with Trait Integration group in our efforts to select appropriate markers for each population to ensure efficient use of genotyping lab resources. Communicates with the Trait Integration group regarding all matters related to data quality and provides feedback to the lab so that delivery of the highest quality data is assured.

For more information visit
NewScientistJobs.com Job ID:
1400763949

Sr Research Associate - Chemical Biology

Genentech
CA - California

We are seeking an enthusiastic and highly motivated biochemist to join a junior chemical biology group as a

Research Associate or Sr. Research Associate within the Protein Engineering Department.

For more information visit
NewScientistJobs.com Job ID:
1400764180

ENGINEERING

Electrical Reliability Engineer (000JF)

Monsanto
IA - Iowa

An exciting opportunity to utilize technology and make an impact within Monsanto Muscatine Plant exists within our Reliability Engineering Team. The Electrical Reliability Engineer is responsible for implementing, monitoring, and maintaining processes that enhance manufacturing efficiency and maximize plant productivity.

For more information visit
NewScientistJobs.com Job ID:
1400767382

Environmental Engineer (001HF)

Monsanto
ID - Idaho

Performs hazardous waste site inspections and recommends appropriate action to management in compliance with regulations. Prepares, maintains and uses protective equipment. May perform tests or experiments requiring the use of unconventional procedures and current line of instrumentation.

For more information visit
NewScientistJobs.com Job ID:
1400767215

Sr Statistical Programmer Analyst

Genentech
CA - California

As a member of a Medical Affairs project team the Senior Statistical Programmer Analyst applies advanced level programming techniques and leadership to the planning, design, development, implementation, and maintenance of software for the reporting and analysis of clinical patient data.

For more information visit
NewScientistJobs.com Job ID:
1400759639

Looking to hire in clinical oncology?

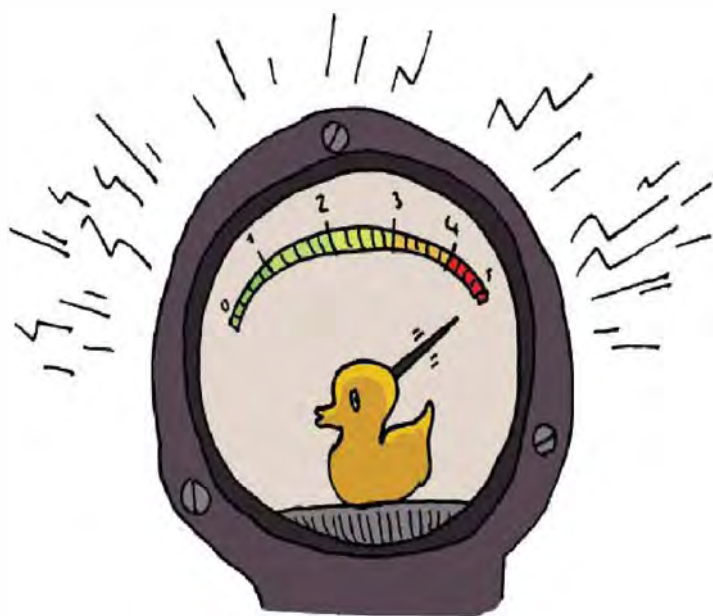
Clinical Oncology Feature
June 5 issue of *New Scientist*.

“Our participation in the New Scientist Cancer Feature yielded a tremendous response to the Cancer/Oncology positions available. We received a large number of extremely qualified applicants, and are in the process of hiring based on the strong response we received.”

Lara Hess, Children's Memorial Research Center

Reservations must be received
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NewScientist Jobs



FRUITLOOPERY is, Feedback has proposed, most readily detected by the uncalled-for use of the word “quantum” (10 June 2006 et seq). Don Jewett proposes a more subtle detector that can spot fractional fruitloopery, no less.

“For example,” he writes, “the first five letters of ‘quantitative easing’ are the first five letters of ‘quantum’, giving a detection-coefficient of 5/7. The fruitloopery of ‘quantitative easing’ in the fiscal sphere involves much spin, but perhaps it falls short of being fully quantal.”

We’ll happily endorse a fractional fruitloopery index, especially one that applies to quantitative easing. But we feel the need for a further, underlying scale of measurement – a universal crackpot standard, in fact.

One such has been proposed by the physicist John Baez. At bit.ly/crackpotindex, he starts by giving every potential crackpot a five-point starting credit, proceeds to add five points for every word of their theses written in CAPITAL LETTERS

and continues through a total of 37 indicators. These include “40 points for claiming that the ‘scientific establishment’ is engaged in a ‘conspiracy’ to prevent your work from gaining its well-deserved fame” and “40 points for comparing yourself to Galileo, suggesting that a modern-day Inquisition is hard at work on your case”.

This index, presented in 1998, has proved its worth over time, but now, as Michael Ludgate informs us, it has a challenger in the Quackometer developed by Andy Lewis (see quackometer.net). This observes that: “Several people have noted how quack websites use similar language and vocabulary and once you can spot the patterns, spotting quackery is easy. Quack words include ‘energy’, ‘holistic’, ‘vibrations’, ‘magnetic healing’, ‘quantum’. These words are usually borrowed from physics and used to promote dubious health claims.”

The site proposes an SI unit, the canard, to express quackery. You simply feed in a website’s

URL and the quackometer goes through its pages and assigns it an appropriate number of canards. We are happy to report that newscientist.com gets 0/10 canards – despite our generous helping of quantum, and indeed vibrations – while quantumhomeopathy.co.uk gets a well-deserved 10/10. Could this be the universal index we have been seeking all these years?

THE tea room in the Caulfield School of Information Technology, part of Monash University in Victoria, Australia, has a fine collection of higher degree theses. They are, Tom Peachey tells us, all in pristine condition and locked behind glass. All pristine, that is, except one that has paper damage and some paint dripped on the spine. Its title is: “Some Conservation Problems of Higher Degree Theses in Victorian University Libraries”. Tom wonders if any Feedback readers know of similarly self-referential theses.



LAST month we mentioned Oxo stock cubes in the context of the note on the plastic wrapping of subscribers’ copies of *New Scientist* saying that it is “Oxo degradable” (3 April). Now Lynne Moffat informs us that she has just bought a pack of Oxo cubes for her kitchen and finds that they are “Same weight, NEW shaped cube!”

Not only that. Dominic Houghton notes that they are “New X-shaped cubes”. He and Lynne both wonder if Oxo has pioneered a new development in geometry.

AFTER reading our report on Morning Chicness Bags, those must-have fashion accessories for vomiting expectant mothers (17 March), Jack Wretch felt he had to buy some for a relative who is “working to add to the world’s population”. He says that “on going to amazon.com I was, being somewhat parsimonious, disappointed to find that ‘Buy new’ was the only purchase option”.

BROWSING through a catalogue from electronics specialist Maplin, Peter Duffell came across an item that is described as a “heated hat”.

This promises to “keep you warm during those winter months” by means of a battery-powered heater “placed between ears area”.

In that case, says Peter, “wouldn’t it be better described as a ‘brain heater’”? He goes on to suggest it could be ideal for people with plenty of empty space in that particular location.

HERE is another strange recommendation courtesy of Amazon’s algorithms (10 January 2009). Apparently, as the online retailer told Tim Stevenson, a popular trend among purchasers of Motorola V3 phones is to buy, in addition, a Pest-Stop Electronic Rat Killer along with a *Batman: Arkham Asylum* game for the PS3.

FINALLY, Allen Lutins was provoked by our report on the “less fat” claims of Fry’s Turkish Delight (6 March) into sending us a scan of a U-Turn energy bar packet featuring the claim: “125 percent less fat than the leading chocolate candy brands”. How do they work that one out?

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.

In the lobby of the Sea Tac Holiday Inn near Seattle airport, Richard Shield tells us, there is a sign saying “Shuttle leaves every half hour on the hour”

In a spin

Why don't adults enjoy dizziness like children do? When I was a kid, I remember thinking that adults were rather boring for not enjoying the feeling of dizziness like I did, and I vowed to always enjoy it. Now, as an adult, I can't stand it - it makes me want to throw up. It seems many other adults feel the same way. Why is this? Does something change in us as we age?

■ I still remember my first - and so far last - trip to a fairground. I was 15 and vomited after a ride on a merry-go-round. I couldn't understand why my brother, who is three years younger than me, stayed for another ride.

Children obviously enjoy the feeling of dizziness - just look at how roundabouts in parks and playgrounds are packed with

proprioceptors - receptors in muscles and joints - help us to figure out how our body is positioned in space, which is particularly helpful if we cannot see. These elements mature at different rates.

The vestibular system is fully operational by the time a child has reached 6 months of age, proprioceptors need three or four years more. The development of the visual element is complete by around 16 years of age.

The sensation of dizziness and nausea following a spinning movement is similar to motion sickness - a result of the conflicting information our brain receives from the three elements mentioned above.

When our body is rotating at speed our vestibular system and proprioceptors can feel it, but our eyes can't locate the horizon. Our brain is desperately trying to resolve this conflict and, because humans are primarily visual, it assumes that the other senses are hallucinating, probably because of intoxication. So the brain tries to get rid of the assumed poison by provoking vomiting.

It looks as if my brother's balance system hadn't fully matured at the time of our trip to the fairground, hence his brain wasn't perceiving the sensory information as conflicting. Therefore, he could enjoy his ride on the merry-go-round while, unfortunately, his older sister could not.

Joanna Jastrzebska
North Shields, Tyne & Wear, UK

"Youngsters need the stimulation of dizziness to develop a healthy balance system"

youngsters. They need that stimulation to develop a healthy balance system, which is necessary to crawl, walk and keep their bodies upright, even on a rocking boat.

Our balance system is controlled by three senses cooperating in complex harmony. The vestibular system in our inner ear informs us about the position of our head; our eyes tell us how our body is located in relation to the external world; and

Questions and answers should be concise. We reserve the right to edit items for clarity and style. Include a daytime telephone number and email address if you have one. Restrict questions to scientific enquiries about everyday phenomena. The writers of published answers will receive a cheque for £25 (or US\$ equivalent). Reed Business Information Ltd reserves all rights to reuse question and answer material submitted by readers in any medium or format.

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



This week's questions

FUNNY ONION

If, after peeling an onion then topping and tailing it, I wait before chopping it, the middle segments push up and outwards (see photo, above). Why?

Alan Middleton
Weymouth, Dorset, UK

TOPSY-TURVY WORLD

Why don't bats get dizzy when they hang upside down? Or do they?

Year 5
Christopher Hatton School,
London, UK

WINE THIEF

During the recent cold snap I inadvertently left a full bottle of sparkling wine outside the back door. It was frozen solid when I found it. I brought it inside and allowed it to defrost at room temperature. However, when

defrosted, the bottle was no longer full (see photo, below). The bottle was corked and the cork was retained by a champagne-style wire cage. Both the cork and the wire appeared intact. Where has the missing wine gone?

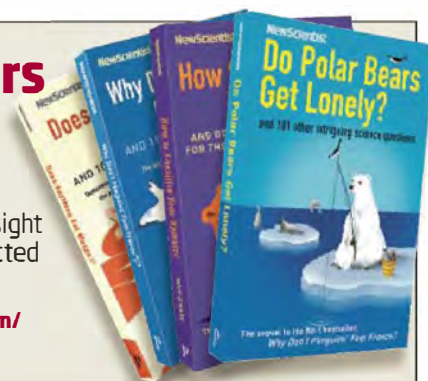
Nigel Healey
By email, no address supplied



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