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I, science

The Imperial College science magazine

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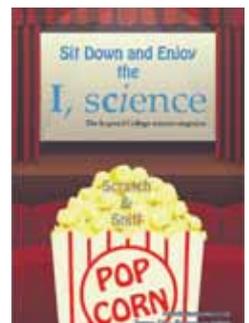
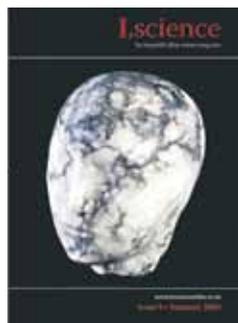
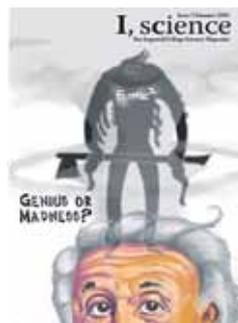
reports on how these birds got here and what their future might hold. If this special smelly issue of the magazine takes you back to your cinema experience, it might be that you're living through a Proust Phenomenon, as Emma Quilligan reports in her examination of how smell affects memory recall. If you haven't yet, then rub your magazine cover now and smell it; this is probably the first-ever scented student magazine in the UK. *I, science* is going multisensory for your enjoyment. Keep reading for more surprises!

Mico Tatalovic

Welcome to the 12th issue of *I, science*. In this issue we take a closer look at renewable energy sources in our special Focus section. From the wacky ideas of capturing the energy of lightning bolts to the brave advances in the already utilised energy sources such as wind power we cover a wide range of possible technologies to replace the current, unsustainable use of fossil fuels as our main energy source. We also examine potential eco-friendly alternatives to petrol cars: electric, hydrogen, compressed air or even wind and solar powered-cars all have potential.

If you have been seeing and hearing tropical birds in London's parks you might have explained it away as going crazy from all the revision you have been doing for the exams. In fact, you're not going mad, the exotic birds really are there; Felix Whitton

The next issue is coming out in November 2009. Send your article and photo submissions by the 1st October to: i.science@imperial.ac.uk



Four years of *I, science*, 12 great issues, three nominations for the best student magazine of the year, two runner-up prizes and a lot of fun science. E-mail us at i.science@imperial.ac.uk if you would like to contribute or advertise in the magazine.

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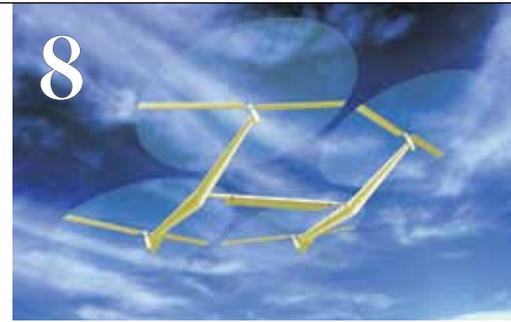
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News from Imperial...



Herschel and Planck Set for Blast-off

On May 14th, two space telescopes, Herschel and Planck will be launched into space. They aim to give us more detailed images and maps of the universe than ever before. Imperial's Astrophysics research group will be particularly interested to see how the software and instrumentation they have designed work in space.

Herschel will build up the first images of the areas of space where stars are born, and come together to form galaxies. This area has never been seen before, as huge gas and dust clouds obscure the view. However 'far infrared' light is able to travel through these clouds, and it is this light that Herschel is able to measure.

Planck will look at echoes of the Big Bang itself. Known as cosmic microwave background, it is subject to temperature fluctuations. These fluctuations can give us clues as to what the universe was like in the early years, how the universe evolved, and the nature of dark matter. Planck has equipment extremely sensitive to these temperature fluctuations, and will produce the most detailed maps yet for scientists to study.

The first results from Herschel are expected in early 2010, with findings from Planck expected in around three years.

Emma Stokes

Alzheimer's Risk Seen in the Young

The chances for early detection of Alzheimer's Disease (AD) have increased, thanks to work by researchers at both Imperial College and the University of Oxford.

Their study, published in the journal *Proceedings of the National Academy of Sciences*, compared 36 people aged 20-35. Half of these volunteers carried the APOE4 genetic variant, which increases the chance of developing AD by up to four times, even in those people with just one copy of the variant.

By using functional Magnetic Resonance Imaging (fMRI), the researchers were able to demonstrate that even at a young age, healthy carriers show differences in cognitive activity when compared to control volunteers.

More specifically, this hyperactivity in the hypothalamus in carriers of APOE4 is thought to contribute to AD by exhausting this part of the brain which is primarily concerned with memory.

The researchers stressed that not all carriers of APOE4 go on to develop AD, but hope that these results will aid the development of a test for the disease.

Emma Quilligan

Nanosensors Progress

Two groups of scientists at Imperial College have made significant developments in the field of nanoscience.

Imperial physicists have designed new nanosensors that could improve security and medical devices. The team paired up two complementary nano-structures to find that they scatter light in a unique pattern. Computer simulations then revealed that these structures are extremely sensitive to tiny environmental changes. It is hoped that specific 'molecular traps' can be added to create sensors tailor made to respond to certain chemicals, including explosives and poisons.

Elsewhere, Imperial scientists are collaborating with researchers from academia and industry to develop sensors that could empower HIV patients to manage their own condition. Portable devices would require just a pin-prick of the patient's blood. Nanosensors in the devices will then respond with treatment advice dependent on virus levels in the blood.

Dr Anna-Maria Goretti, a co-investigator at the Royal Free Hospital said, "If patients neglect to take their treatments or need prompting to see their GP, the device will provide a simple way of letting them know. It will really empower HIV patients to keep a close eye on their health and their treatments."

Catherine Luckin

Particle Partnership

Imperial announces a new collaboration with the Cockcroft Institute of Accelerator Science and Technology in Cheshire to develop the next generation of particle accelerators.

The new partnership creates four new research positions within the two organisations and aims to improve and develop particle accelerator technology.

Challenges include maximising energy efficiency through increasing the accuracy and intensity of particle beams, as well as attempting to reduce production and running costs.

Imperial Professor Maggie Dallman is enthusiastic about the new partnership: "Through close collaboration and sharing of ideas our researchers will be able to make significant progress and new tech-

nological developments in this important field."

As well as being used to investigate the fundamental nature of the universe, such as the experiments at CERN, particle accelerator technology is used in cancer treatment and has potential applications in energy science and electricity production.

Professor Swapan Chattopadhyay, Director of the Cockcroft Institute, is optimistic: "I look forward to this unique partnership propelling the field significantly in the years ahead with the combined scientific and technical prowess of the two institutes. This, I believe, cannot fail to be noted globally as a unique engine of discovery and innovation in the years ahead."

Seth Bell

... and beyond



Cow Genome Sequenced

The cow has become the latest animal to have its genome sequenced by scientists.

The project, involving teams from 25 countries, took five years to complete at a cost of £36 million. Knowledge about the cow's 22,000 genes will be used to inform breeding programmes, potentially leading to healthier herds and bigger yields of milk and meat.

Studying those genes involved in immunity might also further our understanding of human diseases, researchers hope.

A study of 37,000 genetic markers revealed that the cow genome has retained a surprising amount of diversity since breeding by humans began.

Sam Wong

Scripps piPS Rivals

Researchers in California have transformed adult human cells into primitive stem cells without manipulating them genetically.

Like embryonic stem cells, so-called induced pluripotent stem (iPS) cells have the potential to develop into any cell type, but since they are derived from adult cells, the problems associated with using embryonic stem cells are bypassed.

The first iPS cells were produced in 2007, using viruses to introduce four genes into adult cells.

Such cells were prone to develop into tumours, making them unsuitable for therapeutic use.

Several groups have succeeded in removing the foreign genes after the cells' transformation to make them safer.

The team from the Scripps Research Institute in La Jolla are the first to produce iPS cells without using genetic material.

Instead, they reprogrammed the adult cells by introducing a handful of 'recombinant proteins' – they call the result 'piPS', for 'protein induced pluripotent stem cells'. Their work was published in the journal *Cell Stem*. **SW**

Asteroids Get a Tan

Astronomers at the European Southern Observatory have discovered how solar wind causes asteroids to change colour early in their lifetimes.

Asteroids appear redder than the interior of meteorites on earth, but the processes that affect their surfaces were unknown until now. According to research by Pierre Vernazza and colleagues, asteroids become reddened within a million years of new surfaces being exposed.

After this initial period, the colour changes more slowly, and is more affected by the asteroid's composition than its age.

'The charged, fast moving particles in the solar wind damage the asteroid's surface at an amazing rate,' Vernazza said. **SW**



Memory Lapse to Stop Relapse

A novel compound could help overcome drug addiction by weakening memories associated with drug-taking, according to American-based scientists.

A group of rats was repeatedly given cocaine, leading them to develop a preference for the location where they were given cocaine over another location where they received a placebo.

The researchers found that rats that later received an experimental drug called CDPPB became less attached to the environment where they were given cocaine.

The research was published in *Biological Psychiatry*. "It will be interesting to see whether this approach extends to the treatment of cocaine abuse or other addictions," commented John Krystal, the journal's editor. **SW**

News from Elsewhere...

Hope for Hydrogen

New research carried out by researchers at Uppsala University in conjunction with the National University of Singapore has enabled scientists to improve the storage capacity of certain hydrogen compounds.

By adding small quantities of potassium hydride, the scientists were able to drastically lower the temperature for hydrogen absorption.

When burnt, hydrogen does not produce any harmful emissions and with a stored energy density approximately 2.6 times that of petrol, it is seen as an efficient replacement for petrol in internal combustion engines.

The new study is therefore good news for automobile companies that are interested in solid hydrogen-storage materials as a new carbon-dioxide free energy source for cars.

See our Focus Section (pages 8-17) for information on other developments in renewable energy.

Chloé Sharrocks

Mime Artists

The brightly coloured coats of various animals have fascinated many biologists including Darwin, but it was previously unknown why some had such extravagant markings.

Scientists from University of York, in collaboration with the University of Glasgow and Carleton University in Canada, have now achieved a better understanding as a result of computer modelling.

Their study, published in the journal *Evolution*, looked at why animals with an anti-predatory device such as a sting or poison are brightly coloured.

Many defenceless animals mimic dangerous species in an attempt to protect themselves from predators. By looking like a poisonous species, they are avoided by predators who cannot tell whether they make a good meal or an

unpleasant experience!

But this in turn leads to problems for poisonous species which predators might mistake for a good meal.

Researchers at the York Centre for Complex Systems Analysis (YCCSA) believe that to prevent such mimicry nasty prey evolved to have bright colours to make them more recognisable. Vulnerable species do not copy this bright colouring since in being more distinctive it also makes them more detectable by predators.

Lead researcher Dr Dan Franks, of YCCSA, said: "Our computer models show that this way of

looking at the evolution of bright colours explains why in nature we generally find that the nastier the prey species (e.g. the more poisonous) the brighter the animal." CS



Events

"Darwin's London" starting at the Hunterian Museum, WC2A 3PE
Sat 16 May 10:00-18:00

Tickets: £35 (£25 conc); includes refreshments, light lunch and a wine reception. Also includes two museum visits.

"Making choices to conserve the world's species" at the Royal Society

Tues 19 May at 18:30

FREE (no advance booking required).

"Trick or treatment? Alternative medicine on trial" at the Royal Institution
Thurs 21 May 19:00 - 20:30

Tickets: £8 (£6 conc), £4 RI members
Featuring Dr Simon Singh.

"Designer Seeks Scientist" at the Dana Centre

Tues 26 May 19:00 - 20:45

FREE, but advance booking required
Email: tickets@danacentre.org.uk

"The Island of Lost Souls (1933) on the Big Screen" at the Grant Museum

Tues 16 June 18:30 - 20:30

FREE (including complimentary glass of wine). No registration required.

How the Earth Shook



On 6th April 2009, an earthquake measuring 6.3 on the Richter scale struck the medieval town of L'Aquila in central Italy, killing at least 250 people.

In an attempt to further understand the devastation caused by such earthquakes, scientists from Italy's Istituto per il Rilevamento Elettromagnetico dell'Ambiente (IREA-CNR) and the Istituto Nazionale di Geofisica e Vulcanologia (INGV) have been carefully analysing radar data.

Using the data from satellites they were able to analyse the movement of the Earth and map the surface deformations after the earthquake and the numerous aftershocks that followed.

Effectively playing a sophisticated version of 'spot the difference', the researchers used an interferometry technique in which two or more radar images of the same ground location are combined.

They are then able to make very precise measurements of any ground motion that takes place in the time between the images, such that even a deformation of a few millimeters can be detected.

This analysis will ensure that a dense sampling of the ground changes around the L'Aquila area can be carried out over the next few months enabling scientists to enhance their understanding of earthquakes and the devastation that they can cause.

Perhaps such research will one day allow us to accurately predict when and where earthquakes will strike. CS

... and **Eco-News** from Imperial's Students

Racing Against Carbon

Inspired by the likes of Lewis Hamilton and Jenson Button, Imperial students are entering a gruelling motor race at the end of this year. Not only will they be driving along mountain passes and through deserts, but first they have to build their car. And their biggest challenge? Making their vehicle a zero-emission car.

Every year at Imperial around 100 undergraduates participate in an inter-disciplinary engineering teaching project called "Racing Green" which strives to develop integrated electric hybrid fuel cell vehicles.

Back in 2008 one of those students Alexander Schey attended a presentation by Louis Palmer, an inventor and former teacher. The first person to travel around the world in a solar powered car, Palmer was initiating another first – a special race which he wanted Imperial College to enter.

"He approached us to see if we could modify our Racing Green vehicle...however this was far from feasible," Schey told *I,Science*. "It was decided that we would modify an existing car from scratch. As such, a new project was born, and we called ourselves Racing Green Endurance."

'The Zero Race' is a global challenge in which six zero-emission vehicles will race across 40,000 km in just 80 days to prove to the world that clean, renewable energy is a viable solution to global warming. On 26th March 2009, Palmer presented this vision to Imperial and subsequently the UK's only entry began work on their zero-emission vehicle.

Taking an exciting route currently planned across the Rocky Mountains, along a 4000 metre mountain pass in Bolivia and through the deserts of Namibia the conditions will be tough.

"The speeds we will be going at will be moderate to maximise our range and a professional race driver will not be needed," Schey explained. Instead the vehicle, which is capable of reaching very high speeds, will be driven by students who will have had extensive practice prior to racing. Other students, some of whom will be taking a year out from their academic studies, will travel with the vehicle and drivers to act as a support network.



WWW.RACINGGREENENDURANCE.COM

Racing Green Endurance have kindly been sponsored by Radical who have given them a £50,000 SR3 Supersport chassis which they are subsequently modifying into a high performance electric vehicle for the race in December this year.

A third of the world's hydrocarbon fuels are currently burnt in vehicles and consequently contributing to ever increasing atmospheric carbon dioxide concentration levels. However, Racing Green Endurance's vehicle will rely only on electricity, and as a result, no greenhouse gases will be produced anywhere in the energy process.

Their sponsor Ecotricity will be offsetting all the electricity used with UK renewable electricity from wind power.

It is hoped that the race will be filmed resulting in a subsequent documentary that will be distributed worldwide on television and DVD, though David Howey, the staff project manager of Racing Green Endurance, is keen to stress

that like most details it "is not a certainty" yet. In the meantime the students are busy working on their car with the express aim of winning the Zero Race and securing the necessary sponsorship to make the marathon trip a reality. "The more sponsorship we get, the more sea crossings we can make and the further we can travel...for example Australia," Schey stressed. "The race will only take 6 months to complete if every sea crossing we make has to be done by ship. The ambition is to be able to airfreight the car across the necessary sea crossings, thereby actually completing the whole journey in 80 days or less."

With the UK already producing almost a third of engines for the European automotive industry and with Imperial College lying in the top five institutions for engineering education worldwide, Racing Green Endurance's ambitious plan will surely help inspire and foster sustainable innovation for the future.

Chloé Sharrocks



The Spirit of the Sun

Another team of engineering undergraduates are also making waves in the field of renewably-driven transport.

Imperial's 'Solar Spirit' team are currently trying to design and construct a solar powered boat for the Fresian Solar Challenge 2010 competition in the Netherlands.

Last year they participated in the 2008 competition in which they finished 14th after their electronics failed 500metres before the end of a 200km race.

Their boat was made of glass fibre and powered by five solar panels which drove an electric outboard motor. **CS**

Focus on Energy

I, science goes green as we look into some of the more obscure energy sources, alternative fuels and find out about 'greenwashing'. Now that global warming has become one of prime concerns for our planet, 'going green' is the latest craze. Everybody knows about solar panels, nuclear and wind power. However these are not the only options. This Focus section will examine some of the other technologies being developed and researched as alternatives to carbon-based fossil fuels. It will also examine some of the potential technologies to replace the polluting internal-combustion cars. Gloria Jaconelli

Wave Energy: Pelamis

With 70% of the Earth's surface covered in water, it has long been thought that harnessing this renewable energy source would be a step forward in the fight against increasing carbon dioxide levels in the atmosphere.

Generating hydroelectric power through the use of reservoirs and turbines has until recently been the dominant method used to extract energy from water. However, in September 2008 a new style of commercial farm was opened off the coast of Portugal.

Ocean waves are a viable renewable resource with them travelling thousands of kilometres without a significant loss of energy, particularly as most of the power is concentrated near the surface of the water. This means that waves have a higher power density than many other renewable sources, such as solar or wind, making hydropower an important area of future development.

It was with this in mind that in September 2008 the World's first commercial wave farm, Pelamis, became operational at the Aguçadora Wave Park off the coast of Portugal.

The Pelamis, or sea-snake (after which the device is named), is a wave energy converter designed to withstand even difficult ocean conditions allowing it to be used throughout the year with much smaller day-to-day variations than other energy resources.

Sitting semi-submerged, the Pelamis is constructed from connected cylindrical sections hinged together which are able to move and bend as waves pass. Hydraulic machines resist the motion of the cylinders and as a result generators are driven which produce electricity. The power harnessed is fed along a single cable situated on the seabed and several Pelamis devices can be combined to form a wave farm which can be linked to shore through one cable.

More than 1,500 homes can be supplied with energy from the Portuguese farm, which has a power capacity of 2.25MW. Compared to typical values for wind, the power density of the Pelamis is almost five times as large, making it a seriously viable energy source for the future. As a result of its potential, the next



phase of the project is now planned to increase the farm with a further 25 machines so a capacity of about 21MW can be achieved.

Following on from the success of the Aguçadora Pelamis farm, the Scottish Executive have announced the secured multimillion pound funding of the UK's first commercial wave farm which will have 4 Pelamis machines with a total capacity of 3MW.

Chloe Sharrocks

Thinking Deep: Geothermal Power

Like fossil fuels geothermal energy comes from deep down under the Earth's surface. We are practically floating on a large sea of molten hot lava and it makes sense to use this heat from the inside the planet to produce energy needed at the surface. Some life forms such as those at the deep sea vents are fully dependent on geothermal source of energy for survival.

Geothermal power uses heat energy from below the Earth's surface. Used since Ancient Roman times, it is a cost-effective, reliable and environmentally friendly energy resource. Although applications were once limited, recent technological advancements have rapidly expanded the range of uses. Home heating, greenhouse heating, crop drying and several industrial processes including milk pasteurisation can all exploit geothermal energy.

In a domestic setting, the energy can be used to heat buildings and domestic water supplies. For these applications, heat is taken from the upper 10 feet of the Earth's surface which maintains a nearly constant

temperature between 10 and 16°C. One heating method uses systems known as 'geothermal heat pumps'. Each system consists of a heat pump, an air delivery system and a heat exchanger which is a system of pipes buried in the shallow ground near the building. In winter, the heat pump removes heat from the heat exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can be used to provide a source of hot water.

The heat energy can also be converted to electricity via a steam turbine. At present the cost of electricity from geothermal plants is high but technological advancements are bringing costs down and it might soon compete with traditional power plants. For the last 20 years a research project to build the world's first geothermal power plant or the Enhanced Geothermal System has been taking place at Soultz-sous-Forêts



in Alsace, France. Now, after 20 years of research this pilot power station is finally starting to produce electricity. Cold water is pumped to the depth of 5km where rock temperature is 200 degrees Celsius, and then the heated water rises through another well providing energy to produce electricity. Similar projects are sprouting around Europe, Asia, America and Australia.

It is clear that geothermal power is hotting up and its potential uses are diversifying. The next step will be to dig deeper into the core of the earth in an attempt to utilise the heat from magma in the Earth's core.

Louisa Garnier

Fishy Business : VIVACE

Solar and wind power are unreliable, geothermal power geographically limited, and hydroelectric dams unsightly. The traditional forms of renewable energy still retain long-standing drawbacks. However, a new form of renewable energy has been developed and is set to enter the arena. Vortex Induced Vibrations for Aquatic Clean Energy (VIVACE) is the recent creation of Michael Bernitsas, a professor from the University of Michigan's Department of Naval Architecture and Marine Engineering.

The new machine uses the undulations caused by rounded objects in a flow of water, that were first described by Leonardo da Vinci some 500 years ago. Picture a straight, unblocked stream of water. Now drop a large pebble in it. When the pleasing splash clears, you would notice the water flow has split and is flowing past the pebble, but that eddies, or vortices, are being generated in the wake of the pebble as the water flowing along the surface of the pebble is slowed by friction. The

constant flow of water generates a continual flow of vortices perpendicular to the current. Objects in water are pushed and pulled from side to side and up and down by such vortices. Normally, vortices are a problem as they wear out aquatic man-made structures, like oil rigs, and engineering efforts seek to reduce them as much as possible.

The basic model VIVACE machine consists of a rounded cylinder attached to springs. When the cylinder is presented horizontally across a flow of water, alternating vortices are created which push the cylinder up and down. This generates mechanical energy which can be converted into electricity. A commercial structure might use cylinders stacked like a ladder, which could power local structures, or even anchored ships. Best of all, the machines would be unseen, clean, and less likely to disturb marine life or aquatic soil because they do not use fast moving turbines or high speed oscillations. Professor Bernitsas predicts VIVACE energy would cost about

5.5 cents per kilowatt hour, compared to wind energy costs at 6.9 cents a kilowatt hour, nuclear costs at 4.6, and solar power costs at a variable 16 to 48 cents per kilowatt hour. "If we could harness 0.1 percent of the energy in the ocean," he says, "we could support the energy needs of 15 billion people." A pilot project is currently in development for the Detroit River.

The VIVACE machine takes its inspiration from the natural world, where the use of the mechanical energy of vortices is not unknown. Shoals of fish achieve remarkably efficient speed and distance by their use of vortices. Leading fish generate vortices which encountered by fish behind them. However, the individual fish curve their bodies around the vortices, using them to propel the fish onwards. In effect, they use hydrokinetic energy generated by the fish in front of them – similar to the principle of the VIVACE machine. Professor Bernitsas proposes that future versions of his machine will have 'the equivalent of a tail and surface roughness akin to scales.'

Chloe Sharrocks

Piezoelectricity: Energy from Ambient Motion

Every time you step you waste energy. Researchers are now looking into ways of generating electricity from the motion of passing pedestrians and vehicles. Small devices such as mobile phones could be powered with the energy that we produce when we walk. Electricity generators could also be placed underneath roads and pavements to generate electricity from the vibrations caused by the traffic.

Eric Yeatman and his group in the Department of Electrical and Electronic Engineering at Imperial College are working on a micro-generator to power implants which monitor people's blood pressure or insulin levels with no need to change a battery. The generator consists of a small, suspended weight, which vibrates when the person walks. The mechanical energy is converted to electrical energy using the piezoelectric effect: when a piezoelectric material experiences a mechanical strain

an electric field is induced across it. This technique could be used to power mobile phones in the future if generators become more efficient.

Further afield in Japan, Kohei Hayamizu of Keio University put a larger generator under a square metre of pavement outside Shibuya underground station. In the 20 days it was there this single square metre of piezoelectric material generated enough electricity to power 1,422 TVs for an hour. All electricity was generated by footsteps of passing pedestrians.

Engineers at the energy firm Innovattech in Israel are working on a similar system to generate power from the vibrations caused by cars. It is expected to generate 400 kilowatts per kilometre of road and could be used to power traffic lights and road lights – and eventually perhaps electric cars. According to the company, the generators have the same elasticity as the tarmac, so



there would not be any extra resistance to motion and fuel consumption would be unchanged. It should pay for itself in 6-12 years and this is likely to decrease as the technology matures. It would only require maintenance every 30 years.

Ambient motion could be a useful and cheap source of energy in the future, but it would probably only meet a small proportion of our energy needs on its own.

Flora Mactavish

Solar Updraft Tower

A proposed type of renewable energy power plant, the solar updraft tower relies on three well-known technologies – the chimney effect, the greenhouse effect and the wind turbine.

A greenhouse-like structure is at the base through which air is heated by solar radiation and then rises by convection through the tower (the chimney effect). When the air travels upwards it turns turbines at the base of the chimney producing electricity. Heat can also be stored for use at a later stage, such as when there is insufficient sunlight.

This is a particularly viable power station because, apart from during its manufacture and construction, carbon dioxide is only negligibly emitted during its operation and within a couple of years the net energy payback is achieved. It is ideal for remote sunny regions such as a deserts. Despite its large size, the low operating cost and low level of technology required to build and maintain the tower, makes it appealing for developing countries who can use their local resources and labour. Photovoltaic cells underneath the updraft tower could also generate electricity directly from solar power.

With all of this in mind the Namibian government recently agreed to the construction of a 150km tall solar updraft



tower which also comprises of a 37km² greenhouse in which crops can be grown.

Chloe Sharrocks

Sky High Wind Power

Jet-stream winds at 10km above the sea level carry up to a 100 times more energy than the ground level winds. Scientists have predicted that harvesting just 1% of the available energy at this height could produce enough electricity for the whole planet.

The recent development of flying electricity generators that exploit this energy has given a new meaning to blue sky thinking. A number of prototypes exist but Dave Shepard and his team at Sky WindPower in San Diego have produced a particularly ambitious model. Their Flying Electric Generator (FEG) is essentially a helicopter that doubles as a wind turbine.

It has four rotors on an H-shaped frame, tethered to the ground by a long cable. The rotors act like a kite, providing the lift to keep the platform in the air. As they rise, the rotors also turn dynamos that generate electricity. The power is then transmitted to the ground through aluminium cables. If the wind lulls, the dynamos can be used in reverse as electric motors to keep the generator airborne.

The FEGs could produce a great

Deep Sea Solution: Tidal Power

If you thought the only thing lurking in the depths of Scottish waters was the Loch Ness Monster, then think again.

Deep-sea tidal energy farms are one of the latest ideas for producing renewable energy in Britain, with developments earmarked for off the Welsh, Scottish and Irish coasts. With 93% of Britain's tidal energy resources at a depth of at least 30 metres, the development of such farms is an attractive renewable possibility.

Although tidal energy harnessing has been technically possible for a number of years, it has been largely overlooked and treated as more difficult to develop than alternatives such as wind. But, now two of the largest energy suppliers of the UK are actively funding and developing new tidal stream projects.

Fifteen metres high and 25 metres long, two turbines are to be installed deep underwater on the sea bed off the coast of Wales as part of a joint venture between E.ON and Lunar Energy. When it is operational in 2010, it will look very much like a wind farm under the sea. The force of the moving tidal waters turns the

deal more energy at lower financial and environmental cost than current methods. At present, the largest ground-based wind turbines produce about five megawatts each. Shepard expects each FEG to produce about 20 megawatts at less than half the price of conventional energy generation.

According to Shepard, FEG development is already at an advanced stage: "We expect to make a demonstration in the U.S. less than three years from now at high altitude in normal high altitude winds. In four years I would expect this sort of technology to be in active use."

Another similar concept is Selsam's Superturbine that uses several smaller turbines on the same shaft linked to same generator and can be floated on water or suspended by an air balloon to capture winds at high altitudes and with a better efficiency.

It will be difficult to build a flying generator that can make money and maintenance costs will undoubtedly be high. However, the political impetus behind renewable energy is growing and ground-level space is limited. It is likely then that flying wind turbines will take-off.

Louisa Garnier

turbines' blades and each turbine will have an installed capacity of 1 Megawatt, enough to power a large Tesco store.

Tides are predictable, the power produced is not dependent on the weather, and is carbon neutral. This makes deep-sea tidal power an attractive green energy source which may be used around the world.

Environmental impacts are minimal as the turbine blades turn sufficiently slowly that the blades will not damage marine life. Also, unlike traditional tidal barrage schemes, such as that recently proposed for the Severn estuary, the water is not impounded during the process, so large amounts of water do not impact sensitive areas of the surrounding coast.

ScottishPower are also planning to develop the world's largest tidal stream project off the coast of either Scotland or Ireland, using Lànstrøm, the most advanced tidal turbine. With projects planned for operation in 2011, there is hope that as much as 60 Megawatts of energy will be produced by one of their tidal-farms, with enough green energy to supply 40,000 homes.

Studies currently suggest that there is sufficient tidal energy existing around Britain's coastline to supply at least 5% of our total electricity consumption worth about £1 billion each year.

Chloe Sharrocks

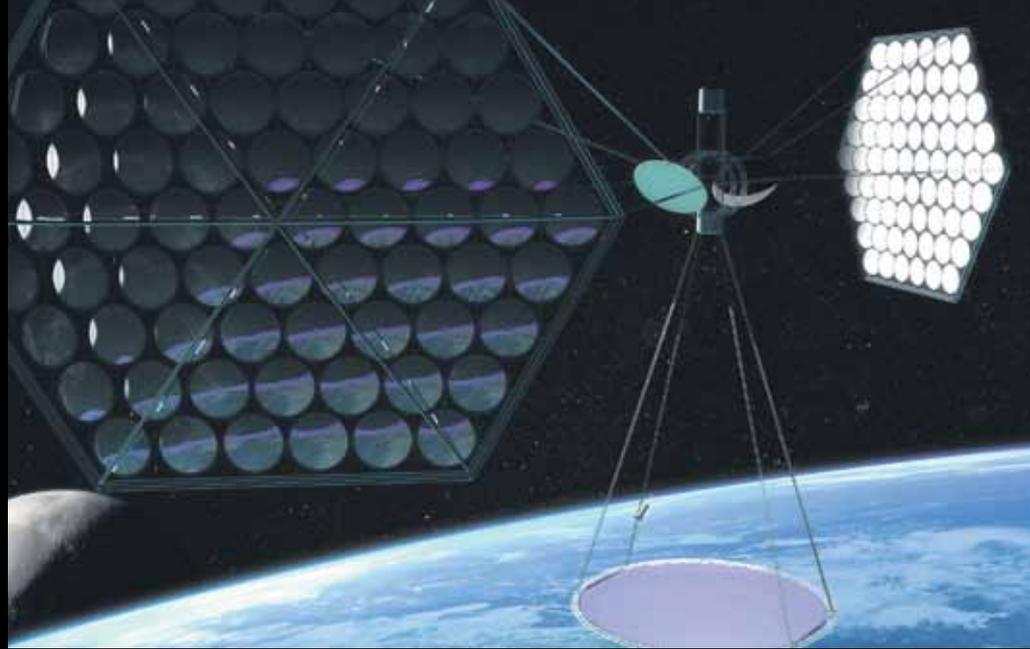
Space Solar Panels

Have you ever looked up on a cloudy day and thought, what a waste? If so, you're not alone. Physicists are developing solar panels that could capture the sun's energy from space – bypassing all those pesky clouds – and send it back to Earth, potentially revolutionising the way we get our electricity.

The space panels could be transmitting power 24 hours a day, without any loss of efficiency from pollution, the atmosphere or night-time. But things are still very much at the testing stage, and an ex-NASA physicist John Mankins, who leads an international team of US and Japanese scientists, believes we are still six to seven years from a demo orbital system and more than a decade from a full-scale operation.

Mankins' team is now testing prototypes to see how far a solar panel can beam energy. A recent trial run on a mountain on the island of Maui successfully transmitted electricity 92 miles to the main island of Hawaii. This was over 100 times as far as previous 1970s tests in the Mojave Desert. But the team still has a way to go – the atmosphere extends for over 6000 miles, although most space agencies agree that about 50-60 miles altitude is the point where you can say "I'm an astronaut".

There are plenty of other niggles to contend with, not least the rather puny amount of electricity that made it to Hawaii – 20 watts, enough for a couple of energy-saving light bulbs – most of it being lost in transmission along



the way. According to Mankin, his team is limited by budget, not physics, and with better transmitters, receivers and solar panels they could up the efficiency by two-thirds.

Another project is underway to put geostationary solar power generators in orbit in a little over a decade. Led by Japan's space agency JAXA, the space solar power system (SSPS) aims to be sending the equivalent of a large nuclear power station (1GW of energy) to Earth by 2030, and at no greater cost to consumers. Orbital generators have long been the stuff of sci-fi, but the recent double-whammy of environmental and energy crises have spurred Japan into action, and the temptation of clean, sustainable energy – without having to rely on geopolitics – is

proving too good to resist.

Along with the above benefits, solar irradiation is 5-10 times stronger in space than on the ground, meaning non-stop high-efficiency power is a possibility. But both the scale of the structures that will need to be blasted into orbit – 10 km-long lasers weighing over 10,000 tonnes – and the cost, are "enormous".

Mankin says "I think we need to maintain a portfolio of energy options... using wind and other renewables in combination with space based solar power." But with enough energy striking the Earth's surface every hour to power a worldwide electricity grid for a year, we may be better off investing in a more down-to-earth solution.

Felix Whitton

Capturing the Lightning

If you ever observed a thunderstorm with lightning you likely wondered if it would be possible to capture the energy from lightning. A single bolt of lightning produces enough energy to light up 150,000,000 light bulbs. Department of Energy states on its website that "One lightning strike has enough energy (~1500 MJ) to power a 100W light bulb for almost half a year. However, you would need to harness over 58,000 lightning strikes each day to equal the electricity production capability of a large (1GW) power plant." Since lightning is produced naturally, all we need to figure out is how to capture that electricity and feed it into the grid. The main problem is how to transform and store the enormous amount of direct current electricity from a bolt into an alternating current that can be used when needed. Another problem is that it is difficult to predict when and where lightning is going to strike. The first problem may be overcome by transforming and then storing the electricity from a bolt; the second one by placing such harnessing stations in areas with exceptional lightning activity such as Florida.



Another way around these problems is to actually produce the lightning ourselves, when and where we want it. This idea is inspired by Nikola Tesla – a Croatian physicist who invented the

alternating current motor we still use today. He believed we could harness the existing background energy of the universe and transmit it wirelessly for free to everyone. Many accounts of his life and work cite his failure to develop such systems not as failures of technology but as manipulations by energy companies eager to keep their profits from selling energy. Many of his followers and enthusiasts still work on this concept of 'free energy'. The most recent advance in the field is an American inventor Steve LeRoy's device that generates lightning and harvests energy from it. The device is based on Tesla's coiled transformer and creates mini lightning bolts that each generates enough electricity to power a 60-watt light bulb for 20 minutes. LeRoy believes a larger version of his prototype could produce bolts that would each be powerful enough to power 30,000 homes for a day. "If you've ever seen a tree hit by lightning, [you know] it's energy for the taking," LeRoy recently told *BusinessWeek*.

Alternative Energy Holdings who have been mainly involved with nuclear energy so far are also developing a system similar to LeRoy's and are stifling his research, although he says their research is based on his own patents. We can only hope that this time round energy companies are interested in this potential clean source of energy to make it available rather than to kill it off.

Mico Tatalovic

Wind-powered Cars: Just a Lot of Hot Air?

Electric cars are bad for the environment. Well, compared to wind-powered cars anyway.

Why plug your car into the mains, draining electricity for hours, when you could drive along being powered by the natural energy of the wind? Well, for one, wind-powered cars look even sillier than electric ones. But with electric cars now seemingly becoming the ultimate eco-fashionistas accessory, I'm not sure this reason alone is good enough.

I think the main problem is that they are just not practical. Whereas it is actually possible to get from A to B in an electric car, so far, their wind-powered counterparts seem suitable only for those people who live in a very windy place, where everything is very close, or those wanting to break the land speed record (which will apparently be possible for the new Greenbird). The Greenbird makes use of the technology seen in Formula One and in aeroplanes, which

"harnesses and optimises airflow." So it achieves maximum efficiency, and could go very fast, yet it's over 12ft (3.6m) long with no room for a bag of shopping.

For those looking for a more everyday vehicle, you may be interested to know that several technologies have already been patented. One of these describes the "conventional sailing rig" which would be attached to the car, and although it claims to be "particularly well



adapted for highway travel", I'm not convinced. Another details an intake valve which would be attached to the roof of the car. An alternator would then convert the winds' kinetic energy to electrical energy, and then to AC voltage by a controller with power diodes.

Others suggest tunnelling the high speed winds created by the car's movement into turbines placed inside the car, hence offsetting some of the drag lost to the air and recovering the energy needed to push the car forwards by generating electricity that is then used to power the car. These designs work very much like the regenerative braking: the wind does not create new energy but is used to recapture some of the energy lost by the car making it more efficient.

Windmobile was featured on

the cover of the *Popular Science* magazine back in 1976. It could go 35 mph in a wind of 35mph. Later designs also included solar-wind hybrids, but somehow cars like this disappeared from our roads before even getting there.

The most useful application of wind-power technology may not be in powering the car itself. Venturi has launched Eclectic, a 3-seater electro-solar vehicle. They claim that the Eclectic can be recharged with a wind turbine which can easily be carried and set up on rooftop of your car. However, with a recharging capacity of just 15km per day (and that's in windy areas), I think I'll hold off a while before I jump on this wind-powered bandwagon. But in the current energy and economic circumstances where every little bit counts, perhaps all electric cars should have features such as regenerative braking and wind-power features.

Emma Quilligan



Fuels for Cars



The Car That Runs On Air

drives a piston with the hot expanding gases that are created when petrol or diesel is burnt in a combustion chamber. An MDI engine uses the expansion of compressed air to drive its pistons.

It does this by using two chambers. Compressed ambient air is fed first into the active chamber. The air is kept at a constant pressure, but by filling the chamber it pushes the piston up, doing considerable work on the crankshaft. The air is then filtered into the expansion chamber where it expands quickly, returning to ambient pressure. This motion pushes the piston in a mechanism very similar to the combustion engine.

But the compressed air technology emits no pollution. The MDI OneFlowAir car will

be able to do this up to 50 km/hr (31 mph). Above this speed, petrol, biofuels or ethanol combustion is required to boost the engine's power. It still then only produces 30 mg CO₂/km compared to the current 180mg UK average.

With this dual system the car has a range of 90km. Refilling takes a couple of minutes if a modified air pressure pump is available at a filling station. Otherwise it takes four hours to refuel using the onboard refuelling system plugged into a domestic power supply.

In 2005, a lithium-battery powered vehicle tested at the same speed outperformed this technology three times over. And public tests have only so far shown the cars to have a range of 7 km. MDI claims to have overcome the problems with the OneFlowAir, claiming that it is ready for production this year in Europe. Their Indian partners Tata say it still requires another two years of work. **Jessica Bland**

Compressed air has been used to improve engine efficiency for almost a century. But French company Motor Development International (MDI) has taken this idea one step further. They have developed a car, rumoured to launch later this year, which uses pressurised air as fuel. A conventional engine

Electric Cars

Who said the electric car is “dead”? The Obama administration recently made a pledge to get 1 million plug-in hybrids on the road by 2015. With this new US governmental financial support, electric vehicles could be back with vengeance.

Electric cars are powered by an electric motor, rather than a fuel powered combustion engine. Hence they are emission free, at least in terms of exhaust fumes. Hybrids use a combination of power sources, with both electric motors and combustion engines.

The concept of electrically powered cars is nothing new, so why

hasn't it had more success? One of the factors deterring use is the limited storage capacity of the batteries. You can imagine how inconvenient it could be to recharge a battery half way through a long journey.

So it comes as no surprise to hear US President Obama has launched a \$2.4 billion competitive grant program for US battery makers. And there are plenty of innovative ideas out there.

The Electric Recharge Grid Operator (ERGO) takes a new approach to the battery issue, using a mash up of mobile phone and automotive technology. Using a network of “smart” charge spots, Satellite navigation directs the driver to charge spots at appropriate times, based on predictions of the destination. These charge spots not only charge, but could quickly swap for a recharged battery for those on the go. With the ERGO system, the consumer purchases the car, but the batteries are



owned by the company. They make money by selling the electricity; you could subscribe to pay as you go, or chose a set number of miles each month.

Electric cars seem an ideal solution for short journeys on congested city streets. Here in London, Westminster City Council have introduced Juice Points – on street electric recharging points. And with electric vehicles exempt from road tax and the congestion charge, plus the first electric Minis from BMW out soon, it now make sense to switch to electric cars.

Katherine Jones



Hydrogen-Fuel Cars

The Honda FCX Clarity is the world's first commercial hydrogen-fuelled car. It should become available for lease later this year, though only in Los Angeles. Wider production may not begin until 2015. This gives us time to think about hydrogen fuel and its plausible impact on our ever-worsening environment. Hydrogen fuel use has been steadily growing. Official figures from the U.S. Department of Energy, predict that the world is consuming 42 million tons of hydrogen per year (2003) and there is a 10% yearly rate of increase. The cost in production is highly variable; it can cost up to ten times the amount of gasoline equivalent per gallon, which is huge considering it is one of the more talked-about renewable sources of energy.

Hydrogen can be produced via several processes, all very expensive, all very long and all very inefficient. Around 95% of hydrogen is still currently made in large quantities from natural gas. Natural gas is not a green and renewable source of energy, so by extension neither is hydrogen sourced from it. But recently several other methods have been developed. Renewable electrolysis is one choice: an electric current to separate water into its components hydrogen and oxygen uses nearly 35 kWh energy per kilo of hydrogen, which is considerably greater than energy needed to produce main-line petrol/diesel. So why bother with hydrogen if it is

initially produced by natural gas (the type of fuel it is trying to replace), it costs a lot more than normal petrol to produce and it actually requires energy to be produced in the first place?

By using a fuel cell, hydrogen can become the non-polluting, green ‘energy carrier.’ Water and energy in the form of heat are the only products of hydrogen fuel cells and these cells are two to three times more efficient than gasoline. These key elements, combined with the fact that hydrogen has the highest energy content per unit weight of any known fuel, at 120.7 kJ/g is why some people are calling the Honda FCX Clarity the car of the century. But there is a difference between a hydrogen fuel cell and hydrogen internal combustion engine vehicles (ICE). A fuel cell vehicle has an electrochemical engine that only produces water vapour as a byproduct. A hydrogen ICE vehicle burns the hydrogen directly, instead of petrol, and still releases some greenhouse gases and nitrogen oxides as byproducts. A fuel cell electric system is better suited to modern vehicles that increasingly use electrical systems in place of mechanical and hydraulic ones to steer, brake and control other various functions.

However, critics have outlined shortcomings that might prevent hydrogen from becoming economically and environmentally viable. Hydrogen fuelling stations are only sparsely available in parts of America and Canada. A

whole new infrastructure of hydrogen filling stations needs to be built in order to support hydrogen vehicles. So a lot of money has to be put towards: building infrastructure, making more efficient fuel cells for the cars and mass producing such cars. All this pushes the likely date for hydrogen based transport further into the future than more readily available electric cars.

Another problem is that using hydrogen may not actually reduce greenhouse gases: water vapour is one such gas, and leakage of mass produced hydrogen could contribute to destruction of ozone layer and production of methane – another greenhouse gas. Rushing into hydrogen-based energy might just replace one problem (carbon dioxide emissions) with another one (anthropogenic hydrogen emissions). Two more points that may raise questions and doubts over hydrogen as a fuel in general are: firstly, the Ford Motor Company has dropped its plans to develop hydrogen cars and focus more on “electrified vehicles” leading one to believe that hydrogen fuel may not be as viable as people have foreseen and secondly, a comprehensive study of hydrogen in transportation applications by the National Academy of Engineering in 2004 concluded that “there are major hurdles on the path to achieving the vision of the hydrogen economy.”

Umar Chaudhry

Biofuels version 3.0

IMAGINE THE day. We develop a new energy source. That is virtually limitless. Restores the environment we live in. And helps us achieve energy independence. That day has dawned.

This is what Solix, a US biofuel company working in conjunction with the University of Colorado, state on their website.

The energy source that Solix is referring to is theoretically inexhaustible, carbon neutral, and seems set to burgeon into a profoundly lucrative industry. It is biodiesel produced by algae. Several private US companies, the US military, and the UK government-funded company Carbon Trust are already researching and constructing pilot algal power plants. Current research suggests that this is the only source of biodiesel that has any realistic potential to completely displace fossil fuel diesel.

Biodiesel is any form of biologically based, diesel-like fuel that can replace petroleum based diesel. Bio-ethanol is the other major liquid biofuel, which can supplement petrol. As vehicle fuel prices continue to rise, and the struggle to combat global warming continues, the fledgling biodiesel industry poses an attractive and lucrative alternative to finite petroleum sources. Primary research and development has focused on well-known and long farmed crops like soybean, canola, corn, and palm, but the feasibility of these sources of biodiesel are limited by a number of practical factors, namely production costs, the amount of required arable land, and a relatively low yield of oil. For example, soybean, the current main biodiesel crop, produces a bodyweight of only 20% oil. On the other hand, strains of microalgae can produce an retrievable oil yield of up to 75% of algal weight, and since a volume of algae can double in volume in a single day, the oil can be harvested more often; it is estimated that one acre of algae could produce up to 10,000 gallons of oil per year. The remaining biomass could potentially be used as fertilizer or animal feed.

Based on algal biodiesel's potential as both motor and jet fuel, the UK government has provided the independent company The Carbon Trust with initial funding of up to £4 million for the Algae Biofuels Challenge, which is ultimately

intended to commercialise an algal oil-based biodiesel by 2020. The full cost of the project, including fundamental research and development of appropriate algal strains, maximizing yield of oil, and designing and constructing a production

atmospheric carbon dioxide during the algae's life. This contrasts to conventional fossil fuels, which release long stored carbon upon combustion, and therefore continually add to the total volume of carbon dioxide in the Earth's atmosphere.

With these benefits, it is unsurprising that the UK government is fixing upon algal produced biofuel as a sustainable fuel which will both provide vehicle fuel, and help reduce carbon emissions in accordance to global anti-climate change policy.

So what are the downsides and limitations of algal biodiesel? These are summarized in a feature article by Bob Grant, in the February issue of *The Scientist*: "The key challenges include selecting the most suitable algae strains, growing these algal cells at optimal rates, engineering the metabolic pathways that control oil production to create cells pregnant with desirable oil products, and extracting the oil in an efficient and economic manner." These factors contribute to overall cost; despite its heady potential, estimates show that producing algal biodiesel is still more expensive than producing crop biodiesel. In 2008, the production cost of algal oil was about \$2.80/L, while the production cost of petroleum diesel was around \$0.48/L in the US.



plant, is expected to be £15-23 million, half of which will be funded by the Carbon Trust.

Algae do not need arable land, like other biofuels from cultivated plants such as maize, therefore algal power plants could be set up in arid or salinated land. This would have less impact on local biodiversity. The oil, consisting of a mix of fatty acids and lipids, is constructed from the products of plant photosynthesis, meaning that this form of biodiesel is carbon neutral – combustion only releases the carbon which was taken from

But neither crop biofuels nor petroleum will meet our energy needs in the future: crop biofuel takes up large arable spaces invaluable to food production, and petroleum supplies are predicted to soon tail off and become scarce and expensive. So perhaps these limitations are only a mixture of biological and mechanical challenges for future research to tackle. With development of algal biorefineries, identification of beneficial growing factors, stabilising environmental factors, and new strains of algae, algal biodiesel researchers appear confident that improvements will

be achieved. There is also the possibility of creating hybrid or engineered strains of algae to improve yield and lower production costs. In light of the growing exclusivity of petroleum and the practical problems of crop biofuel, the future for diesel looks microbial, be it algae or fungi!

Oyster mushrooms are not only tasty but also capable of breaking down petroleum in polluted land into harmless by-products. With an estimated diversity of 1.5 million species of fungi, surely many other species of fungi could also prove useful to environmental technologies. And indeed, a species of fungus which actually produces a diesel-like fuel has been recently discovered. A team of researchers, led by a professor from Montana State University, found the fungus *Gliocadium roseum* while searching for yet undiscovered fungal species in the rainforests of

Patagonia, South America. The discovery caused a stir when tests showed it produced a gaseous, diesel-like fuel from cellulose and starch sources under limited oxygen conditions. Dubbed 'myco-diesel' (myco-, Greek for fungi/mushroom), the substance contains many of the same hydrocarbons found in diesel derived from crude oil, and consequently, this fungus offers a new way of producing alternative fuel. Researchers in government agencies and private industries have already shown interest in studying the fungus further to identify the nature of the myco-diesel production process.

Under appropriate conditions, the fungus could potentially become a future organic, living biorefinery producing usable and renewable fuel. As the diesel is produced by breaking down cellulose from organic matter, it could even generate usable fuel

from agricultural or biofuel by-products: imagine a flock of fungi breaking down excess biomass from biofuel refineries, removing the problem of what to do with the waste plant material. However, by identifying the genes and enzymes responsible for the production of myco-diesel, researchers hope that we will learn how to refine their action, and to scale up the process to industry-level efficiency. A study by the team leader points out the diversity of medium-chain hydrocarbons produced by *Gliocadium roseum*, which sets it apart from other microbes and indicate the myco-diesel's ready potential for commercial use. The work on this fungus illustrates the importance of basic research: an accidental, routine discovery of a new species might lead to solutions of some of the most pressing technological problems facing mankind today.



High oil yield algae are preferable to reduce processing costs, yet generally higher oil strains grow more slowly than low oil strains. Contamination and takeover by faster growing algal strains is a risk of open plan algae plants.

The oil is extracted from the algae using a variety of different techniques including: solvent, enzymatic and ultrasonic methods.

BIOFUEL FACTS

Researchers hope to study the genes and enzymes involved in the production of algal oil to potentially create hybrid strains that can lessen the problems of balancing oil production and growth rate trade offs. Growing 'extremophile' algal strains which can survive in extreme conditions where other strains cannot may also be possible.

Closed 'photobioreactors' prevent contamination and produce better yield than open systems, but are more costly to build. Building an algal oil plant as part of another industrial system, or using waste products for other uses, would reduce costs.

In effect, algae are prolific, fast growing, don't require large tracts of land, and possess a low biomass but have a high percentage of oil.

The oil is converted into usable biodiesel through a transesterification reaction, which typically uses methanol and an alkali catalyst to transform the oil's triglycerides into fatty acid alkyl esters.

In 2008 the U.S. military signed two deals worth about \$35 million to develop biodiesel made from algae.

Getting High on Science: Helpful Hemp?

Annabel Slater investigates biofuel potential of hemp.

This stuff is not just for smoking. There are three species of plant in the genus *Cannabis*. The strains of these plants that have not been bred to be high in the psychoactive compound, tetrahydrocannabinol (THC) are generally referred to as 'hemp'. Hemp plants typically contain less than 0.3% THC. The strains bred to be higher in THC are called 'cannabis': they contain anywhere between five to 20% THC. These are the plants usually grown for illegal or medicinal purposes. Yet hemp has been used throughout history to produce fibres, textiles, paper, and edible seeds (high in vitamins). Today, major producers of hemp include Europe, China, and Canada.

There is another highly relevant use of hemp today. When pressed, hemp seeds produce nice, appropriate, green-coloured oil which is a usable biofuel. So could the plant be a viable biofuel option?

Currently, the positives and negatives for hemp farming cloud the plant's true usefulness. On the one hand, hemp is a tough and fast-growing crop, which can grow well even on poor land – hemp has even been grown successfully on radiation-contaminated land to produce usable products, and can be used as a 'mop-crop' to take up impurities from wastewater lands.

Oil can be extracted from the seeds and stalks – the volume of extractable oil is relatively high, at 33% of seed weight – while the fibrous material of the plant can be used in building materials, textiles, and paper.

Although hemp is hardy and fast growing, its lower seed yield per acre puts the total oil yield per acre at a value lower than current primary biofuel crops such as canola. Then there's the problem of controversy (See our *SuperHigh Me* film review on page 28).

It seems likely that hemp's biofuel potential is maintained at a low profile and slow rate of research because hemp is still

linked in the political psyche to its more notorious cousin, cannabis.

A search on Pubmed yields nearly no studies of hemp as a prospective biofuel crop, although a Google search produces a number of pro-hemp websites by green activists and farmers. Seemingly worried that intensive production of hemp could

on farmers. In February 2007, *Biodiesel Magazine* pointed out that although at least seven states in the US had passed basic legislation to grow hemp commercially, the US Drug Enforcement Agency had not yet provided final approval. Commercial farming of hemp seed as a health food has been slowly progressing in Canada since 2001, but again, it remains a niche crop.

Will hemp ever be able to shrug off its contentious connotations? It seems possible, provided that sufficient research and development are carried out. However, the basic problem facing biofuel researchers and prospective investors today is one of production costs. There are many species of plant that offer potential as biofuel crops, from unicellular algae, to foodcrops like corn, to inedible plants like switchgrass.

The major deciding factor on whether a biofuel crop possesses enough merits for serious attention is cost, compared to alternatives: can a volume of biofuel be produced at a low enough cost to outweigh other sources of energy, including remaining petroleum supplies? Is there going to be a sufficient market for the biofuel? How much arable land is required, how much farming effort, how often can a crop be harvested, what are the costs of extraction, how can waste be disposed of, what is the overall carbon cost?

These are the questions that lead to criticism and doubt being leveled at biofuel crops. It may be possible to offset costs by using the rest of the crop to make other useful products for building and weaving, which is where hemp may have an advantage against canola or palm oil, and by taking advantage of the plant's hardiness in poorer environments.

Perhaps in exploring these benefits, hemp's usefulness as a biofuel will be more clearly revealed and its psychological connotations and prospective links with its illegal cousin may be overcome.

“Hemp has been used throughout history to produce fibres, textiles, paper, and edible seeds (high in vitamins).”



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Eco-advertising:

watch out for 'greenwashing'

Environmental issues are certainly among science's hot topics at the moment and the media are thriving on them. Climate change or global warming, practically every day the media remind us that we are destroying the Planet and we need to do something about it.

And this is not just 'flash in the pan' coverage in newspaper and television reports. While we have been aware of the problems for a few years now, they will undoubtedly be making headlines well into the future.

But the spaces between the articles are now also taking on green issues. While flicking through the pages of a newspaper or a magazine, we do not tend to study the adverts of global corporations in detail, but there can be underlying environmental messages too.

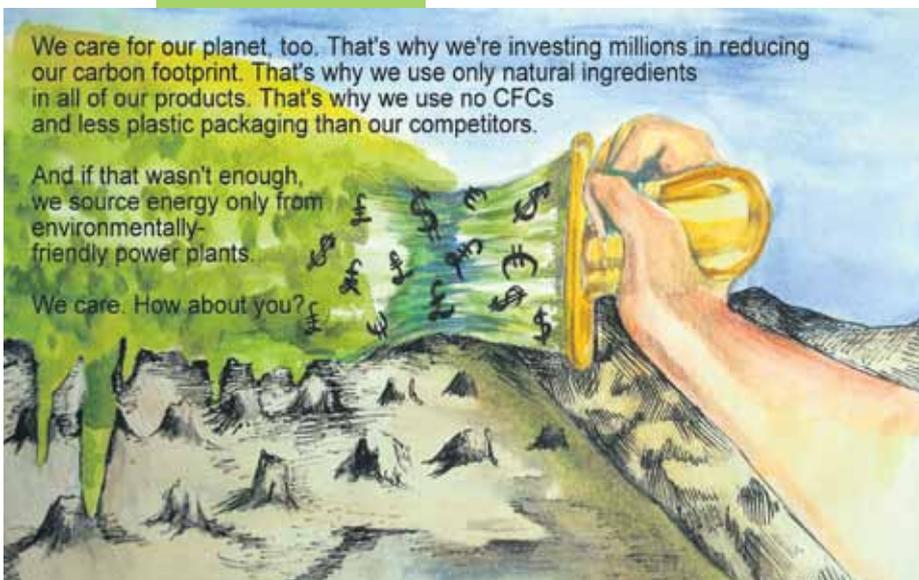
As society has become so aware of the Earth-damaging practices of large global companies and their products, some businesses have acted by taking on 'green' projects. Millions have been invested in reducing their carbon footprints and developing alternative energy in a bid to appear 'environmentally friendly.' Factories are being powered by 'clean' electricity from wind turbines while scientists work

on future renewable energy sources. As well as doing all this commercially, companies are telling us about it through their advertising and marketing campaigns. These re-branding efforts – which include minor adjustments to company names and touching up their environmental image – are being used as a selling point.

It is a clever move during these worrying times. For many multinationals, continuing the battle against these issues was going to be pointless. Our attitudes towards the environment were changing; we are much more careful about recycling and like to buy organic. So companies had to change their ways. After all, are we not more likely to buy from a company which is doing its bit to protect our Planet? Greenpeace and other organisations have used green marketing for some time, and commercial advertising has caught on. And now these agencies are making a fortune while at the same time picking up awards for their work.

I personally do not have a problem with these ads as long as they clearly and fairly reflect company developments. But there is always a risk of taking it too far; placing too much marketing spin is misleading. Yes, they may be investing their profits in reducing their carbon footprint. But are these just token efforts to make us all feel better and relieved that they are taking action? Firms must avoid 'greenwashing' where consumers are completely distracted away from the real practices of the company. For example, parts of a 4x4 may be produced by a factory powered by alternative energy; but the vehicle still continues to churn out huge amounts of CO₂ into the atmosphere. Is this really making a difference and helping the environment? You can rate more examples at www.greenwashing.net.

Next time you flick through a newspaper or a magazine, do not just read the articles; take a look at the ads too. Advertising is a powerful medium which subtly attracts our attention; and you may just come across these 'green' messages from companies. Most people argue that ethically, 'greenwashing' is wrong. But commercially it is popular, and it is working.



Solar Cars: Cutting Emissions 100%

SOLARTAXI.COM



Mico Tatalovic explores the feasibility of using solar power for fuelling cars.

"I would like to tell you something about the first tour ever of a vehicle that went around the world without petrol: it was a solar car" said Louis Palmer, a Swiss teacher, in his talk at Imperial College this March in front of a packed lecture room. He traveled around the world in a solar car. He did it to make a point: we could get all the energy we need for driving cars from the sun – there is no need for the polluting petroleum cars anymore. His chic blue Solartaxi got most of its energy from the solar panels placed on its roof. It also had a solar panel trailer – not because it needed it but simply to attract media attention, to get people to notice the car and hear the message: electric car technology is viable and solar panels can fuel all of our road travel. "The sun is shining for free" he says.

Palmer explained that he wanted to do a road trip around the planet to "see the beauty of this world" since he was eleven, back in

1982. But his teacher warned him that such a trip would cause a lot of damage to the planet – polluting gases from the exhaust pipe would contribute to the growing pollution and global warming of the very planet he was so eager to get to know better. By the time he was 14 he made plans for an eco-friendly solar car; he figured that in 20 years time everyone would be traveling in solar powered electric cars anyway. With all the problems petrol cars caused such as global warming and wars for oil, he thought electric solar cars that cost nothing to drive would for sure replace the petrol cars.

Some twenty years later, disappointed that solar cars were unavailable, he ventured to produce one himself. "In 2004 I decided: 'OK, if I cannot buy a solar car I will build it myself'" he said, "but I have no idea how to build a car and no money to do it." These two tiny problems might have discouraged a less optimistic person, but not Palmer, as he explains: "I thought if this is a good idea I will get support, I will just go and find the support." With help from over 200 friendly individuals and sponsorship from several corporations, he produced a car that would take him across 38 countries in 18 months without emitting any carbon dioxide, using only clean solar energy. He is no engineer or venture capitalist – part of his message is that everyone can make a difference to the way we live by making changes in their own lives – he is just an ordinary Swiss school teacher but he managed to build a solar car and raise awareness all over the planet about electric cars because he believed in it. The main problem with accepting electric cars is not technology, he maintains, it is people's attitudes. "I want to change the mentality of the people. We have the technology but people are

hesitating to buy it. I think where we have to do changes is in the mind."

Solartaxi is an electric car that gets its energy from either solar panels or the grid by a plug-in. To make sure he wasn't contributing to any carbon dioxide emissions during his trip, Palmer installed solar panels on his house and fed electricity back into the national grid. This way he could charge his car from the grid when the sun wasn't shining on his travels without actually using any more electricity than he produced by the solar panels. And this is the future of solar cars, he says. There is no need for pricey solar panels on top of the car, or incongruous solar panel trailers – just put the panels on your house roof and use the electricity to charge your regular electric car. Using an area the size of Switzerland would be sufficient to produce enough electricity to power the current needs of the entire planet, and that is with current, still nascent, solar panel technology. Per area size solar panels produce 70 times more electricity than the best biofuel crops, and of course the best places to put them are in sunny deserts where we cannot grow any food crops anyway.

Sims-Williams, an engineer from University of Durham and a technical advisor to the Durham University's Solar Car team shares Palmer's conviction that although cars with solar panels on their roofs work, the future lies in regular electric cars, powered by stationary solar panels. "If we want to reduce emissions for production vehicles then it would make more sense to run plug-in hybrid or pure electric vehicles and to put more 'green' electricity into the grid that you are plugging into. Solar is likely to be the best renewable energy source in the very long term but with plug-in vehicles we



Louis Palmer standing next to his Solartaxi with the solar panel trailer.

have the flexibility to generate the electricity in whatever way is best.

Michael Roberts, an engineering student from Massachusetts Institute of Technology and a captain of the MIT Solar Electric Vehicle Team, doubts the promise of a self-sufficient solar car; he says that a car such as Solartaxi "will not be practical because mounting solar panels to a car just doesn't make sense; solar panels get much more light when mounted to rooftops, they won't be damaged as easily, and you can use a much larger area and therefore use cheaper, less efficient cells to generate the same amount of power. The real future of solar powered cars is in electric vehicles that charge their batteries from solar power sources."

After production, Palmer's Solartaxi did not emit any carbon dioxide; it was 100% emissions-free, and this is important, as no one is talking about such drastic emission cuts, but it is the only way we can reverse global warming, Palmer believes. And solar energy is the only way to do this efficiently, he says. After the tour, Palmer is still using Solartaxi as his personal vehicle, driving on the same batteries, paying nothing to run it and having spent nothing on repairs (there were none). To bring this technology to the mainstream market the cost of electric cars has to come down, says Palmer. Everyone he talked to in every corner of the globe would love to buy such a car but cannot afford to pay say 30,000 pounds for such a vehicle. We need to invest in mass production of electric cars that would bring costs down so people who can afford a car at least have the option to buy electric.

Students from four Swiss universities helped Palmer design and construct Solartaxi. Similar student efforts have helped build many different solar race-cars for the World Solar Challenge since 1987. Currently more than forty universities have solar car teams which compete at this biennial event that takes place in Australia. The 2007 winners averaged speeds of more than 90km/hr, were powered solely by sun and covered 3,021 km from Darwin to Adelaide. Similar races take place elsewhere as well, such as North American Solar Challenge (Plano, Texas to Calgary, Canada, biennially since 2001), round trip South African Solar Challenge (from Johannesburg to Pretoria via Cape Town and Durban, since 2008) and Zero

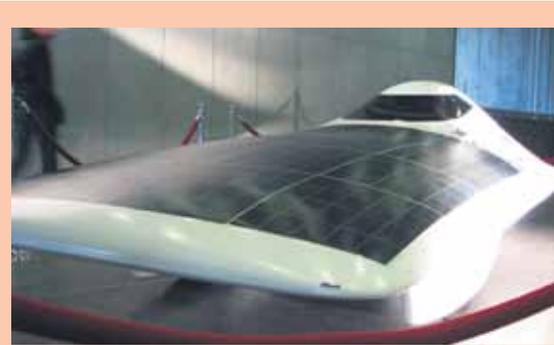
Rally Africa (open to any carbon-neutral, renewable-energy vehicles). But with some of the brightest young engineers working on designing solar-powered cars for over 20 years now, an obvious question springs to mind: Why aren't we seeing more of these cars available for purchase at our local car dealerships?

Sims-Williams says that solar-powered race-cars "are not intended to be prototypes of future road vehicles. We do not see production versions of them on the highway in the same way that we do not see production versions of Formula 1 cars! Like Formula 1, however, there are good examples of technology migrating to production cars (such as electric drive, battery technology and light weighting)."

But he explains why these cars are still invaluable for development of these technologies in the near future: "I think that solar car designs provide a good illustration of how to run a vehicle at highway speed while consuming very little energy (<2kW). Also, we should note that most solar car teams are made up of engineering students, many of whom will be engineers for road vehicles in the decades to come. Developing and racing a solar car has to be about the best way possible to develop the expertise required to engineer the high-efficiency electric-drive production vehicles of the future." Just being aware of such technology may help engineers that work for commercial car companies to start playing with the idea. A good example is Greg Johanson, an engineer who recently added solar panels to the roof of the new Toyota Solar Prius; this is the same person who built the first purely solar race-car, the Sunrunner; back in 1980 and entered the Guinness Book of Records for setting the first speed record of 41mph in this car.

Apart from illustrating the energy consumption benefits of well designed cars and training future engineers in eco-friendly technologies, another important reason why the cars from World Solar Challenge are so valuable is that the technologies developed for these solar race-cars eventually find their way into the mainstream production vehicles says Sims-Williams. "There is a pretty continuous stream of technology being demonstrated on solar cars and then later adopted on electric and hybrid production vehicles. Battery technology is a good example: The most famous hybrid, the Prius, has relied on 'Nickel-metal hydride' batteries up until now and a Lithium-Ion version is due to be released later this year. This basically follows the lead of solar cars with about a ten-year time delay. We might anticipate something similar for drive motors, with future electric vehicles moving to in-wheel motors. Aerodynamic streamlining is also likely to rise in prevalence for next generation electric vehicles; since this will be key to increasing range."

In fact Volvo has recently announced a first commercial car with in-wheel motors currently scheduled for 2015 release, suggesting that Sims-Williams is onto something when he says that current innovative solar car technologies will become standard technologies in future commercial cars. According to Volvo such motors would be 10% more efficient and much safer. Also, Aptera, a new Google-sponsored electric car with sleek, futuristic design is revolutionary in terms of using aerodynamic streamlining. This streamlined design helps to reduce drag and increase efficiency of the ve-



A selection of recent solar race cars from universities around the world.

V4 NEWSPAPER TIMES APRIL 2008 cars.bbc

Around the world in a solar car



Solartaxi made headlines in the media across the globe in 2007/2008.

hicle. Aptera is scheduled for 2010 release in the USA and it will cost around \$35,000. It is Palmer's favourite car; he says "that's the car of the future, light and very energy-efficient."

Like Palmer, Sims-Williams also highlights importance of public awareness of this technology: "I think that one of the roles of solar car racing is to show the world what a high efficiency vehicle would look like. Making the public more aware and accepting of the traits of a high efficiency vehicle might help manufacturers continue to make mainstream vehicles more efficient without the risk of alienating their customers."

Michael Roberts explains that "The main point of solar car racing is to push the technology of electric cars to an extreme – such that the cars can power themselves based off of the solar energy absorbed by the car alone." But he highlights that this is not an end in itself. Instead of developing commercial cars with solar panels on their rooftops, he says the main reason for having solar challenges is "to generate ideas and push technology in the area of efficient and electric vehicles. Apart from the solar array, the systems on our solar car are exactly that of any electric vehicle. We are pushing technologies such as developing light, reliable, safe lithium-ion battery packs, efficient electric motors, lightweight composite construction, aerodynamics and systems engineering for electric cars. Our goal is to excite and educate engineers by proving it is possible to drive a car on the highway using less power than a hair dryer. The engineering challenge of building a solar car achieves these goals."

But Sims-Williams maintains that "There is still scope for installing some solar panels on electric vehicles which would be able to charge the battery slowly if that were more convenient than plugging into the mains; this is much less demanding than trying to drive for 9-10 hours a day on solar power alone." This is the idea behind a recent Solar Prius with roof solar panels that can power the air-conditioning system or harness solar power that is then stored in an auxiliary battery that extends the range this gas-electric hybrid goes on electric power

alone. Similar technology features on the new French-Italian company Pininfarina's BlueCar, an electric car with solar panels on the roof, and on the Australian Ultra Commuter (developed by HybridAuto Pty Ltd), a gas-electric hybrid. BlueCar has "solar panels on the roof and bonnet [that] will contribute towards powering the car's electrical equipment as well as its heating and air-conditioning system." BlueCar is scheduled to go on the market in 2010, but you can already sign up for one of these on its website. The Ultra Commuter is built by a team from Queensland University and was inspired in part by their award-winning solar race car Sun Shark. This two-seater commuter car can go amazing 60 km a day on solar power alone. It is a "vehicle with substantially reduced energy requirements which offers the possibility of daily commuting powered only by the sun falling on the rear glass and bonnet."

Richard Bucknall, an engineer at University College London and programme director of the UCL's solar car team SolarFox, is also optimistic about commercializing solar cars with the panels on the vehicle. Asked if he sees a commercial future for solar cars he points to the existing conversions and hybrids that have solar panels installed. For example, advertised as the world's first commercial solar, French Venturi Astrolab was launched in 2008 and is available for 92,000 Euros. But although a few individual examples of this exist, the vast majority of cars in use today are not solar, not even electric. Commercializing and making solar car technology common is still in its infancy. What is the purpose of the World Solar Challenge if we are still not seeing commercial solar-electric hybrid cars on our highways? Bucknall says: "At the presentation of his discovery of the principle of electromagnetic induction, a journalist asked: "But what's the use of it, Mr. Faraday?" and Michael Faraday replied: "Ah, but what use is a baby!"

So will the solar electric car technology revolutionize the way we drive as much as electricity changed the way we live? Palmer says this is up to us. For him it already has.



University of Cambridge's solar race car.

Several commercial car companies are now installing solar panells on their car's roofs and bonnets to extend the range. From top to bottom: Solar Prius hybrid; solar-electric BlueCar; Venturi Astrolab; solar-electric UltraCommuter.

The French Evolution: Lamarck meets Darwin



Tim Jones reports on epigenetics and the potential role of acquired characteristics in evolution.

We celebrate 150th anniversary of Darwin's theory of evolution by natural selection this year. But before Darwin, Jean-Baptiste Lamarck came up with his theory of evolution by transmutation of species: characteristics acquired during an individual's life-time are passed on to its offspring. Largely discredited and ignored since Darwin, Lamarck's theory might not be all wrong.

Forty years before Darwin published *On the Origin of Species*, Jean-Baptiste Lamarck proposed his theory for the 'transmutation of species'. Organisms, he said, adapted to their environment through a mechanism by which their tissues and organs developed into a more fit-for-purpose form, dependent upon their use or dis-use during life. The improvements passed to, and cumulatively built up in, subsequent generations.

It followed that an animal required to run fast would build up stronger leg muscles. And giraffes' long necks could be put down to their ancestors' craning for ever-higher food stocks. Darwin conceded a lesser role for these so-called 'acquired characteristics' alongside his natural selection, suggesting modifications passed down the generations via information-rich 'gemules' produced by the body's cells. By

the twentieth century however, Lamarck's ideas, and Darwin's gemules (despite a superficial resemblance to genes) proved inconsistent with the concept of Mendelian genetics, bound with natural selection to form the so-called Modern Evolutionary Synthesis.

Yet the idea of heritable adaptation resulting from processes other than the commonly accepted mutation of DNA is far from dead. The field of study known as epigenetics recognises that the form of an organism (its phenotype) is both an expression of the DNA blueprint it carries, but also the influence of chemical factors controlling how the blueprint is used. The result is an epigenetic code that overlays the genetic code: a kind of the instruction for the instructions.

Inheritance thus comprises the gene's state of expression, coded by chemical markers attached to the DNA, rather than the gene alone. The biologist P. Z. Meyers has helpfully described epigenetics in terms of 'cellular memory... sufficient to reconstitute the state of gene activity between generations.'

Epigenetic effects appear as eye colour difference between genetically identical fruit flies, as inherited modification to disease susceptibility in mice, and as physical differences between human identical twins. Epigenetics is key to understanding how

environment and lifestyle might impact present and future generations' well-being, and also pokes the fire of the nature versus nurture debate. Following the successful coding of the human genome, the priority for much current research and funding is a full characterisation of the even more complex epigenetic code.

Perhaps one day we will see Lamarck as one of the fathers of the modern evolutionary theory, alongside Darwin and Wallace. But there is still a lot to be done in the study of epigenetics.



Some acquired characteristics can be transmitted to offspring epigenetically.



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Planet of Parakeets: the Rise of Wild Urban Parrots in the UK

Felix Whitton retraces the mysterious origins of London's 'posh pigeon', the parakeet, and investigates its current and future status of an exotic invasive species.

They generally announce themselves with a loud squawk, followed by a sudden flash of green and red. They are brash, gregarious, and are unafraid of most competitors, bird or squirrel. The ring-necked parakeet is an exceptionally non-British bird; so how did it come to be one of the commonest species seen in London?

Native across large parts of West and Central Africa, stretching all the way to the Himalayas and India, the ring-necked parakeet (*Psittacula krameri*) is a cosmopolitan beast, a true "supertramp" to use Jared Diamond's phrase. It has spread from its native range to 35 countries on five continents, allowing it the honour of most widely distributed parrot in the world.

Unusually for such a ubiquitous species, the ring-necked parakeet is not a great migrant, and it has few traits that would suggest a great invader. Like many parrots, it is extremely long-lived (up to 30 years), lays few eggs, and prefers the company of its own kind to setting off alone in search of new pastures.

Its special talent seems to be coexistence with humans, as well as a generalist nature that allows it to forage widely and without a fuss. The two main factors behind the parakeet's spread appear to be its appeal as a pet (there is an established link between boom years in the British population and the number of birds imported in the previ-

ous year), and the rise in popularity of the garden bird table.

But that fails to answer the question of how it first got here. Nobody knows for sure, although the first breeding colony was recorded back in 1855 in Norfolk and another one in the 1930s in Epping forest, north-east London; both colonies went extinct soon afterwards. But the most popular theory holds that several birds escaped in 1951 during filming at Shepperton Studios in Surrey of "The African Queen", starring

"Several birds escaped in 1951 during filming in Surrey of the African Queen."

Humphrey Bogart and Audrey Hepburn. Almost as frequently cited, with some wishful thinking, is the story that in 1969 Jimi Hendrix released a number of parakeets to brighten up London's dull grey skyline – although with their raucous quick-fire calls the birds are less purple haze, more machine gun.

What is known is that ring-necked parakeets have been breeding in Kent from 1969, and that since then their numbers have exponentially increased. One Oxford University study from 2003 put their rate of population growth at 20-30%,

enough to double the population size every three to five years. The British Trust for Ornithology's (BTO) annual garden watch survey recorded an astonishing 459% rise in sightings between 1994 and 2007, with a hazy current estimate of between 20,000 and 50,000 birds across the UK. There has been a concurrent northward spread from southeast England. Whether this is due to dispersal under its own steam or further releases of captive birds is unknown, but the growing number of sightings from ar-

eas such as Bolton, Rotherham, and even Scotland suggest that if the species hasn't already established further strongholds, it is only a matter of time until it does. The British Ornithologists' Union recognized them as an established exotic species in 1983.

This has led scientists and birdwatchers to ask two questions: why is the ring-necked parakeet doing so well here, and will it adversely affect native species? There is little concrete evidence to answer either question with certainty, but anecdotally at least, it seems clear that the parakeet's suc-

cess is due to a combination of warmer winters, green urban environments, lack of predators, and the ever-popular bird feeder. In their native range they inhabit deciduous woodland or mountainous foothills, but across Europe – including cities such as Lisbon, Barcelona and Brussels – they have thrived in urban parks and gardens.

The few studies looking at the parakeet have added relatively little to the debate. A 2009 study by scientists from Israel and Belgium found that, once established, the birds are able to spread because of reduced pressure from co-evolved predators – the “enemy-release hypothesis”. But this spread in the UK is limited by the number of frost days compared to the more Mediterranean climate of Israel. This suggests that future warming in the UK may remove this constraint and allow the parakeet to spread further afield. But parakeets already don’t mind the British weather too much; their original habitat includes the cold foothills of the Himalayas and indeed, part of the worry that they will negatively affect other native hole-nesting birds (kestrels, jackdaws, starlings, tawny owls) comes from their tendency to breed early in the spring, occupying the best nesting holes before the natives.

Another study from 1997 looked at how populations in Belgium affect native birds and found a strong negative correlation with one species, nuthatches. Both birds are secondary cavity breeders – they find a pre-existing tree hole and move in – but the parakeet appears to out-compete the smaller nuthatch, either through aggression or by dint of earlier breeding.

Whether this is true of our own populations is the subject of much debate. Last year the Department for Environment, Food and Rural Affairs commissioned a study at the request of the Royal Society for the Protection of Birds to investigate the parakeet’s spread and its effects on native birds, as well as on fruit crops (in its native range the birds are serious agricultural pests). The research was aimed at addressing the lack of data, but the press picked up



However they got here, London’s ‘posh pigeons’ are here to stay.

on the story as news that a cull was being considered, pitting the “immigrant” parakeets against our own hard-working and put-upon natives. The Royal Society for the

optimistic about parrots’s settlement.

The success of the ring-necked parakeet is indicative of a wider trend of “biotic homogenisation”, a sort of biological globalisa-

“Current estimate is hazy: between 20,000 and 50,000 wild parakeets across the UK.”

Protection of Birds said that even as non-natives the parakeets were still protected by law (Wildlife and Countryside Act 1981).

The future of these noisy and colourful invaders remains uncertain, but it is doubtful that much can be done to halt their spread. Certainly the idea of introducing another species to try and reduce their numbers – biological control – has been dismissed on the grounds that in the past it has caused more harm than good. Many people would argue that, in spite of the racket they cause, parrots add colour to the otherwise drab surroundings of London. Others are less

optimistic about parrots’s settlement. Human impacts such as change and destruction of natural habitats, climate change and most importantly introduction of foreign species are slowly but inexorably shifting the balance away from rare specialists (e.g. the lapwing in the UK) towards a few widespread exotic invasive species that are capable of cohabiting with humans. In my opinion at least, the result will likely be what writer David Quammen has called a “Planet of Weeds”:

“... a crummier place, a lonelier and uglier place, and a particularly wretched place.”

BRITISH TRUST FOR ORNITHOLOGY



Map of the recorded presence of ring-necked parakeets in the UK based on surveys from 2003-2008.

Smell to remember



Emma Quilligan sniffs out the current understanding of the “Proust phenomenon”. Best read with a cup of tea and a *madeleine*.

It all started in the shower. One whiff of my new shower gel and it was as if a TARDIS (Dr Who series time machine) had transported me back three years; suddenly I was in Cornwall, living in a caravan with ambitions of becoming a pro surfer. Of course I wasn't, I was standing in my cupboard-sized flat in London, but the memories were so vivid I could almost feel the sand between my toes. And yet, I could not have previously told you what shower gel I had taken to using during those brief three months spent on the beach.

It got me thinking, how could something as simple as a smell evoke such powerful memories? It is not the first time this has happened; only the other week I spun round in the street thinking I had just walked past my friend Neil. Unfortunately it wasn't him, just someone who smelled like him, though I had never actually noticed what he smelled like before! And before you start thinking that I am just slightly strange person with an ultra-sensitive nose, it appears I am not the only person this happens to. In fact, it is an occurrence known as the ‘Proust phenomenon’, after famous poet Marcel Proust. In 1919 he documented how he was vividly reminded of his childhood whilst dunking and smelling *madeleine* biscuit into his cup of tea, and the Proust phenomenon

was born. If only I could name a phenomenon so easily.

This year marks the 90th anniversary of that biscuit-dunking incident, but it is only really in the last decade that technology has allowed us to properly explore this phenomenon. Some scientists thought that we may have a separate memory system for olfaction, and even that odour memory could itself be separated into different component subsystems. However, ‘Proustian retrieval’ proved very hard to investigate, and no-one was really able

“Proustian retrieval proved very hard to investigate, to give it a scientific explanation.”

to give a valid, scientific explanation for these occurrences.

But there were several aspects that researchers did seem to agree on. Studies where participants have been given olfactory cues and these compared to visual or verbal cues have shown that odour-evoked memories tend to be highly emotional, vivid, specific, rare and relatively old. They are also usually pleasant memories although they occur less often than those caused by other types of cue, probably because olfactory information is harder to store, encode and retrieve than visual information. So although people may say

that odours are more evocative of memories, this may just be because the memories they induce are more vivid.

So are olfactory cues better than visual or verbal cues for evoking memory? It may be that they just lead to stronger memories because they are encoded with complex autobiographical memories from that time. One study by Herz and his colleagues in 2004 aimed to investigate this by asking the participants of a study to identify a perfume that they associated with a particularly pleasant memory involving a specific person, place or event. Up to two months later, the participants were presented with their chosen perfume, and

also a control odour, as well as pictures of the perfume bottles. The researchers found that when participants were presented with the experimental odour or visual, they experienced the same memory they had described months before, and this ranked highly on a scale of emotion. However the control odour also occasionally elicited memories in the subjects, although these were not specific and were more inconsistent.

It seems then, that these studies which merely ask people to describe their feelings and responses to smell may not go far enough. To investigate the Proust phe-



Proust is sometimes referred to as the 'first neurobiologist' for his realisation of how scent affects brain's memories.

nomenon, we may have to delve deeper.

It has long been recognised that for people to express and experience emotions and therefore have an emotional memory, they need an intact amygdala. This is an almond-shaped part of the brain located deep within the temporal lobe. It was long known that the olfactory system is unique amongst the senses in that it projects directly to the amygdala. But scientists were finding it difficult to find neurobiological evidence that would back up the idea that there was a special relationship between olfaction and emotion during memory. It was only when research involving functional magnetic resonance imaging (fMRI) became more common that a relationship could be seen.

During the experiments by Herz and his team the participants also underwent MRI scanning. The MRI data showed that when the participants were presented with the experimental odour, there was significantly greater activation in the amygdala and the hippocampus (associated with declarative, factual memory). The fact that the control odour did not elicit activation in the amygdala-hippocampal complex showed that the finding was due to the emotionality of memory and was not merely an olfactory artefact.

Another interesting finding was that the experimental odour elicited more activation in the anterior cerebellum than the control odour. The anterior cerebel-

lum is usually activated during active sniffing (rather than passive smelling), so it could have been that the participants were smelling more actively when they were presented with an odour that was meaningful to them.

It should be recognised that the Herz's study had a very small sample size of five women. However, this does not mean that we should discount the results, merely that more research needs to be done, so if anyone at Imperial would like to do a PHD to satisfy my whim then please be my guest! In the meantime, I will have to be content with these findings. That is, that many studies have found that odour cues evoke memories which are vivid, usually pleasant and often from a long time ago (so it's not just something that happens to me!) in comparison to visual or verbal cues. fMRI data indicates that this is probably due to the olfactory complex being unique among the senses in that it connects to the amygdala, which is a part of the brain associated with emotional memory. Apparently, we are also more likely to sniff when presented with an odour associated with memory, and this activates my anterior cerebellum.

So if you see me walking along with a grin on my face, and possibly sniffing slightly, it's not just me being weird. I am simply experiencing activation in my amygdala-hippocampal complex, and it is really quite nice.

Living in a scent bubble

iSmell. No, this is not a typo: it's the name of the first digital scent device designed by the American company DigiScents. Featured on the cover of the *Wired* magazine in 1999, DigiScents predicted a smelly future with their technology that allows digitalization and transfer of scents via Internet. Smell was to become another dimension of modern day communication technology. Just two years later, DigiScents went out of business: they failed to develop a commercial version of their iSmell prototype. Since DigiScents' failure, digital scent technology passed under the radar of the popular press. But a handful of enthusiasts have continued working on this nascent technology. One of them is Jenny Tillotson, a researcher and a designer at the University of the Arts in London, who just recently moved to Cambridge with her new spin out company, Sensory Design.

Tillotson produced the world's first interactive scent outfit as part of her PhD in emerging textile technologies. She called her prototype dress Smart Second Skin: 'smart' because it senses the wearer's mood; and 'second skin' because it interacts with both the wearer and her environment, enhancing skin as the interface with the environment.

Smart Second Skin combines emerging lab-on-chip technology with miniature bio-sensors. Lab-on-chip technology allows for the storage and handling of tiny amounts of fluids such as fragrances on small chips. These can be programmed to release specific scents

at specific times. Such an interactive scent system could be used purely for fashion purposes. You could programme different perfumes to be released at different times of the day: one perfume for work, another one for a dinner party and yet another for clubbing afterwards—with no need to apply any on your skin. Tillotson calls this the iPod of fragrance industry embedded into fashion: it is capable of storing a selection of fragrances available for enjoyment on demand.

Bio-sensors monitor changes in the skin's electric potential, blood pressure and respiration. When they detect a change they send signals to the emitting devices, equipped with lab-on-chip, which then change the type or intensity of fragrance released by the dress. This system can be used to detect mood changes such as the build-up of stress or anxiety and control these by releasing appropriate scents to soothe the wearer. There is ample data to show that there is a link between scents and human health. Some fragrances can affect our moods and feelings.

The first technology to emerge from this recent start-up is eScent, a button-sized scent dispenser that can be disguised as a clothing accessory or jewellery. Another application of this interactive scent delivery system is eMos. This miniature gadget senses the sound frequency of a flying mosquito approaching the skin and then triggers the emission of a small amount of insect repellent. This targeted, localised release of insect repellent avoids the



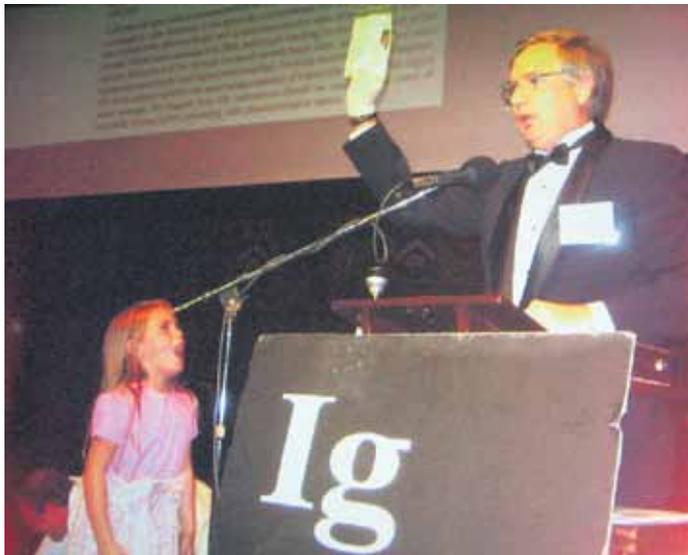
COURTESY OF SMART SECOND SKIN

need to apply large quantities of the chemicals onto our skin and reduces environmental effect of such chemicals. By targeted release of desired fragrances these devices create a personal "scent bubble" around the person, promoting their wellbeing, health and mood as well as enhancing their olfactory communication with others.

Mico Tatalovic

Funny but Smart

Olivia Sharp visits the Ig Nobel Awards tour at Imperial.



Local hero Piers Barnes from Imperial College, won the Ig Nobel Maths prize in 2006. He was on hand to explain his prize winning research on how many photos should be taken of a group of people to (almost) ensure taking one where nobody blinks. Barnes and his crew did some complicated calculations to do with shutter time, blink duration and 'window for blink spoiling photo'. They worked out for a group of less than 20, in bad light, divide the group number by 2, in good light, divide by 3, and this will give you the optimum number of times to click.

Barnes kept us amused by conducting an audience experiment which paralleled the methods used for his research. Asking everyone to switch on their mobile phones, he showed calculations on how long it would take before a phone rang, considering there were 700 people in the room and on average a phone receives 3 calls an hour. Sure enough, phones started to ring, but we weren't entirely sure if he proved his point!

The roadshow included a taste of the macabre, in Kees Moeliker's presentation on the first recorded instance of homosexual necrophilia in the male Mallard duck. 'Working in a glass building has its benefits', Moeliker explained, 'as birds tend to fly into the windows and kill themselves.' One day, a mallard duck lay dead outside Moeliker's office window, and was visited by a fellow male who succeeded in mating with him. Moeliker's segment was quite disturbing, especially when he presented said duck (the dead one) from a plastic bag he had brought

"Working in a glass building has its benefits as birds tend to fly into the windows and kill themselves."

on stage, and offered it to Miss Sweetiepop. Clearly this man has a dark sense of humour- every year he and colleagues celebrate 'dead duck day', giving a short service for the violated duck, and visiting the local Chinese restaurant for something crispy and aromatic.

New Scientist's Feedback editor, John Hoyland, was on hand to distract us from unsettling mental images. Or so we thought! The dead bird theme continued, as Hoyland highlighted the 'lack of sympathy for geese who brought a plane down in the Hudson river' in January this year. After some digging around he found there have been 1266 reports of aeroplanes hitting Canada geese between 1990 and 2008. On top of this there are recorded fatalities of 145 bald eagles, and, oddly enough, 80 turtles! Hoyland incredulously went on to list fatalities of 14 armadillos, 13 alligators and 1 pig. He sensibly came to the conclusion that these animals may not have been killed in flight.

Sword swallowing expert Dan Meyer provided the showstopping segment of the evening. He demonstrated his special talent after presenting his paper - 'Metal to Medicine - Sword Swallowing and its Side Effects', which picked up the 2007 Medicine Prize. Meyer has the world record for most swords swallowed at a time, and was not afraid to amaze and frighten us by allowing an audience member to pull a very sharp sword from his throat. Reminding us several times 'this is very dangerous. I could severely harm myself', Meyer then attached a sword to a whip, and a terrified and slightly confused looking volunteer waited for him to swallow the sword, bend over at the waist - '3 times more dangerous than normal sword swallowing' - before whipping the sword out. I'm not going to lie, I wasn't expecting success! But the consummate professional was, of course, uninjured.

Though I'm not sure if any of the research truly made me 'think' and wonder as to its implications, I was certainly reminded of how entertaining science can be, and what a bizarre and wonderful sense of humour certain scientists possess. Long may the Ig Nobel Awards show the world that scientists can poke fun at themselves.

High jumping fleas, hot-potato mouth and necrophiliac ducks were but a few of the ridiculous topics of research presented at the London leg of the Ig Nobel Awards Roadshow in March. For those unfamiliar with the Ig Nobel Awards, they are held each year to celebrate improbable scientific research which 'first makes you laugh, then think' - a parody on the venerated Nobel Prizes. Past Ig- winners include, for Economics, research on how ovulating strippers earn more tips; and in 2008 the Ig Nobel Peace prize went to the people of Switzerland, for adopting the principle that plants have dignity.

Scientists have the opportunity to discreetly refuse the prize before the ceremony, as the work is generally not intended as a joke. Luckily most scientists are game for a laugh. The roadshow, hosted by Imperial College, saw previous winners taking to the stage, giving short presen-

"Luckily most scientists are game for a laugh."

tations on the research which earned them the prestigious accolade.

The show was hosted by Marc Abrahams, founder of the Ig Nobel prize, and editor of the *Annals of Improbable Research*, the Ig Nobel magazine. Mirroring the original ceremony held annually at Harvard University, Abrahams gave each speaker exactly 5 minutes to summarise their research. If they committed the crime of overrunning, 'Miss Sweetiepop', an 8 year old girl in a party dress, commanded them to 'please STOP! I'm BORED!!' over and over until they were forced to exit the stage. This made for a highly enjoyable evening, far removed from typical long-winded science lectures. Highlights included Dr Mahmood Bhutta's presentation, 'Hot Potato Voice in Peritonsillitis: A Misnomer'. Patients with advanced tonsillitis can experience pus around the tonsils, which apparently makes their voice sound like they have a hot potato in their mouth.

By listening to healthy subjects speak with and without a hot potato in their mouth, and patients with peritonsillitis, Dr Bhutta discovered ill patients did indeed form sounds differently from the healthy subjects, as muscles around the soft palette (the dangly bit at the back of your throat) were weakened. However, the differences did not match up with the 'hot potato' subjects; proving 'hot-potato mouth' to be a misnomer.

Science Comics Exhibit in Virtual Life and at Imperial

Tim Jones gives us a tour of his virtual science centre in Second Life.

Who amongst us would not want to spend time on Star Trek's Holodeck, were it real? Regrettably, 24th century technology is some way off but, as was discussed in last Autumn's issue of *I*, science, there's always Second Life (SL). With several million signed-up residents, and 70,000 'in-world' at any time, I thought I should explore Linden Laboratories' virtual world SL for myself. As a student in the MSc Science Communication, with a special interest in the role of virtual worlds for science education and outreach, my first project was a no-brainer; I would build my very own science centre!

Visiting Second Life is free, but owning land and buildings costs money, so my first task was to bag some real estate in a nice location. The Zoonomian Science Centre sits on a 2480 square metre ocean-facing hillside, and costs \$280 a year to run.

Somewhat to my surprise, what began as a pure learning experience is starting to function as a genuine virtual museum, interactive conference venue, and teaching aid. Zoonomian may not compete with the excellent Second Life version of San Francisco's Exploratorium Science Centre, the Elucian Islands of Second Nature, or Imperial College's own virtual medical school, but the principle and many of the capabilities are the same – just scaled down.

Zoonomian is currently gearing up for an exhibition of educational comic books that will run in conjunction with a 'real life' exhibition at the Humanities Exhibition Space on the third floor of Sheffield building at Imperial. In the meantime, visitors to Zoonomian can engage with a small but growing collection of Sci-Art and audio-visual exhibits, interact with my real-world blog, or leave messages and ideas with the automaton receptionist.

With all this great virtual content out there, will we see a 'Twitteresque' explosion of enthusiasm for virtual worlds any time soon? I see two barriers: technically, a fast computer with broadband is required and; cul-



turally, Second Life retains a reputation (partly deserved) as an animated chat-room of the most unsavoury kind. Yet with the arrival of mid-range SL-capable portables, and imminent restructuring of the cultural landscape by SL's owners, accessibility and usability should improve.

Besides, unless you go looking for trouble, most of Second Life is civilised, especially in the dedicated 'science-oriented' regions like The SciLands. Everyone I have met in Second Life, not least ad-hoc visitors to the Centre, have all been polite and interesting characters. Just treat people with the same respect and caution you would in real life (after all, there are real people behind the avatars) and you will be fine.

If you want to look round, get in touch, or have an idea for a collaborative project, please drop by: Erasmus Magic at <http://slurl.com/secondlife/Haddath/79/99/69/?title=Zoonomian>

13 Things That Don't Make Sense

by Michael Brooks

DOUBLEDAY PRESS: NEW YORK (2008)



I'm writing this review as a break from revision, with the ideas of science philosophers Kuhn and Popper still swimming round my brain. Both men have their supporters, but with *13 Things That Don't Make Sense* Michael Brooks is definitely throwing in his lot with the Kuhnians.

Kuhn argued that science is framed by paradigms, established bodies of knowledge that define the scientific questions of the day. Eventually problems with the paradigm will emerge, and science will undergo a "paradigm shift." *13 Things That Don't Make Sense* is a compilation of problems with our current understanding of the uni-

verse, and Brooks suggests that solving any one of them could lead to a paradigm shift. A classic example of such a change is the move from Newtonian to relativistic physics, and the book begins firmly in the physics camp. Over the first two chapters dark matter is put forward as a possible explanation for both the apparent "missing" mass in the universe, and the unexplained drift of the Pioneer probes. From there we move to the prospect of varying fundamental constants (like G , the gravitational constant) and a look in to the controversial subject of cold fusion.

Next we get six chapters dealing with the troubling subject of life.

Where did we come from? Is there life elsewhere in the universe? And why do we die? These are just some of the questions that science doesn't yet have an answer to, but Brooks lays out some possible explanations. The end of the book deals with two ongoing controversies in medicine, the placebo effect and homeopathy. I was intrigued to learn about the concept of epitaxy, in which the molecular structure of one material can influence another without any chemical reactions taking place. In the same way that plasticine forced through a mould will take on a certain shape, is it possible that the molecular structure of water could be rearranged by homeopathic substances to produce healing properties? No one has done the research, so I remain sceptical, but it's an intriguing possibility.

So far I've skipped over one chapter in this review; number 11, entitled *Free Will*. In it Brooks describes a device called a transcranial magnetic stimulation, in which two electric coils create a magnetic field to induce currents in the brain. Neuroscientists can use such devices to cause unconscious bodily movements in their subjects, which Brooks experienced first-hand. It is with this evidence, along with other brain experiments, that he claims the concept of free will is nothing but an illusion. Maybe it's just my fundamental philosophical objection to giving up free will, but I found this chapter to be on far less firm ground than the others. The experiments described just didn't seem to say to me what Brooks wanted them to.

One dodgy chapter aside, *13 Things That Don't Make Sense* is a very good read. The chapters are short and mostly self-contained, making it easy to dip in to, and it's refreshing for once to read a popular science book about what we don't know. The book looks to the future rather than just recounting the past, and left me wondering when the next new discovery will allow us to whittle the list down to a nice even dozen. JA

Thou Shalt Invent, Kid.

Jacob Aron and Mico Tatalovic become kids again at the Science Museum. Jacob reports.

Wallace & Gromit present a World of Cracking Ideas at the Science Museum



The nation's most beloved plasticine duo are known for their crazy inventions that inevitably go horribly wrong, and it seemed that the Science Museum's lifts were getting in to the spirit of things. As we waited for a ride to the exhibition floor one of the Museum's sleek glass lifts arrived, but refused to open its doors before shooting off again. It eventually returned and we step aboard, only to find ourselves stuck between floors. "Perhaps we'll get the stairs next time," I said to Mico. Thankfully we were not trapped for long and, for the rest of the morning at least, the inventions on display behaved themselves.

Working in collaboration with Wallace & Gromit creators Aardman Animation, the Science Museum have recreated their home, 62 West Wallaby Street, and stuffed it full of things to see and do. With funding from the Intellectual Property Office, the £2m exhibition is designed to inspire the nation's creativity and get us all inventing.

Visitors will find "Idea Stations" in each room of the house where they can scribble down their new creations, before sending them off to Wallace & Gromit through a suitably wacky delivery process, the Eureka Brainwave. This overhead conveyer belt channels ideas through the exhibition to the Thinking Cap Machine, which... turns them into paper hats. A bit of a let-down if you have just sub-

mitted your idea for the next iPod killer, but kids will love it.

As well as coming up with your own ideas, you can play around with Wallace & Gromit's. In the living room you'll find the Tellyscope, their answer to the television remote. After throwing enough balls at a target (both myself and Mico were hopeless throws), a television will move towards a massive sofa. Take a seat, and a series of levers move a gloved hand to select the button of your choice, which will play a short video clip. Very silly, very Wallace & Gromit. Other fun things include a slide down the plughole from the bathroom to the garden, where you'll be to take part in a modelling clay activity.

It's not just Wallace & Gromit's inventions on display though. The Science Museum have dug through their extensive catalogue to find examples of weird and wonderful inventions from the real world. Displays range from an early electric kettle to 1960's food packaging. You can also track the development of inventions like the telephone, from Alexander Graham Bell's original to the latest shape-shifting Nokia prototype – unfortunately a model, and not the real thing just yet!

If old inventions aren't your thing, there's still a lot on show for Wallace & Gromit and fans. Sets from the films are lovingly displayed, and simply walking through the house really feels like you're taking part in one of their crazy adventures. It would be very easy to spend almost two hours taking in everything the exhibition has to offer.

I have just one very minor criticism, of an ideological nature. A message throughout the exhibit is the importance of protecting your intellectual property by registering inventions with the Intellectual Property Office, and I have no qualms with that. Up in the bathroom, in a display all about music, was a poster that left me feeling rather different.

Nestled in a corner, away from the karaoke disco in the shower and a charming vinyl jukebox, it said that the music industry is the only way for artists could "avoid losing out to copycats" and "benefit from hitting all the right notes". In other words, sign a record deal or go broke. In a world where internet exposure and digital distribution is making the music industry increasingly irrelevant, it struck me as nothing more than an out-of-place attempt at propaganda. I'm sure though that kids will just run past without a second glance as they head for something fun to do, so perhaps it doesn't matter.

My woolly liberal sensibilities aside, the exhibit is well worth a visit. You might not learn anything as such, but you'll be too busy having fun with all the crazy contraptions to care. The exhibition will run until 1st November 2009, and the usual fees apply: Adults £9, Concessions £7, with extra deals for families. Cracking good time, Gromit.

Just a Lot of Pot Air?

SuperHigh Me Doug Benson (2007)



This film seems to have been conceived when the main protagonist asked himself: 'Why don't I make a movie about smoking pot for a month, just like the guy in SuperSize Me made one about eating nothing but McDonald's for a month?' Well, the result is good enough reason why he shouldn't have done it; it is a boring and pointless film about a pothead smoking marijuana and doing un-funny stand-up comedy in dodgy clubs across the USA. This could have been a good way to examine the controversial science about the health benefits and dangers of

marijuana and to look at the controversial locally legal, but federally illegal medical marijuana pharmacies in California, but the film fails on both accounts, that is, if one wishes even to suggest that the film attempts to address these issues in any meaningful way. The amount of science is minimal, and social aspects of marijuana are under-represented. In fact, it appears that the whole film has been made by guys high on marijuana, and the problem is that if the viewer is not also high s/he is unlikely to be laughing with

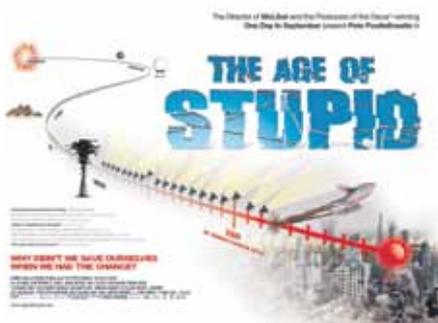
the film crew, and since the whole situation is a bit sad, one cannot even laugh at them. All in all, this film is a superhigh waste of time. **MT**

Is Ours the Age of the Stupid?

Katie Wookey watches a film about our current non-willingness to stop climate change.

The Age of Stupid

Rob Stewart (2008)



Devastated by rampant climate change, in 2055 Earth is an inhospitable place. London is under water, Las Vegas under desert, fires rage in Sydney. The human race teeters on the verge of extinction.

These post-apocalyptic scenes would be apt in many a Hollywood movie.

But Director Franny Armstrong is deadly serious when she argues that this is our not-so-distant future if we continue to use and abuse the world's resources at the rate we do today. This film, *The Age of Stupid* is her heartfelt call to halt environmental exploitation, now - before it's too late.

Starring as the last surviving human, Pete Postlethwaite is curator of a vast repository of human history. Delving into the media archives he brings us footage from 2007 to explore exactly what went wrong. Using touch screen technology to weave together six

documentaries - telling tales of climate change, oil, war, politics and plain old human stupidity - Postlethwaite questions why people didn't take action when they had the chance.

The breadth and contrast of these individual stories effectively shape the film's emotionally charged argument for controlled consumerism. Armstrong succeeds in building a sense of conflict by juxtaposing contrasting individuals - it's hard to reconcile Indian entrepreneur Jeh Wadia's new budget airline with the disturbingly rapid glacial erosion witnessed by 82-year old French mountain guide Fernand Pareau.

The sentiments of lifelong Shell employee Alvin DuVernay convey an uneasy ambivalence towards the oil industry - a testament to Armstrong's intelligent journalism. Alvin tells us that the favourite part of his job is the smell of money when oil starts flowing, it's beautiful. But losing everything to hurricane Katrina has given him fresh insight - "With our use or misuse of resources the last 100 years or so, I'd probably rename this age something like The Age of Ignorance, The Age of Stupid."

A couple of the documentaries revisit familiar arguments, the story of the British wind-farm-adverse NIMBY gang, for example. But the situation exposed is so eye-wateringly infuriating (those nasty windmills will just ruin the view, you know) that you can't help but get drawn in.

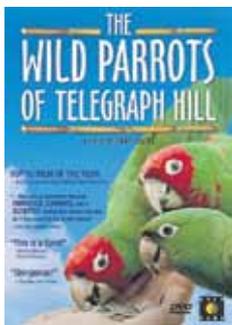
There is a strong sense that the film is preaching to the converted, and I found the tone of Postlethwaite's links somewhat patronising as he endlessly reframed the film's obvious moral message. However, this is a relatively minor gripe. Don't let it put you off watching an otherwise provocative and entertaining documentary.

Urban Parrots: Wild but Cute

Katie Wookey watches a film about wild urban parrots (see Planet of Parakeets, p.22).

Parrots of the Telegraph Hill

Judy Irving (2003)



The Wild Parrots of Telegraph Hill is a mellow documentary following Mark Bittner and his feathered friends - a colourful flock of cherry-headed conures. How the parrots came to make San Francisco their home is a mystery steeped in urban legend. But there they are, and they're breeding too. Notoriously hard to study in their natural rainforest environment, these city-dwellers offer a unique opportunity for study.

However, this is a film that transcends the nature documentary genre. Director Judy Irving has instead produced an empathetic study of human nature and our relationships with non-human animals. A slow pace allows Mark's character time to develop and the viewer a smooth transition into his rather bizarre world.

The opening scene presents Mark - an unemployed, ponytailed, aging hippy - feeding and talking to the birds, an intriguing sight to the city's passing tourists. "But they're not really wild if you feed them, are they?" asks one tourist, voicing the question also running

through my mind. Mark assures us they are, and over the course of the film this is established. The parrots can, and do, survive without him. The documentary has a habit of subtly addressing the questions it raises, Mark's palpable anthropomorphising of the birds, for example.

Whilst few would agree with Mark's claim that "I'm not an eccentric", there is a certain self-awareness of his actions - a knowing that his way of life seems weird to the rest of the world, he just doesn't care. Mark's thoughtful personality and astute voiceovers add warmth to the film and aid efforts to understand his relationship with the parrots. For example, his sharp observations on co-habiting with Mingus, a partially disabled parrot who has chosen to nest beneath the fridge, and considered reflections of long-past experiences with a terminally sick parrot.

Any doubt over Mark's eccentricity flies out the window when we see him kissing, preening and even matchmaking the parrots. This suggests it's actually a case of whether he can live without his avian companions, rather than the other way around. And when Mark's generous rent-eschewing landlords finally ask him to move on we find out.

The Wild Parrots of Telegraph Hill's leisurely pace may not be to everyone's taste but is certainly well suited to its San Francisco origins and the subject matter at hand. My initial scepticism of the documentary's ability to entertain for a full 80 minutes didn't last. Irving's extensive footage of the parrots, and consequent insight into their behaviour, rivals any nature documentary. But it's the human angle that really gives it appeal.

Web Comics

Felix Whitton dives into the world of science comics on the web.

LabBratz

<http://labbratz.comicgenesis.com/>

You may have seen LabBratz crop up in the pages of *Felix* newspaper. The long-running comic is set in a lab and its characters are caricatures based on people writer Ed Dunphy has met over his many years in research. There's a radioactive undergrad kid (apparently based on his own experiences working with radiation), a long-simmering row between two bitchy co-workers, a world-weary manager, and a chippy midget Chinese boss.

Certain parts of the comic ring true for anyone who's ever worked in a lab – presenting results in front of your competitive colleagues, for example – and Dunphy and illustrator Tony Maldonado make an admirable attempt to communicate the essential normality of science. Just another job, as lab manager Nanz says, counting down the years to retirement.

But... and there's always a but... LabBratz just didn't manage to make me laugh. While not lacking in (lab) life observations, it never follows through with situations long enough to make them amusing, beyond simply reiterating each character's flaws – the fat clumsy one, the world-weary one, the mood-swingy one. Perhaps I missed something; after all, there are 173 online episodes, some of which must be funny, so feel free to check it out for yourself and prove me wrong. But after dragging myself through 100 of them I felt drained from the effort of simply trying to laugh. LabBratz never made me want to come back for more, and that is its fatal flaw.

xkcd
<http://xkcd.com/>

An unhealthy obsession with velociraptors; flow charts about life; how to express your love for someone if you're a geek – these are the thoughts that trouble xkcd creator Randall Munroe, a former NASA programmer turned web-cartoonist. In Munroe's words, xkcd is “a webcomic about stick figures who do math, play with staple guns, mess around on the Internet, and have lots of sex. It's about three-fourths autobiographical.” Maybe that description doesn't do it justice, because there is clearly something more to his creation, something that reaches out to its readers.

And boy do they exist – since its launch in 2005 xkcd has grown in leaps and bounds, from photocopied notebook doodles to MIT lectures, t-shirts and between 60 and 70 million hits in October alone. People seem to identify with Munroe's stick creations and their sense of alienation; perhaps they make them think, act more decisively, or maybe they're just genuinely funny. As Munroe says, “Noticing when the stoplights are in sync, or calculating the length of your strides between floor tiles – normal people notice that kind of stuff, but a certain kind of person will do some calculations.”

Far from being something that exists purely in cyberspace, xkcd inspires real-life action. Youtube videos have appeared of people playing chess on rollercoasters, shower-guitaring, and attacking infamous US hacker Richard Stallman dressed as ninjas, all after depictions in xkcd strips. Most famously, around a thousand fans from all over the world descended on a Massachusetts park – according to *Wired.com* “bearing tape measures and Rubik's cubes” – after a comic featuring: a dream with an unrequited love, coordinates, and a date and time. Munroe then stepped out at the allotted second and addressed the cheering, sword-fighting crowd, saying “Maybe wanting something does make it real.”

Truly a case of life imitating art, xkcd could probably incite a revolution. A few hours clicking ‘random’, and I promise you won't be disappointed.



Arctic Circle

<http://www.moonton.com/arctic/eco.htm>

Created in 1992 by English ex-pat Alex Hallett while working as a waitress – she now lives in New Zealand and works in clinical research – Arctic Circle is a comic with an environmental conscience.

Peopled (or should I say ‘animaled’) with a cast of Arctic creatures, including three penguins (apparently they migrated from the Antarctic before any pedants object), a cynical polar bear, a gullible lemming, eco-aware snow bunny, and a ruthless Arctic tern, the daily comic allows Hallett to always be topical.

Plenty of worthy themes are covered, including the evils of KFC cloned chicken, veganism, planet-conscious celebs and their private jets, and consumerism, all covered with a sly wit and all the while referencing iPods and Xboxes and other hip merchandise.

However, the underlying theme rarely strays from the perils faced by the North Pole, and the ‘softly softly’ approach taken by politicians to deal with climate change. In this respect I heartily commend Arctic Circle – being able to reach out to everyday people is vital to combat the apathy and denial surrounding environmental issues.

But try as I might, I couldn't get past the wearily repetitive primary school-like message (“Reduce! Reuse! Recycle!”), endless references to reducing your carbon footprint, and general smugness. This could be ignored if Arctic Circle was consistently funny, but apart from a few chuckles I felt myself itching to look at Gary Larson's cartoons instead. This is the problem with Arctic Circle; it isn't witty enough for adults, nor is it understandable to children who might be keen to learn about the issues. Hallett says, “My blog tagline is ‘Caring about the environment should be fun.’” Unfortunately, you'll have to look elsewhere for the ‘fun’ part.

PhD Comics
<http://www.phdcomics.com>

Another depiction of ‘everyday’ life in academia, PhD is the brainchild of Jorge Cham and centres around the lives of several students in grad school (that's American for ‘anything-after-undergraduate’). Cham began the comic in 1997 when he was himself a grad student at Stanford, and subsequently took up full-time writing and talking about his PhD (you might have seen him recently give a lecture at Imperial on ‘The Power of Procrastination’). Eerily, like xkcd's Randall Munroe he also worked on robots before becoming a full-time cartoonist.

Procrastination is one of the main themes of PhD, which as any student (grad or otherwise) will know is true to life. We also encounter the full range of academic clichés – the nameless hero, followed from innocent newbie to jaded, humourless cynic; the never-ending PhD student who lives off free food and is happiest when sleeping; the lone female lab researcher who gets eyed up by every frustrated male; and the activist-minded humanities (sorry, ‘social science’) student forever demonstrating against some injustice in order not to work.

The clichés never detract from Cham's acute observations of academic life, especially when it comes to departmental politics and the student-professor relationships (a particularly acute strip concerns the average amount of time spent composing an email: Professor – 1.3 seconds; grad student – 1.3 days). Anyone who has spent some time becoming institutionalised (in the university sense) will find something to recognise in PhD, be it a figure of fun or that coffee addiction you just can't seem to shake. Who knows, you might even come across yourself.

Science Magazines

Katherine Jones reviews *The Scientist*;
Mico Tatalovic reviews *Science Spin* and *research*eu* magazines.

Science Magazines

www.the-scientist.com

www.sciencespin.com

<http://ec.europa.eu/research-eu/>



The Scientist provides “compelling print and online coverage of the latest developments in the life sciences including research, technology and business.” It is for “active researchers that are interested in maintaining a broad view of the life sciences by reading articles that are current, concise, accurate and entertaining.”



“The goal of *Science Spin* is to present science in a dynamic, attractive and informative manner for both a lay and specialist readership. The coverage extends from Astronomy to Zoology, but the editorial approach remains the same; to make science interesting to all.”

The Scientist refers to the prestigious “Magazine of the Life Sciences.” As science magazines are quite numerous, I guess there could be a temptation to dismiss them as ‘standard fare’ or not for you. To do so would be to miss out on the intricacies of the magazines out there, with their distinct styles, character and content. “Life by numbers” reads the sensational headline on the front cover of the March issue. This bold and to some people, slightly alarmist, statement is qualified with “Peculiar microbes prove the predictive power of systems biology.” The cover is filled with somewhat witty illustrations of microbes, drawn in the paint-by-numbers style. The article itself is on the topic of the use of computational modelling to “fill in the gaps” and make predictions from existing experimental data. Researchers are using *Halobacterium salinarum* to test the systems biology approach as relatively little is known about it, a bit like starting with a clean slate.

If “Life by numbers” seems technical, it is because the magazine content targets the professional life scientist. There is a “Hot Papers” section, featuring the hottest life sciences papers. “Fixing Fraud” looks at the ways of detecting and maintaining the integrity of your research. “Biobusiness” profiles Frankie Tull, a biotechnology lobbyist at the US congress. “Companies that don’t hire lobbyists wonder why their competitors are getting all the money.” *The Scientist* too has its commercial side. I counted 19 adverts dedicated to laboratory equipment, including the slogan “we challenge you to find a

pipette this comfortable.”

This professional theme continued with the results of a specially commissioned web-based survey on the “Best Places to Work for PostDocs 2009.” According to the survey, 61% of postdocs are not citizens of the country where they are doing their postdoc research. Results have been compiled into a list of the top 40 institutions for postdocs in America. And the top spot goes to... the Whitehead Institute for Biomedical Research in Cambridge, Massachusetts.

So this sounds like a magazine for a postdoc life sciences researcher, but I’m not sure that only biologists per se would enjoy this magazine. It’s strangely compelling even for those outside of the loop. This issue featured a variety of the latest news, from laboratory animal nutrition to orthopaedic diseases, with more experimental detail than you might find elsewhere. Really though, this seems a high quality, prestigious publication for the professional life scientist who cares about their career and reputation.

Science Spin is an unpretentious popular science magazine that comes out six times a year. It is the only magazine covering science, nature and discovery in Ireland. The focus of both the articles and the adverts in the magazine is Irish, and it appears especially aimed at Irish scientists, students and school pupils. But they are articles covering wide areas of science beyond Ireland, especially in the exhaustive, yet simple and straightforward cover of science news in the “Upfront” section. Interviews and feature articles cover anything from science policy through science initiatives for kids to recent discoveries in zoology or astrophysics. There are also reports from events such as ESOF (EuroScience Open Forum) and big projects such as CERN and a book review section. All in all *Science Spin* makes for an enjoyable and easy to read magazine and it is a welcome contribution to coverage of international science issues in English.

*research*eu* is the magazine of the European research area published in English, French, German and Spanish. It is available for free download and free subscription to the print issue is available through their website. It comes out ten times a year and each issue is themed. The last few themes included geosciences and research into differences between humans and animals. The articles are easy to read and focused mainly on European researcher. As its name suggests, the magazine focuses on the most current research, so many of the articles can bring a reader up to date with current issues related to a wide range of sciences practiced in Europe. The themed approach as well as its large size (48 pages) allow this magazine to cover many aspects of science in a good amount of detail and it does not shy away from controversy either. Apart from feature and interview articles there is also a short science news section “In Brief” and stunning photos on the back cover section “Image of Science.” This magazine is an excellent resource for keeping up to date with a wide range of scientific and technological research for a non-specialist; although an interest in science is essential, since the approach aims not to dazzle with fancy, sexy science but to talk seriously about important issues in science.



“*research*eu* is a European Union research magazine, written by independent professional journalists, which aims to broaden the democratic debate between science and society.”

POP CORN

