

I, science

The Imperial College science magazine



Vertical Farms
Future eco-cities

Creationist Britain
Antirationalism arrives

Digital scents
Smellophone technology

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The *I, science* team brings you another exciting issue packed with cool science that you can use to impress people at dinner parties. Early printing this year meant we had to prepare this issue in an express manner, but we hope we managed to maintain the high quality our readers at Imperial and beyond have learned to expect from the magazine over the years. In the news section, as usual, we bring you the latest development in science and technology from Imperial and further a field. In this issue you will also find a list of events taking place at Imperial, that we thought you might enjoy.

Features section begins with an award winning article about herpesvirus. We then explore a somewhat forgotten concept of digital scents. After making a big splash in the late 1990s with several start-up companies promising to deliver mass-produced digital scent technology within few years, the whole

idea slowly died away, at least in the West. In Japan, on the other hand, they are already experimenting with smellophones and use of digital scent in advertising. We continue is this futuristic manner to investigate the idea of self-sustainable, zero-emission, farms within skyscrapers. These buildings could integrate our living and work space and reduce our reliability on importing and delivering fresh produce. These exciting ideas are often thought of in the lab, but it takes effort and knowledge to transfer them into profitable business, and this is what our From Lab to Market feature talks about.

Most rational people would accept that science and religion can coexist without any conflict, but recently a backward thinking pseudo-religious views have attempted to artificially create a conflict between science and religion. Felix Whitton reports about the arrival of creationism in Britain. Internet is changing the way science is done and the way it is communicated. You can read more about it in the Webolution in Science.

Our regular sections offer some timely and exciting content, from credit crunch to science comics, so don't forget to have a look at our Opinions and Reviews sections as well.

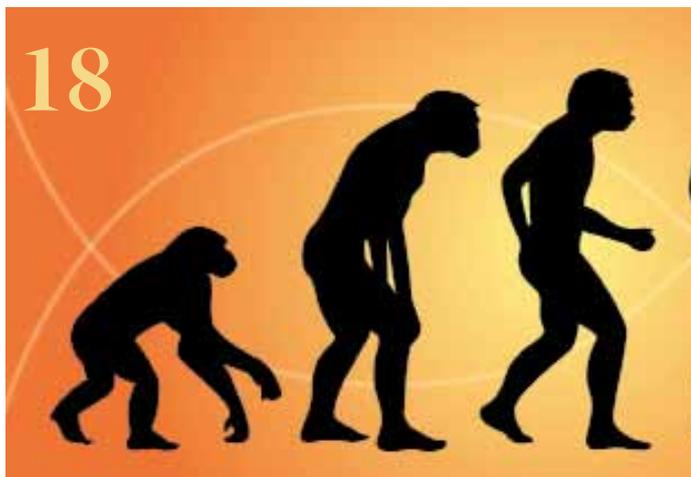
Mico Tatalovic

The next issue is coming out on the 1st of February. Please send your article and photo submissions by the 15th December to: i.science@imperial.ac.uk

In the next issue: Science Pornography, String Theory and much more....



A highly commended image from the Wildlife Photographer of the Year 2008. The image and the competition are property of the Natural History Museum and *BBC Wildlife Magazine*. *City descent* [London] © Piers Calvert / Wildlife Photographer of the Year 2008.



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TV: Extraordinary Animals in the Womb, Channel 4.

Radio: Selection of web podcasts.

Magazines: Imperial's Sci-fi magazine, Zenith.



News from Imperial...

Green Light for Laser Project



Finely detailed images of microscopic surfaces such as molecules and atoms became a step closer today after 14 countries agreed on a convention to initiate the construction and operation of the European X-Ray Laser Project (XEFL).

A 3.3km length facility is being planned for Hamburg, Germany where electrons will be accelerated sufficiently fast enough to produce high energy, short wavelength laser light that can then be used to study molecules which were previously too small for current technology. With the possibility of using the technique to help develop better drugs and analysing the composition of stars, Imperial researchers are excited by the facility.

Future of Fusion

Imperial College along with partners from over 20 organisations have launched the start of a 3 year planning phase of the European High Power Energy Research Facility (HiPER) project.

The goal of HiPER is to turn the dream of a sustainable nuclear fusion powered energy plant into a reality. Using high-power laser beams to squeeze vast amounts of energy out of atoms found in sea water, the energy plant would create less radioactive waste than conventional nuclear fission power stations.

Top Award for TB Technique

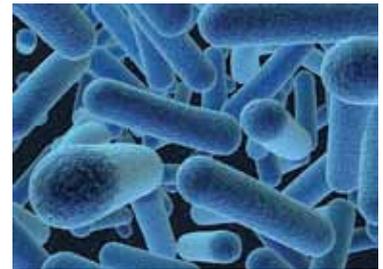
A “delighted” Professor Ajit Lalvani, was this month awarded the prestigious Weber-Parkes Trust Medal, for contributions to the prevention and cure of TB.

His revolutionary T-cell based test (ELISpot) gets results within 48 hours, rather than weeks, and has become a standard recommendation worldwide.

Bacteria in a Crisis

A large molecule called a ‘stressosome’ has been observed in certain bacteria cells in a joint study between Newcastle University and Imperial College that investigated how bacteria respond to crises.

Should the bacteria find itself in a danger, for example if its habitat becomes too warm or salty, a warning signal is sent to the stressosomes to trigger the production of over 150 proteins. Bacterial cells have around 20 of these stressosomes and the stimulated production of these new proteins enable the cell to adapt to its changing environment.



Rock Gives Clue to Evolution

With the help of a US particle accelerator, an Imperial college researcher has moved a step closer to understanding the evolutionary formation of the Earth. Using x-rays produced by the circular particle accelerator, Dr Andrew Berry along with his international colleagues was able to investigate the chemistry of a rare type of molten rock called a komatiite, found to be formed in the Earth’s mantle more than 2.7 billion years ago.

This research was particularly significant as it dispelled a long held alterna-

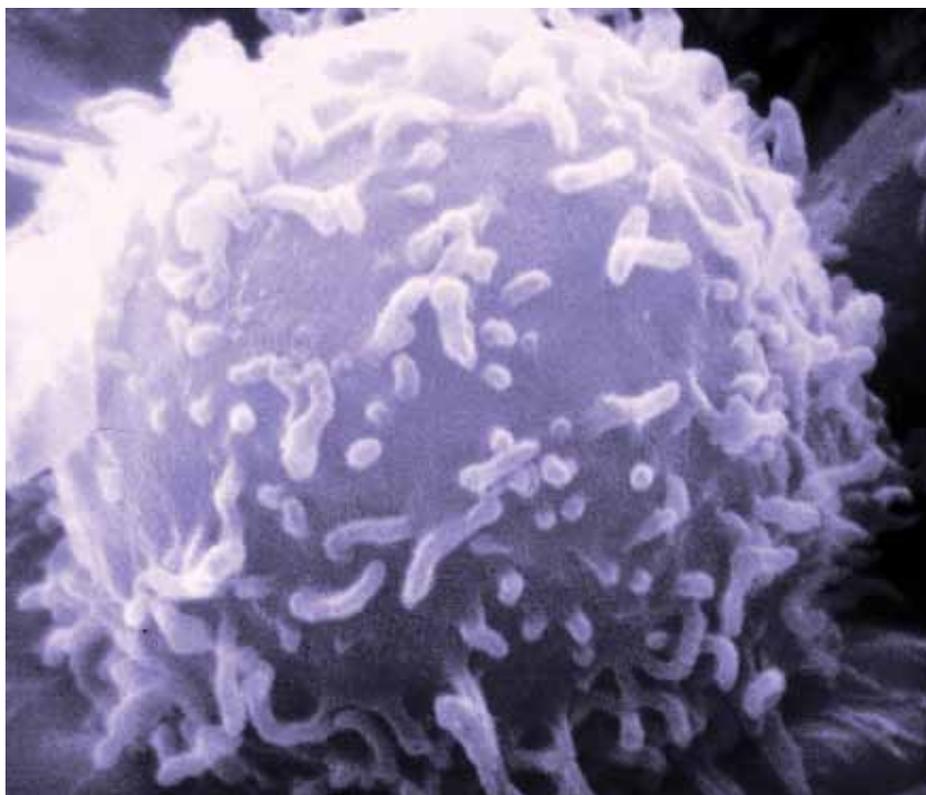
tive theory which believed the komatiites were formed at a temperature cooler than 1,700 degrees Celsius. If water is added to the komatiites their melting temperature is significantly lower and this “wet or dry” controversy over komatiites has split Earth science in two – the prize of this controversy is the knowledge of the state of our planet’s interior over the first few billion years of its history.

Dr Berry’s research, published in *Nature*, has finally settled this controversy proving that komatiite magmas

contained virtually no water. “Komatiites were definitely bone dry”, says Berry from the Department of Earth Science and Engineering, “and the Earth had a distinctly hot, but not steamy, interior.”



Chemical Orienteering



Single-cell organisms have long been known to find their way around their surroundings by detecting the chemicals present in their environment. Research published in the *Proceedings of National Academy of Sciences* by Dr Robert Endres, a Senior Lecturer in Systems Biology at Imperial, is now able to show accurately how they achieve this.

It is important that microscopic organisms such as bacteria, amoeba, yeast cells and even human immune cells are able to judge if they are travelling in the correct direction. They do this by chemotaxis: detecting the concentration levels of certain chemicals in their surroundings. Human white blood cells, such as lymphocytes, for example, have to find their way through the human body to the site of an infection by analysing the gradient of the important chemical across cells, even if the concentration difference is only tiny. Considering that these organisms are trying to analyse gradient measurements when the chemical particles are bobbing around at random, this is no mean feat.

“Our paper deals with the accuracy of direct gradient sensing of single cells,” says Dr Endres. “These cells are able to notice the gradient spatially by comparing how much molecules are bound at the cell front versus cell back within some short

amount of time.”

Dr Endres and his researchers developed a theoretical model known as the “perfectly absorbing sphere” which assumes that every chemical particle is only counted once as it comes into contact with the cell surface – thus there is no erroneous double counting. Thus creating an accurate picture of different chemical concentration levels on all sides surrounding the cell. Simultaneously, once a chemical particle has become bound to a receptor on the cell, it is ‘sucked’ inside, or ‘internalised’, preventing the chemical particles from being detected again.

By preventing double counting of chemical particles, the inaccuracies or ‘background noise’ of measuring the surrounding concentration gradient are reduced, making it easier for the organisms to detect even the most miniscule gradients and correctly move in the right direction.

The importance of gradient sensing is visible by the various examples available in biology as Dr Endres is keen to point out: “Gradient sensing is done by cells of our immune system.” He is hopeful that “a better understanding of receptor internalization will also improve our understanding of viral infections.”

Autumn Leaves

As winter slowly approaches, the trees in London’s many parks change from green to autumnal hues of yellows and reds. Yellow pigments are present in leaves throughout the year but it is only in autumn that the leaves appear yellow. This is due to the termination of tree growth and the recovery of green chlorophyll from the leaves, to help the tree preserve energy to survive the winter months. However, until recently it was not understood why some leaves turned red instead.

Dr Thomas Döring, a visiting post-doc at Imperial College, suggested that the red colour in leaves is caused by pigments produced just prior to leaf fall called anthocyanins. He hypothesised that the production of red pigment was to disguise the underlying yellow leaf colour that would attract insects such as aphids which can be dangerous to trees. His inspiration was an idea “proposed by one of the most influential evolutionary biologists of the past century, Bill Hamilton”.

Using a colour choice experiment in which 140 dishes were painted in 70 different colours and filled with water, Döring and his colleagues at Imperial College and the University of Oxford investigated the effect of colour on the prevalence of aphids which landed on the water traps.

Döring discovered that “there were 15 times more aphids in the yellow than in the red traps” with similar but smaller results for green traps. He then went on to sample the colour of hundreds of leaves from a variety of different tree species.

The combination of these results allowed him to establish that aphids found yellow leaves more attractive than either green or red ones. Thus the production of red leaves in autumn is a protective mechanism developed by the tree to stop aphids landing and laying large number of eggs on their leaves, which could significantly harm the growth of the tree the following spring.

The implications of Döring’s work may have far-reaching benefits. He explained that his results “might help to design alternative pest control strategies by exploiting the colour choice of pest insects, for example red coloured lettuce varieties are expected to be less attacked by aphids.”

...and elsewhere.

Strong Adhesive

A team at the University of Dayton has successfully produced an adhesive that is ten times stronger than a gecko's 'stickability'.

Geckos, small lizards found in warm climates, are capable of sticking to ceilings and walls thanks to an abundance of hairs and pads on the underside of their feet which allows them to stick to surfaces with the help of Van der Waals forces.

However, researchers have now produced an adhesive using two slightly different layers of multi-walled carbon nanotubes which has a strength 100 newtons per square centimetre. Like a gecko, the adhesive is capable of sticking to a wall and can be easily removed when required.

Secure Networks

Improved security could be a step closer after the unveiling in Vienna of the world's first computer network protected by unbreakable quantum encryption.

Quantum cryptography relies on the Heisenberg Uncertainty Principle which states that you can't measure quantum information without disturbing it.

In Vienna, photons (quanta of electromagnetic radiation) were fired at great speeds between nodes in the network. The moment an intruder tried to listen, the photons became scrambled and the system automatically shut down.

Stop that Racket!

New research has confirmed the harmful effects of listening to music through headphones at a high volume setting.

Up to one in 10 people risk permanent hearing loss if they listen to a personal music player for more than one hour a day each week for at least five years. This could equate to about 10 million people in the EU alone.

Advice for keen listeners is to ensure that you don't listen at maximum volume and to avoid using your mp3 player for prolonged periods of times.



New research on monkey brains gives hope for paralysed patients

A team of scientists has developed a method of getting a brain signal for movement from a healthy brain to a healthy arm, bypassing a damaged nerve connection. The research was carried out on monkeys with chemically-induced paralysis, who, with the aid of a "brain-machine interface", were able to move muscles in their arms.

For years scientists have been developing new techniques to allow brain-computer communication. In previous experiments, monkeys have been able to control robotic arms and computer cursors with their minds. This latest development by the Washington University team is particularly exciting because of the future



prospects for quadriplegic patients, who are paralysed in both their arms and legs.

The scientists mimicked this paralysed state in the monkeys by blocking nerve conduction in the spinal cord - the communication pathway between the brain and the limbs. This was achieved temporarily using a local anaesthetic.

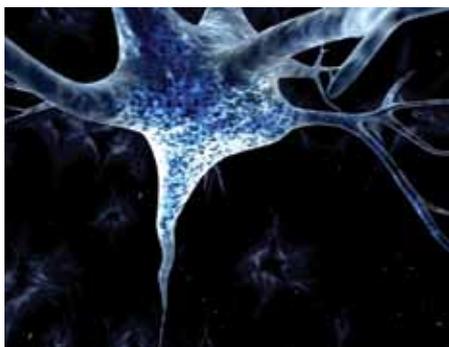
An artificial connection between the monkey's brain and its wrist - a brain-machine interface - was set up, bypassing the nerve injury in the spinal cord. This enabled the monkey to tense and relax the muscles in its otherwise paralysed wrist.

The nature of motor cortical neurons (brain cells that control muscle movement) allows great scope for the therapy. These neurons have been shown to be capable of adapting to learn new types of

movement, and forming new connections if their original set-up is disturbed, for example during surgery. What's more, the researchers found that the monkeys could use any motor cortical neuron to control muscles in the wrist, even if the cell originally had nothing to do with these muscles.

The study, published in *Nature*, suggests that this new technique could revolutionise existing therapies for patients. Lead author of the study, Chet Moritz, reckons that similar techniques could be developed in the future to stimulate muscles in the legs, enabling paralysed patients to walk again.

Jessica Hamzelou



Wetter Mars



A new category of minerals have been discovered across large areas of Mars.

Using an imaging spectrometer on board a space probe, NASA have found evidence of hydrated silica, more commonly known as opal.

The spectrometer works by “reading” over 500 colours in sunlight which has been reflected from the red planet’s surface. Using information obtained from the spectrometer, the scientists were able to detect which minerals were present in the Martian landscape.

The discovery of opal on the planet’s surface suggests that liquid water remained on Mars a billion years later than had been previously thought suggesting that water was a critical feature of the Martian surface and possibly even supported life.

Colour of Love



The colour red has long been linked with romance, but now a study published in the *Journal of Personality and Social Psychology* has found evidence to support the link between the colour red and attractiveness.

Using an experiment in which their male volunteers were given photographs of women and \$100 researchers discovered that men were more willing to spend larger amounts of money on a night out with a woman wearing red.

When asked to rate the attractiveness of the woman, those dressed in red generally received a higher rating of attractiveness, although when the same question was posed to women looking at the photographs no correlation was found between outfit colour and attractiveness rating.

The researchers believe that their study is clear evidence that the colour red induces a more romantic feeling in men but not in women.

Upcoming Events

Divided Yet Whole

Wellcome Collection

Thursday 13 November, 7-8:30 pm

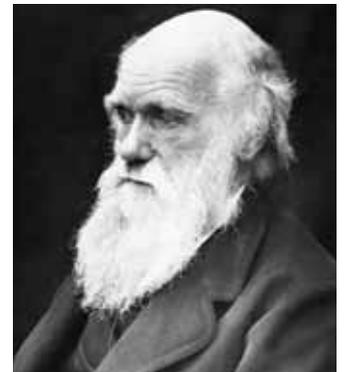
An impressive venue dedicated to “exploring what it means to be human”, the Wellcome Collection on Euston Road hosts various, mostly free, events every week, often combining scientific insight with an artist’s perspective. Part of a series on identity and change, *Divided Yet Whole* explores the world of twins: our fascination with twins, what it is like to be one and their use in research, with contributions from poet Michele Roberts and geneticist Lynn Cherkas.

Darwin

Natural History Museum

Friday 14 November onwards

As part of a huge national programme of events to celebrate the great man’s 200th birthday, the biggest ever exhibition about Charles Darwin opens at the Natural History Museum this month. The exhibit will feature Darwin’s own specimens and notebooks showing the clues that guided him towards his theory, as well as a section demonstrating the significance of evolutionary biology in today’s world. Adults £9; Concessions £6.



Zero to Infinity

Dana Centre

Thursday 20 November, 7-8:30 pm

The Science Museum’s Dana Centre stages free, adult only events that explore scientific issues through discussion and performance. On this occasion Oxford professor of mathematics Marcus du Sautoy, fresh from his recent BBC Four series *The Story of Maths*, looks at how mathematicians throughout history have approached the challenging concepts of zero and infinity. Check out the Dana Centre’s website for details of this and other events – other topics being discussed this month include science film-making, out-of-body experiences and the use of bacteria in art.

Embodiment

Tate Modern

Thursday 11 December, 7-9 pm

Renowned neuroscientist and author Antonio Damasio challenges the notion of the mind and body as separate entities in a “conversation” organised by the Performing Medicine project, part of a series of events that explore the relationship between the arts and medicine. £10/£8.

Nine Lessons and Carols for Godless People

Hammersmith Apollo

Sunday 21 & Monday 22 December, 6:30 pm

An alternative festive show for those who favour selfish genes over nativity scenes. The impressive lineup features Richard Dawkins, Simon Singh and a host of comedians including Robin Ince, Phill Jupitus and Stewart Lee. Two nights at the Bloomsbury Theatre sold out rapidly but at the time of going to print there were still tickets available for these extra dates at the Apollo. Tickets £25-30.

From great discoveries....

The 2008 Nobel Prizes

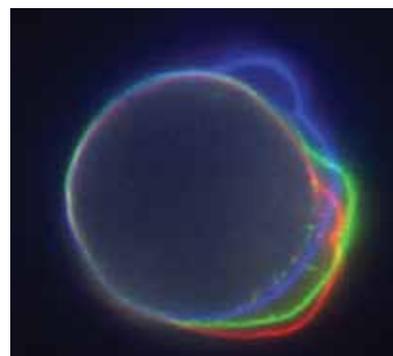
Sam Wong reports on this year's awards, which recognise the discovery of viruses that cause disease, the illumination of broken symmetry in particle physics and the isolation of a glowing protein from jellyfish. All three of the prestigious prizes, each worth 10 million Swedish kronor (£770,000), have been shared by three individuals. The laureates will receive their awards at a ceremony in Stockholm on December 10th, the anniversary of Alfred Nobel's death.

Glowing proteins

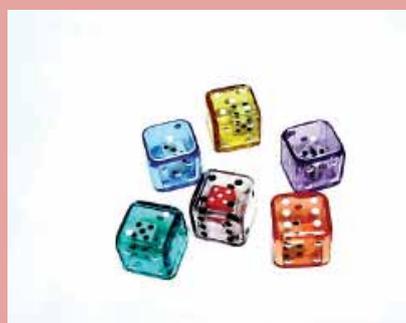
The chemistry prize, awarded by the Royal Swedish Academy of Sciences, was given to three American-based researchers, Osamu Shimomura, Martin Chalfie and Roger Tsien, for the discovery and development of green fluorescent protein (GFP).

GFP glows under ultraviolet light, and occurs naturally in the bioluminescent jellyfish *Aequoria victoria*. Shimomura was the first to isolate this protein, working at Princeton University in the 1960s. GFP has proved to be an invaluable tool in biological research, allowing scien-

tists to observe structures and processes that were previously invisible. Martin Chalfie showed by expressing the cloned GFP gene in the bacterium *E. coli* and the nematode worm *C. elegans* that GFP can be used to tag cells or proteins of interest in any organism, making them visible under a fluorescence microscope. In addition to contributing to the understanding of the mechanism of GFP's fluorescence, Roger Tsien discovered that introducing mutations into the GFP gene can produce related proteins that fluoresce in different colours, allowing researchers to label many proteins at once.



A *Xenopus* zygote transfected with GFP



Broken symmetry

The physics prize has also been split between three recipients. Half of the prize was awarded to Yoichiro Nambu of the University of Chicago for the discovery of the mechanism of spontaneous broken symmetry in subatomic physics. The methods Nambu introduced in the 1960s are still used by physicists today.

The other half will be shared between Makoto Kobayashi and Toshihide Maskawa, who "provided an explanation of the breaking of Charge-Parity (CP) symmetry" in 1972. Professor Nick Jelley,

from the University of Oxford explains they "found that by introducing six quarks then weak interactions such as beta decay occurred via mixtures of these quarks and the mixing was rich enough to explain CP violation".

Broken symmetries of this sort have a crucial role in our very existence. Jelley concluded that "this year's Nobel prize winners made very important contributions to the development of our understanding of the fundamental particles and their interactions."

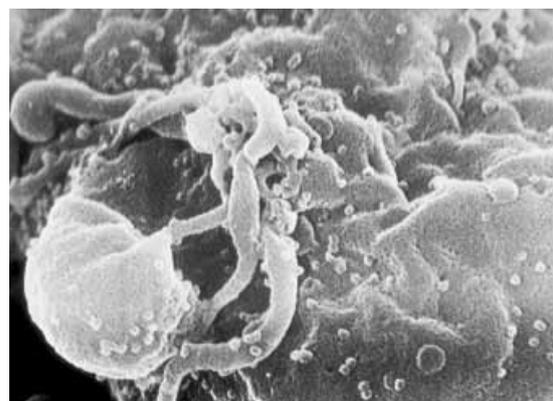
Deadly viruses

The prize for physiology or medicine will be shared by Harald zur Hausen, who discovered the link between human papilloma virus (HPV) and cervical cancer, and Françoise Barré-Sinoussi and Luc Montagnier, who discovered human immunodeficiency virus (HIV).

Cervical cancer is the second most common cancer among women. Harald zur Hausen first postulated that HPV was the causal agent in 1974, when the prevailing view was that *herpes simplex* viruses were responsible. His suggestion was not well received, and it took ten years of studying cervical cancer biopsies before zur Hausen finally discovered the new, tumour-causing HPV types 16 and 18. His discovery led to the development

of vaccines that provide over 95% protection against these high risk viruses. The Nobel Committee, from the Karolinska Institute in Stockholm, has awarded one half of the prize money to zur Hausen.

The other half will be shared by two French virologists, Françoise Barré-Sinoussi and Luc Montagnier. Barré-Sinoussi becomes only the 35th woman to win a Nobel prize out of 809 laureates since the prizes were first awarded in 1901. Her work with Montagnier culminated in the isolation of HIV in the early 1980s. Their achievement led to the development of better diagnostic methods and antiretroviral drugs, which have resulted in a dramatic improvement in the life expectancy of HIV patients.



An HIV particle

...to quirky science!

Pills, Pringles and Pole Dancers

This year's Ig Nobel Prizes highlight some surprising discoveries. Sam Wong explores.

The week before the Nobel Prize winners were announced, some awards of a slightly different nature were handed out at a ceremony at Harvard University. Every year since 1991, the Ig Nobel Prizes have honoured some of the quirkiest discoveries in science. The Ig Nobels are administered by the magazine *Annals of Improbable Research*, and are intended to celebrate "achievements that first make you laugh, then make you think".

Among the surprising discoveries recognised by the awards committee was the finding that slime moulds can solve mazes. The Physics Prize was awarded to Dorian Raymer and Douglas Smith of the University of California in San Diego, US, for mathematically proving that strings will inevitably tie themselves in knots. A French team was awarded the Biology Prize for discovering that fleas that live on a dog can jump higher than fleas that live on a cat.

The Chemistry Prize went to Deborah Anderson and colleagues for discovering that Coca-Cola is an effective spermicide, and to Chuang-Ye Hong and colleagues for showing that it isn't (!). Receiving her award, Prof Anderson said that Dr Sharee Umpierre had "planted the seed for our study by mentioning one day in the lab that sexually active girls in her convent school use Coca-Cola douches for birth control". She also emphasised that this was not a reliable method for contraception, since some sperm could get into the birth canal before the 'douche' could take effect.

Some Ig Nobel winning discoveries are not only amusing, but also have far-reaching implications. This year's Medicine Prize winner is a case in point. In a paper published in the *Journal of the American Medical Association* this year, Dan Arieli of Duke University and others demonstrated that expensive fake medicine is more effective than cheap fake medicine. Out of 82 volunteers given the same placebo pill, those who believed the pills cost \$2.50 each experienced less pain from electric shocks than those who believed that the pills cost 10¢ each. The authors



concluded that commercial features can affect the efficacy of not only placebos but also real drugs by influencing patients' expectations, a finding that has great significance for the pharmaceutical industry.

The Ig Nobel Economics Prize also recognised a baffling discovery that points towards a very surprising truth. Most female mammals give overt signals to indicate when they are in the fertile part of their oestrous cycle, and only engage in sexual activity during this period of 'heat'. Humans, by contrast, are generally thought of as 'concealed ovulators' – there is no discernable external sign of when women are able to conceive. Geoffrey Miller, Joshua Tybur and Brent Jordan of the University of New Mexico took an unorthodox approach to look for evidence that women do subtly advertise their fertility in some way that men are able to detect. Their study recruited 18 lap dancers to record their menstrual cycles, work shifts and tip earnings for 60 days. They found that during oestrus, the dancers earned on average \$335 per 5 hour shift, compared with \$185 per shift when they were menstruating. These differences were not present in dancers who used the contraceptive pill.

"Scientists can learn a lot from lap dancers," Jordan said upon receiving his award. "Yet we know one technique that lap dancers don't: hierarchical linear modelling of time series data. Lap dancers can now schedule their work shifts to match their fertility and make around \$200,000 a year, and we get this Ig Nobel,

which is beyond all price".

Charles Spence, Professor of Experimental Psychology at the University of Oxford, was one of two British recipients of this year's prizes. Spence and his colleague Max Zampini had subjects eat Pringles while wearing headphones. When the subject bit into the crisp, the sound of the crunch was digitally altered and played back into the headphones in real time. When the sound was made louder or the higher frequencies were boosted, subjects reported that the Pringles were crisper and fresher. Based on these findings, Unilever (who funded the original research) and Nestle have begun their own in-house research into how sounds affect consumer enjoyment of food. Prof Spence, who also works with chef Heston Blumenthal on using sounds to enhance tastes at the Fat Duck restaurant, suggests that his work could lead to new ways to help those who lose their sense of taste to enjoy food.

The other British winner was David Sims of Cass Business School, who received the Literature Prize for a study entitled "You Bastard: A Narrative Exploration of the Experience of Indignation within Organizations".



Up close and personal with a herpesvirus

Think you know what herpesvirus is? In this award-winning article **Rebecca Robey** reveals it's not just an STD...

RECENTLY, MY best-friend's husband of three years developed a nasty rash. His GP took one look at it and immediately diagnosed it as a herpesvirus infection. I can still hear my friend's resonating response to this news: "you've got WHAT???" Fortunately, it wasn't nearly as bad as it sounds.

Herpesviruses carry with them something of a social stigma, and are widely associated with sexual promiscuity. Their name conjures up images of the unpleasant and unsightly rash of genital sores commonly known as herpes, which can be spread by sexual contact. But the truth is, most of us are riddled with herpesviruses and never even know it – and that is what makes them so fascinating.

Herpesviruses are, in fact, a large family of viruses one of which – Herpes simplex 2 – causes genital herpes. The other family members include Herpes simplex 1, the virus responsible for cold sores, Varicella zoster virus, which causes chicken pox and shingles (it seems only fair at this point to clarify that this is what the husband in question was actually suffering from), and Epstein-Barr virus, which is usually unnoticed, but can cause glandular fever and, rarely, certain types of cancer.

What all herpesviruses have in common is that they have evolved cunning and complex

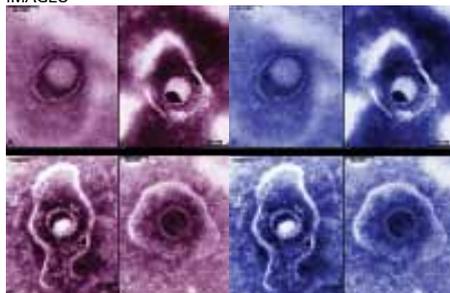
"The truth is, most of us are riddled with herpesviruses and never even know it."

ways of living undetected in their human host. They often lie dormant in their host's body, displaying no outward signs of infection. They are experts at avoiding the attention of the immune system, which seeks out and destroys invading pathogens. And leading the pack is Kaposi's sarcoma-associated herpesvirus (KSHV), arguably the most silent and stealthy of all the herpesviruses.

KSHV causes Kaposi's sarcoma, a cancer characterised by multiple purple-brown lesions on the skin. It was once a rare cancer, seen only in isolated pockets - elderly men of Mediterranean origin and younger people

of both sexes in parts of sub-Saharan Africa. For the most part, KSHV infection remains asymptomatic and goes undetected. But in the early 1980s, an unusual epidemic of Kaposi's sarcoma among young men in San Francisco and New York alerted medical practitioners to a new, devastating phenomenon – the outbreak of HIV and AIDS. In AIDS patients, who have severely damaged immune systems, KSHV no longer lies dormant, but frequently results in an aggressive case of Kaposi's sarcoma.

DAVID GREGORY AND DEBBIE MARSHALL, WELLCOME IMAGES



Herpes virus

The association of Kaposi's sarcoma with AIDS has taught us a fascinating thing about KSHV. It has not just evolved to hide from its host's immune system, but has developed a fine balance of host-virus interaction. By provoking a low-level of immune response, KSHV helps its host keep its own infection under control. In this way KSHV can persist at low levels in the host for the duration of their life – it is not in the virus's best interest to replicate uncontrollably, resulting in a cancer that may kill the host it relies on to exist. And this is where my research comes in.

The question I am addressing is how the immune system, when it is functioning correctly, is able to control KSHV infection. Specifically, I am interested in the T-cell immune response against KSHV infection. T cells are the foot soldiers of the immune system. They are specialised into regiments, each one of which is programmed to recognise and destroy one specific invading pathogen. After an infection is cleared, just a few members of that regiment remain in the body and are called 'memory T cells'. If the body comes under future attack by the same pathogen, these memory T cells are on hand

"I can still hear my friend's resonating response to this news: you've got WHAT???"

to react, and proliferate massively to create a defending army to clear the infection again.

I am investigating this system by isolating T cells from blood samples donated by patients who have recovered from Kaposi's sarcoma. These patients have, through chemo- and antiretroviral-therapy, boosted their levels of memory T cells that recognise KSHV, so bringing their infection back under control and clearing the cancer. I take a panel of different KSHV proteins that make up the virus as a whole, and test which of these proteins are recognised by the patient's memory T cells, prompting them to proliferate. If we can begin to understand this, then we have taken the first steps towards developing new therapies to boost the immune response to KSHV infection and potentially even a vaccine against it.

Kaposi's sarcoma has declined in the West since the introduction of antiretroviral therapies but it remains one of the most common cancers in sub-Saharan Africa, accounting for as much as half of all cancers in some countries. This is pretty shocking for a cancer that is almost unseen in the developed world. There is a desperate need for a cheap, widely available treatment or prophylaxis, and I hope my research will contribute towards its development.

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Herpes virus infection

THIS ARTICLE WAS HIGHLY COMMENDED IN THE MRC MAX PERUTZ SCIENCE WRITING AWARDS COMPETITION (NOW IN ITS ELEVENTH YEAR) RUN BY THE MEDICAL RESEARCH COUNCIL (MRC).

Scent over internet

Are smellophones and fragranced e-mails just around the corner? Mico Tatalovic sniffs out historical and recent developments in digital scent technology.

SCENTDOME, © TRISENX

Olfaction is considered the most primitive of the senses, connected directly to our emotional centres, bypassing the conscious control of our feelings evoked by it. An article in the September issue of *Scientific American Mind* says that "far from being a weak and unimportant sense, our odour detection ability is surprisingly acute and shapes our social interactions in ways we do not consciously realize," and that "fragrances trigger subconscious responses in the brain before eliciting a conscious perception of an odour". Recent research suggests that even while we sleep pleasant smells trigger happy dreams, and bad smells trigger negative dreams.

For a truly immersive experience of watching a movie, playing a computer game or just browsing the web, smell plays as important a role as sight or sound. Imagine shopping for flowers for your Valentine online and being able to sniff them before you decide which ones to buy. Downloading scent the way we download music might not be such a far-fetched idea: in fact, some companies have already developed technologies necessary for digitizing scents. Among the scent-producing plug-ins are the DigiScent's iSmell, developed in the late 1990s and projected to cost around \$200, and the recent TriSenx's ScentDome, that is currently available over the internet for \$390.

ScentDome was said to be further researched by Telewest Broadband in UK to

allow the sending of scented e-mails. Chad Raube, director of internet services at Telewest Broadband told the BBC, "this could bring an extra whiff of realism to the internet". So, just as you connect a speaker or a printer to your computer now, you could soon be connecting some sort of a 'smeller', or as they refer to it in Woody Allen's film *Sleeper* (1974) 'aromatron': a scent-emitting device that would be able to transform the digital information received from the computer into real life scents. In fact, with ScentDome you can already fully enjoy the Scenttv.tv, the first and only "scent enabled portal" that allows you to enjoy 'smell-o-web': films and other scent-enhanced online content. Also, the first scent-enabled music CD was released by Dadd's Productions Inc. based in Savannah, USA: artist Zan's album is called *Unleashed* and the 'scent-track' is enabled by ScentDome.

Current stronghold of digital smell technology is in Japan. There, one of the scent interfaces is Kaori Web produced by K Opticom and another one is USB Aroma Geur that can be connected to radio and release scents appropriate for the melody and tone of the music from Tokyo FM station. Similarly NTT Communications (NTT Com) produced Kaori Tsushin: a fragrance communication system that uses a special scent-emitting device, an aromatron, which communicates with the web and releases scent as instructed. This system has been available to the public since 2005, and in 2006 it was used in cinemas in Osaka and Tokyo to achieve a Smell-o-vision effect during screening of *The New*

World with Collin Farrell. NTT Com also tested their technology in scented adverts: apart from visual logo, some adverts were enhanced with a scent sent via Internet and emitted by an aromatron. When businesses used these scented signs they attracted many more customers than just with regular signs. Starting in August 2008 this 'digital scent signage' service is available for rent to busi-

"Scent-emitting device able to transform the digital information into real-life scents."

nesses around Japan to enhance their advertising; it is set to add a whole new dimension to marketing. Apart from advertising it is also used to enhance services offered, for example guests of the Imperial Hotel in Osaka can order a scent to suit their mood: something to relax in the evening or an invigorating smell along with a wake-up call in the morning. NTT Com's newest contraption is Mobile Fragrance Communication: a Kaori Tsushin mobile phone! (See box: "Smellophones").

And this is no new idea either, from the early origins of cinema people toyed with the idea of synchronised smell. In 1906, before sound was introduced to cinema, a family theatre in Forest City, Pennsylvania used scents to accompany their news reel of the

Pasadena Rose Bowl. They dipped cotton wool into rose essence and then used an electric fan to waft the scent towards the audience. Then in 1929 a cinema in Boston added a lilac fragrance to their ventilation system while the opening credits were rolling for Lilac Time and the same year at the premiere of Broadway Melody, a New York cinema released orange blossom fragrances from the ceiling during the screening. But these early experiments did more to distract the audiences than to add to film experience.

“Aroma-Rama was advertised with the slogan: You must breathe it to believe it”

Adding to film experience was also the idea behind ‘feelies,’ cinemas of the future envisaged by Aldous Huxley in his novel Brave New World (1932): alongside 3D vision and sound, these cinemas would offer the physical sensation of touch and movement (the “feely effect”) and “synchronized scent-organ accompaniment”, all of which were intended to enhance the spectator’s immersion into the film by increasing the illusion of reality. “The scent organ was playing a delightfully refreshing Herbal Capriccio – rippling arpeggios of thyme and lavender, of rosemary, basil, myrtle, tarragon; a series of daring modulations through the spice keys into ambergis; and a slow return through sandalwood, camphor, cedar and new-mown hay (with occasional subtle touches of discord – a whiff of kidney pudding, the faintest suspicion of pig’s dung) back to the simple aromatics with which the piece began. The final blast of thyme died away; there was a round of applause; the lights

went up.” This sort of control, diversity and fidelity of scents is still largely in the domain of science-fiction although modern-day scent output devices are slowly beginning to approach this high-tech standard set by Huxley.

In the 1940s a Swiss scientist, Hans Laube, who studied ‘osmics,’ the science of olfaction, developed a machine he called Scentavision. This was eventually picked up by a film producer, Mike Todd Jr, who re-named it Smell-o-Vision and used it for a film called Scent of Mystery (1960). “First they moved (1895). Then they talked (1927)! Now they smell!” went the advertising slogan for Smell-o-Vision. The machine had a central ‘brain’ with a rotating drum which housed the bottles of different scents. This was connected to the film tape which contained markers that would indicate when the scents were to be released. The scents would then travel through a system of plastic pipes until they reached the audience. The scents were released from underneath the seats. A similar contraption known as Aroma-Rama was invented by Charles Weiss: it released scents

“Why would people want to pay lots of money just to be able to smell things coming out of their laptop?”

through the cinema’s ventilation system and was used in 1959 for the film Behind the Great Wall with over 30 scents. Aroma-Rama was advertised with the slogan, “You must breathe it to believe it.”

Neither of these technologies was well accepted by audiences or critics. One *New York Times* film critic said, “if there is anything of a lasting value to be learned from Michael



AromaJet’s vision of Smell-o-vision

Todd’s Scent of a Mystery it is that motion pictures and synthetic smells do not mix.” *Time* magazine similarly slammed Aroma-rama: “most of the production’s 31 odours will probably seem phoney even to an average, uneducated nose. A beautiful old pine grove in Peking, for instance, smells rather like a subway restroom on a disinfectant day.” The main problems were that the scents, once released, would linger about and mix with other scents, causing unpleasant smells, allergic reactions and nausea for some people in the audience. The release of scents was also accompanied by a hissing sound which would distract from the movie, and in the case of Aroma-Rama, the scent took a while to diffuse and would reach some people too late, when the appropriate moment in the movie had already passed. Although media hype predicted scents to be as important as sound in cinema’s evolution, the first public appearance of ‘smellies’ also marked their immediate demise.

Paying homage to Scent-o-Vision, John Waters used Odorama in his 1981 film Polyester, with the ad slogan, “Smelling is believing!” In Odorama, the audience would receive scratch-and-sniff cards as they entered the cinema. The cards had 10 scents covered by 10 numbers and the audience would have to wait until a number would flash on the screen



SCENTDOMIE, © TRISENX

Smellophones

A NNT Com tested Mobile Fragrance Communication in early 2008: “a mobile version of an existing service for enjoying downloaded audiovisual content together with specific fragrances that are emitted by a dedicated device.” This service allows download of scent information on a mobile phone, which then uses infrared link to communicate with a small aromatron that releases ordered scents. Further feature of this system is that it allows a user to set the release of fragrance at their home remotely using their mobile phone, for example on their way home from work.

Meanwhile, back in Europe, the Institute of Sensory Analysis and Marketing Consultancy in Göttingen (ISI) and specialist for interactive services Convisual announced a patent in April 2008 for software that allows sending scent via mobile phones. Using a special scent card and a mobile phone this would allow sending scented text (SMS) and picture (MMS) messages as well as ringtones and games over mobile phones.



© GRAHAM PATERSON

As early as 2010 you could be sending your Valentine a rose-scented “I love you” and your friends a cinnamon scented “Merry Christmas” texts. To avoid stink spam, users will have an option of rejecting suspicious stinky-texts.

Similarly, Motorola has just patented a Smellophone: a mobile hardware that

contains a small fragrance cartridge that would use heat from the battery to release scents. Its competitor on the mobile phone market, Samsung, also recently patented concept of a mobile phone with a perfume-spraying apparatus that could release scents when the mobile phone rings.

to scratch and sniff a scent related to that moment in the movie. The scents included pizza, leather, flowers, a skunk, natural gas and farts. The cards were printed with an emulsion of essential oils containing an aroma-forming chemical. The emulsion contains millions of tiny scent bubbles only microns in diameter. Once the cards are scratched, the bubbles rupture and release volatile scents that then find their way to people's noses. Smell-o-Vision and Odorama have only been used in a handful of films since and perhaps don't hold much promise for future either. But, personalised computer scents sent over the internet - cyber-scents - may soon become as common as online shopping. That is if they don't go the way of Smell-o-Vision.

Digital scents in user interfaces include a

“There are also a couple of hoax websites ridiculing the idea of digital scents”

peripheral device that is connected to a computer and able to release scents based on digital information received by the computer. Just as a printer mixes primary colours, so these scent releasers can mix primary odours, stored as oil-based fragrances in the cartridges inside the device. These cartridges can be replaced as needed. The smells are mixed in a mixing chamber and then fanned out into the room through an olfactory speaker – or ‘reeker’. Humans have around few hundred different odour-receptor proteins on their millions of olfactory cells. By looking at the 3D structure of some of these proteins, the creators

of the DigiScent were able to determine the shape of odours that bind to these receptors, effectively creating a human smell index.

Although the technology is here, scented Internet is still not very popular. The DigiScent company already went out of business in 2001, just two years after they featured on the cover of *Wired* magazine with their digital scent technology. Another similar company, AromaJet, whose one and only press release announced successful transfer of scent over the Internet in 2001, also failed, although their website is still up detailing various possible uses of digital scent technology like a ghost of a good idea. There are also a couple of hoax websites ridiculing the idea of digital scents such as Scenteck.com which released Scratch-and-Sniff Pro, Version 1.0 software on an April the 1st! Why would people want to pay lots of money just to be able to smell things coming out of their laptop? And who would stand unpleasant smells that might form and hang around their room if they indeed bought an ‘aromatron’ such as the ScentDome? There is also potential for exploitation by for-profit businesses: porn websites could send you whiffs of sexy fragrances that would enhance your libido and promote addiction to pornography, supermarkets could tempt you with smells of fresh produce and travel agencies could send you smells of summer beaches or alpine ski resorts to make you buy their products. The subconscious perception of smell may mean that these new advertising tricks become more efficient and sneaky way of getting consumers to buy stuff.

On the positive side, smell could enhance virtual experiences such as computer games and online film, as well as enhance learning. Olfactory icons that are semantically related to the information they convey, such as the smell of rubber

burning when a car brakes in a car racing game, would help make films and games more realistic. Multi-sensory experiences capture the attention of audiences better and olfactory stimulation positively affects learning and memory and

“Wonderful contraptions such as Smell-e-scope depicted in an episode of Futurama cartoon”

so may have a future in education. It could also provide information about computer activity: for example, a smell of chocolate could be released while your file is downloading, while a switch to an orange scent could inform you that your file has been successfully downloaded. These so-called smell icons or ‘smicons’ are smells that only have an abstract relationship with the information they convey. This could be especially useful for visually or hearing impaired people who might find olfaction to be an excellent alternative means of informing them of the system status on their computers. Also, aromatherapy might be available over the Internet, providing antimicrobial scents to disinfect the air or soothing scents to help with some mental states such as mild depression and phobias. It seems noses are set to become more important for our use and enjoyment of internet if products like the ScentDome take off. Perhaps this one day leads to wonderful contraptions such as Smell-e-scope depicted in an episode of Futurama, in which character called Prof. Farnsworth presents his scent-detecting-telescope that can smell distant objects (Jupiter smells like strawberries, Saturn as pine needles, and Uranus as, well...)

Vertical Farms

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Is Dr Despommier's brainchild of high-rise farming just pie in the sky, or a serious solution to the problems surrounding today's modern and intensive agriculture? Olivia Sharp investigates.

TODAY'S AVERAGE farmer on a modern and intensive farm produces a variety of high-yielding crops. But the by-products include a cocktail of greenhouse gas emissions from the many machines running on fossil fuels and from the chemical fertilisers, pesticides and herbicides, also made with fossil fuels. Throw in chemical pollution of waterways, habitat destruction and soil degradation as consequences of intensive agricultural practices and it all adds up to a gloomy and depressing picture of food production. And even more so when you consider that the world's population is set to increase by three billion (3,000,000,000!) by the year 2050, while 80 per cent of land suitable for agriculture is already in use.

So, what is the answer? One possible solution is vertical farming, the brainchild of Dickson Despommier from Columbia University, USA. His idea of an indoor, multi-storey garden that takes a fraction of the ground space of traditional farms seems to be an appealing alternative for inner city food production; high rise growing for high rise living. As well as taking up less space, this way of farming could potentially reduce the environmental impact of an industry that is currently a major contributor to greenhouse emissions, and which has been partly responsible for a reduced global biodiversity. Food grown on the doorstep would be fresh, it would have racked up fewer food miles, and therefore

produced fewer greenhouse gas emissions. This indoor growing would also do away with traditional gas-guzzling machinery and the need for chemical protection from the weather and disease.

As some critics of the scheme have pointed out, however, apart from the energy needed to build the farms, they will also need huge amounts of energy and light to run all the processes needed in such a complex and large system.

“With waste in and food out, a vertical farm would be like a perpetual-motion machine that feeds a lot of people.”

To ensure that these needs are met in a way that is as sustainable as possible, the buildings will have an integrated system of sustainable technology using renewable energy sources such as solar power and wind energy. To supply the vast quantities of water needed the farms could make use of waste water from the cities and recycle it to irrigate the crops; a neat idea that at the same time reduces the problem and cost of dealing with urban waste water. There may even be ways of reprocessing this water to produce drinking water. “With waste in and food out, a vertical farm would be like



a perpetual-motion machine that feeds a lot of people.” said Despommier.

Indoor farming is not a new phenomenon, indeed acres of land across the world are under glasshouses and polytunnels, and the technology is continually developing. Plants are already being grown in solutions of water and nutrients (hydroponics) or even in mists of water and nutrients (aeroponics), removing the need for soils and reducing reliance on the natural elements.

The obvious difference and advantage, however, of vertical farming is the space that it would occupy. According to research into humans living in space, an estimated 300 sq feet of intensively farmed land is needed to produce enough food to support one person. The vertical farmers have worked out that just one of their projects, the size of a 30-storey New York City block, would produce enough food to support 10,000 people. Moving agriculture to these skyscraper sites would free up exhausted agricultural land, allowing it to regenerate and provide breathing space for people and wildlife.

Another, maybe more pressing, use of the farms could be in countries and situations where climate or conflicts have resulted in food shortages. Vertical farming could be developed in such places so that communities could work together to produce crops all year round and to be independent and self sufficient.

“Your broccoli will come from the third floor of your local skyscraper-farm, located just below your flat!”



Clearly there are great reasons to go vertical when it comes to farming, but this is a project that is still just ‘ideas on paper’ and there will be the inevitable obstacles along the way. Taking the farm into cities and into an indoor environment creates a host of complications with innovative building structures, irrigation systems, controlled indoor flow of air and nutrients, energy supplies and water treatment apparatus. The development and building of the project will be expensive, and the farms would have to be highly efficient to be an economically viable rival to conventional farming. Indoor farming also goes against the concepts of organic farming that are in tune with the complex but beneficial interactions and interdependence between crops, soil and the natural environment.

Despite the difficulties and the differences in approach, vertical farms have caught the interest of large developers, including multi-national firm Arup, who are looking to take the idea to the next level. City governments have contacted Despommier and his team, and there are talks to turn the farms into a reality for entire eco-cities.

Who knows, maybe in the foreseeable



future your broccoli will come from level three of your local multi-storey farm. Just below your flat.

Images courtesy of verticalfarm.com



From lab to market

Michelle Cotterill explains the commercialisation of research at Imperial.

IN THE 1990s UK universities began to appreciate the benefits of translating research into commercial success and the commercialisation of research shifted higher on their agenda. In parallel, the government's policy towards commercialisation changed from viewing universities as principally research and teaching institutions to encouraging the application of their research for the social, economical and environmental benefit of the country. In 2007 the Department for Innovation, Universities and Skills was created, reflecting how important innovation is to the UK.

Imperial College has an innovative approach and an entrepreneurial culture. It was an early champion in the commercialisation of research. Imperial recognised the immense benefits that commercialisation offers to wider society and the advantages for inventors and the university, through income generation and improved relations with industry to aid further research.

Imperial Innovations, the College's technology transfer office, was one of the first such operation in a European university. It was established in 1986 to make the most of commercial opportunities at Imperial and to transfer ideas and inventions into valuable products, therapies and processes. As opportunities flowed from the College's labs and commercialisation activity grew, Imperial Innovations was transformed from a university department to a separate company. In July 2006 it became a publicly quoted company, listed on

the AIM Stock Exchange.

Today, the College is the main shareholder of Imperial Innovations and the company's role remains close to the research activities of Imperial. Imperial Innovations has an established process, to support the commercialisation of research at the College, which has several key stages:

1. Intellectual Property Assessment

Once an idea or invention has been disclosed to Imperial Innovations its technology transfer experts will make an initial assessment of the commercial potential.

2. Intellectual Property Strategy

If it does have commercial potential then the first steps will be made to define and protect the Intellectual Property (IP).

3. Product Validation

Products and markets that can be developed from the IP are identified. It may also be necessary to develop a proof of concept strategy to demonstrate the performance and commercial potential of a technology to industry.

There are two routes to take a product to market: by licensing it to an existing company or forming a spin-out – a company created specifically to develop and market an invention. Imperial Innovations experts can identify which route is most appropriate. Commercialisation through licensing to a commercial partner is often best suited to products with a single application and market. In comparison, a technology with a wide range of applications is usually best managed through forming a spin-out company.

4. Licensing

If licensing is the preferred option, further research will be carried out to find the right licensing partner to give a greater chance of getting the product to market. The most appropriate terms and conditions of an agreement will be negotiated with the licensee.

5. Spin-out company formation and investment

Forming a spin-out company may be preferable to a licence. Imperial Innovations will support early stage company development by raising seed-funding, recruiting experienced managers, directors and investors, and incubating the company to increase survival and financial security. It also manages a dedicated incubation facility, the Imperial Incubator, located in the basement of the Bessemer Building, which provides space and assistance for early stage businesses.

Becoming a public company has enabled Imperial Innovations to raise funds to invest in new businesses from Imperial College, leading or co-investing in investment rounds to accelerate development and increase value. The money invested will typically be used for continued product development, scaling up manufacturing, clinical trials or certification, sales and marketing and recruiting employees.

Over 90 spin-out companies have been formed from Imperial and hundreds of wide-ranging technologies have been licensed to industry, in the last year alone 40 license agreements were signed.

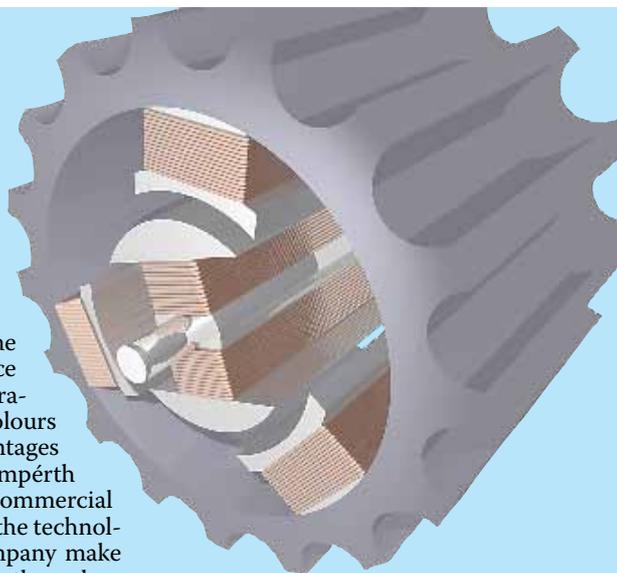
Green Technology

Dr Michael Lampérth formed spin-out company EVO Electric to commercialise pioneering electrical motors and generators based on his research in the Department of Mechanical Engineering. He says that setting up the company provided an opportunity to see something from the lab become a real product. The technology is being commercialised to provide high performance, cost effective and environmentally friendly machines for use in hybrid electric buses and taxis and other specialised vehicles.

His company used both office and lab space within the Imperial Incubator, which helped them to get off the ground. Dr Lampérth says it was helpful, in the early stages of company development, to be

near other new business. "I would advise all aspiring inventors to talk to other entrepreneurs," he explains.

With now bigger premises off-site for heavy duty engineering, in June 2008 the Ricardo Group performance tested a prototype motor/generator, which passed with flying colours and showed competitive advantages over current technology. Dr Lampérth has recruited an experienced commercial team so he can concentrate on the technology. He is keen to see the company make a real impact in contributing to the reduction of greenhouse gas emissions.



Easier and clearer tourniquet

Former Imperial medical students, Dr Christian Fellowes and Dr Ryan Kerstein, developed a disposable tourniquet which could help reduce the spread of hospital acquired infections such as MRSA.

Tourniquets are wrapped around a limb and tightened to make veins become more prominent, and are an essential tool for medical staff when taking blood or inserting a drip.

Dr Fellowes explains that their clinical observations at Imperial stimulated this entrepreneurial idea. "We saw medical staff using reusable tourniquets which could transfer infective organisms from patient to patient," he says.

"Disposable rubber gloves were also used as tourniquets but this seemed unprofessional and uncomfortable," he continues.

"We wanted to design a device which could minimise infections and would provide a practical and cost-effective alternative to current methods."

They came up with the Tournistrip, made of plasticised paper with a quick seal and release mechanism. "Professor Lord Ara Darzi suggested we approach Imperial Innovations with our idea," Dr Fellowes says. "They liked it and helped us to develop it. We were able to produce prototype products which were tested on patients in two major hospitals. The trials offered an insight on usability from a patient's perspective and proved that the concept could work."

Spin-out company Asep Healthcare was set up with a commercial management team to take the Tournistrip™ fur-

ther. Dr Fellowes is hopeful that within a few months it will be used routinely in hospitals.

He says he enjoyed the challenge of developing the device but that it was hard work. "It's true that invention is five percent inspiration and 95 percent perspiration," he explains. "For a product to be successful you have to believe in it and refuse to give up."



Professor Timothy Williams, from the National Heart and Lung Institute (NHLI), was involved in a discovery which was ground-breaking in the field of asthma and allergy.

Professor Williams and NHLI colleagues identified a new protein, which they called Eotaxin, that was found in the lungs of asthmatic patients in high levels. They also

New drug development

recognised that these levels were linked with the severity of lung dysfunction.

Patents covering Eotaxin and antibodies to it were filed worldwide by Imperial Innovations and they were first licensed for the development of Eotaxin antagonists to LeukoSite Inc. Eotaxin is now widely used experimentally and diagnostically and several more licences have been granted, generating a steady royalty stream for the College and the inventors. A therapeutic antibody is currently undergoing clinical trials for allergic conditions.

Professor Williams says that it was exciting to see a basic research discovery grow into a major drug development programme. He believes that research teams such as his should concentrate on basic re-

search with clear scientific aims. However he says, "Researchers should always be alert to new opportunities to develop and protect intellectual property."

The Eotaxin discovery encouraged the recruitment of an exceptional team of scientists Professor Williams explains, adding, "Exciting new research areas are being explored, for example, tissue remodelling and stem cell trafficking, which have resulted in possibilities for novel therapy in a range of diseases."

Eotaxin is now the subject of well over 2000 scientific publications. It is also implicated in diseases other than asthma, most recently in atherosclerosis, although its precise role in blood vessel disease is yet to be established.

New cement absorbs carbon



Researchers from the Department of Civil and Environmental Engineering have formed a spin-out company, Novacem. It is based on research completed by Dr Nikolaos Vlasopoulos during his PhD. Novacem aims to develop new types of cement that have a negative carbon footprint.

The production of Portland cement is estimated to contribute around five percent of global CO₂ emissions. In comparison, Novacem cement is manufactured through a process that causes minimal CO₂ emissions and uses low temperature processing. The Novacem product also absorbs CO₂ from the atmosphere as it sets and hardens.

The research offers major environmental benefits and there is currently significant interest from the construction sector, which is under increasing pressure to improve its record on sustainable development.



Creationist Britain?

Felix Whitton calls for rationality amidst the climate of faith-based segregation and dubious pseudo-religious campaigns.

LAST MONTH, amid all the talk of doom, gloom and bust in the financial markets, a story from what seems a more innocent time made headlines across the British media. The Rev Professor Michael Reiss, the Royal Society's director of education and an ordained Anglican minister, was forced to resign from his post after appearing to support at least some discussion of creationism in school science classes. Creationism is the belief that the Earth was created by God in six days and is around 10,000 years old.

This came in the same week as news that the Church of England was apologising to Charles Darwin for "misunderstanding" his 150-year old theory of evolution, while elsewhere scientists at Southampton University were beginning experiments in cardiac rooms to find out whether near death experiences are a "glimpse of an afterlife", and the Government pushed ahead with plans to open more than a dozen state-funded faith schools.

One might be forgiven for thanking the present economic turmoil for bringing us, as it were, back to earth. However, the reaction from sections of the press and scientific establishment to Prof Reiss's comments tells us a lot about the kind of society we live in, compared to the one we think we inhabit. What he was suggesting, in a speech at the British Association Festival of Science in Liverpool, is not revolutionary or controversial; simply that if a student brings up creationism in a biology lesson, the teacher should be intellectually equipped to discuss its failings as a scientific theory without demeaning the student and his or her beliefs.

What should have raised eyebrows was Prof Reiss's defeatist attitude towards teaching evolution: "the most a science teacher can normally hope to achieve is to ensure that students with creationist beliefs understand the scientific position"; and his assertion that to discuss

something in a science lesson you should be prepared to "defend [your] thinking in a way that admit[s] objective evidence and logical argument", which seems to contradict his entire premise of discussing creationism as a "world-view", not an evidence-backed theory.

What instead brought Reiss down was not his woolly thinking, but what Richard Dawkins called "a little too close to a witch-hunt for my squeamish taste." Various members of the Royal Society appeared to jump at the chance to campaign for Reiss's resignation. Among them were two Nobel Prize winners, Sir Harry Kroto and Sir Richard Roberts, who organised a petition to be sent to the Society. Roberts was quoted as saying: "I think it is outrageous that this man is suggesting creationism should be discussed in a science classroom." Dawkins, himself a distinguished member of the Society, has been seen discussing creationism with students in a recent television programme about Darwin.

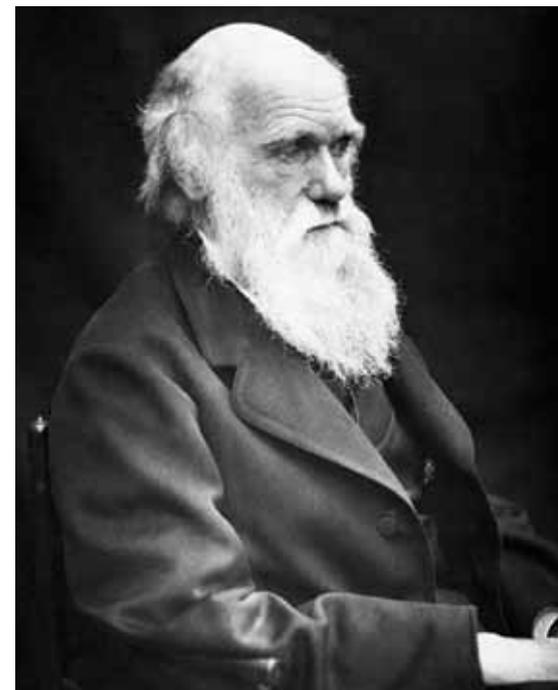
Some in the scientific community appeared worried by the reaction. Imperial's Professor of Science and Society Robert Winston said: "I fear that in this action the Royal Society may have only diminished itself", and called on outspoken writers such as Christopher Hitchens and Daniel Dennett to stop being "irresponsible" and take a more sophisticated approach to the dialogue between science and religion.

While moderates such as Lord Winston call for the Darwinian attack dogs to be restrained, the rest of us are left wondering whether this is another media-inspired storm in a teacup or whether, outside our own enlightened existence, the twin tendrils of creationism and its pseudo-scientific offshoot Intelligent Design (ID) are gradually worming their way into hitherto undreamed of areas of public life, from state-sponsored 'faith schools' to museums and university research departments.

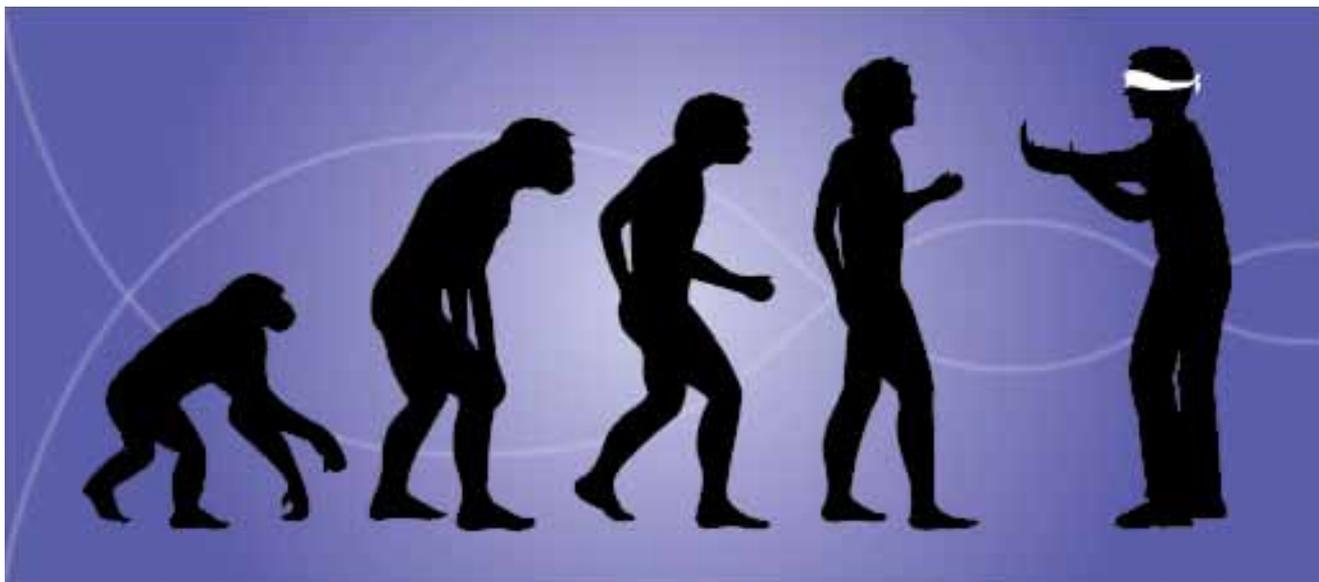
Privately, many people profess to anti-Darwinian beliefs. In a 2006 poll

for BBC's Horizon, 39% of people said that creationism or ID – the belief that a 'designer' played some part in evolution – best described their views, compared to 48% for evolution. It is unknown how many of this significant minority take a literal interpretation of the Genesis story (so-called "Young Earth" creationism), but Keith Porteous Wood of the National Secular Society believes the numbers are rising: "There is no question that creationism is growing. It is increasingly well funded and well organised."

This trend is mirrored in the US, where a 2001 Gallup poll found that 45% of Americans believe "God created human beings pretty much in their present form at one time within the last 10,000 years or so", while 37% chose ID. The proportion of adults who accept evolution declined from 45% to 40% between 1985 and 2005 according to Science magazine, with some polls putting the figure as low as 14%.



Charles Darwin



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Two-fifths of people in the UK reject evolution

In this context of evolution-rejection – two-fifths of people in the UK and over 85% in the US – the debate about school science lessons seems utterly crucial. Recent research by Pam Hanley, of Southampton University, found that a third of science teachers believe in some form of ID, with only 50% saying no divine being was involved in ‘creation’. With only 66 teachers interviewed, it is difficult to draw solid conclusions from her research, but there does appear to be more intense polarisation than many people had thought. Last year, Anglia Ruskin and Brunel universities found that around half of British science teachers had been challenged on evolution by a student. Whatever the curriculum says, if a teacher has their own private doubts about evolution they are less likely to persuade a sceptical pupil of its merits.

Schools may be the new battleground of evolutionary debate, and at the forefront are New Labour’s ‘city academies’: failing state schools that are taken over, re-branded and overhauled – and partly funded – by businessmen with previous track records of turning round failing companies. Putting aside the issue of how stripping a company of its assets and staff and selling it for a profit qualifies one for the job of running a school, many academies have a definite whiff of controversy about them.

For a start, the private contribution is minimal (£2 million), with the rest – usually over £20 million initially for new buildings and staff, with a further £5 million a year for upkeep – being paid by the taxpayer. Then there is the issue of how academies are run. The new sponsor is given carte blanche to micro-manage the school, which includes power to appoint the majority of the board of governors, controlling what aspects of the National Curriculum are taught, and even influencing which pupils are expelled and selected (which goes against the state school system’s code of conduct). On top of this, there have been attempts to cover

up, or simply ignore protests from parents at new academies in the planning stage.

Most fishy of all is the fear that sponsors are using the scheme to foist their own beliefs and prejudices onto children. Notoriously, Sir Peter Vardy (labelled a “Christian fundamentalist car dealer” by the Times Educational Supplement) has been accused of allowing the teaching of creationism in his three Emmanuel academies in the North-East of England. Two of his closest allies at Emmanuel, academic advisor John Burn and director of schools Nigel McQuoid, are active and influential British creationists and advocate, among other things, the return of school beatings (“if properly regulated and administered”), the punishment of homosexuality (as being “against God’s design”), and the teaching of evolution and creationism side-by-side as “faith positions.”

“A third of science teachers believe in some form of intelligent design”

Although the Emmanuel academies have passed their Ofsted (Office for Standards in Education) inspections with flying colours, and have given at least 10% of places to children with special needs, there are still suspicions among scientists, parents and former pupils that the trio are pushing a regressive agenda based around a “Christian moral framework”, with the support of major political figures (Tony Blair, who recently converted to Catholicism, said he was “very happy” with the schools’ science teaching and personally opened King’s Academy in Middlesbrough). It has been alleged that the same Ofsted inspector was sent to all three schools, and that the visits were timed so as not to coincide with science lessons where evolution (and any alternatives) were being taught.

The Labour government appears to be more firmly behind academies than ever, with another 47 opening in September, a third of which were faith schools. Despite having full support from the three main political parties, there is mounting opposition to academies, especially those with a religious element. A 2005 Guardian/ICM poll found that 64% of the British public opposed government funding of faith schools. Teaching unions, parent groups and independent organisations such as the Accord coalition have highlighted the social problems caused by selecting on the basis of faith – one need look no further than the example of sectarian Northern Ireland.

A recent report commissioned by the government revealed serious breaches of the admissions code by faith schools. On top of this, nearly a quarter are performing worse than before their takeovers. In January, the Commons Select Committee on Children, Schools and Families gave their verdict on faith schools: “We fear divisions in society will be exacerbated...it is hard to see why our taxes should be used to fund schools which discriminate against the majority of children and potential staff because they are not of the same faith.”

Taken in isolation, the furor surrounding Michael Reiss’ comments might seem innocuous enough. Taken against the backdrop of the increasing organisation of the ID movement (including the opening of a creationism ‘museum’ in Portsmouth); the rise of the religious right (for example the Templeton foundation, an American evangelical Christian organisation that simultaneously funds research in British universities and donates money to the Republican party); the disturbing trend towards religious segregation in our schools; and what US economist Jeffrey Sachs calls the “anti-intellectual threat”, and we have an explosive cocktail of reasons for why those on the side of rationality have cause to sit a little less comfortably.



Blog post title: A wevolution in science
Category: Science/Technology
Posted on 07/11/2008, by: Mico Tatalovic

Mico Tatalovic examines the recent rise of science 2.0 and digitalization of scientific research.

If Darwin were alive today he would probably be online, blogging about his evolutionary ideas. Back in the 1800s, he would mull over his theories for years before deciding to allow them to go public, pub-

first ever science blogging conference in January 2007. "It all started as a wish for a bunch of science bloggers to finally meet offline and have a beer!" remembers Zivkovic.

science blogging to those in the audience who were new to the science blogosphere." Both conference and the anthology proved popular and so Zivkovic organised the second conference in January 2008 followed by another anthology of science blogs, best from 2007. The book of blogs does not do them justice though. Online, blogs are alive with images, videos, podcasts, readers' comments... In a book they show that some of these bloggers are great science writers but for a full blog experience you really have to go online.

Some of the best blogs of 2007 included blogs from Nature Network (NN). NN is a social, online network that allows scientists to discuss various issues, engage in discussion forums, attend virtual lectures by real people and write blogs. "We want

"Science 2.0 is already here. Some think it is here to stay."

lishing his theory of natural selection in a book. Since then scientific books and journals have been reigning over the world of science publishing and communication between scientists and the people. Now, science is entering a new age. The online age. Science 2.0 is already here. Some think it is here to stay.

'Blog' was picked as the word of the year in 2004 by the US dictionary publisher Merriam-Webster. 'Weblog' or 'blog' for short is "a Web site that contains an online personal journal with reflections, comments and often hyperlinks". Scientists didn't wait long to join the blogging community. Bora Zivkovic was still doing his PhD in biology at the University of North Carolina, USA, when he organised the

When he and his fellow bloggers thought about it a bit more they decided to bring together science bloggers and practicing scientists, as well as science journalists and teachers to discuss, for the first time, how blogs are changing science communication and teaching. "We designed the anthology

of science blogs, The Open Laboratory: The Best Writing on Science Blogs 2006, to go along with the conference in an effort to showcase the quality and diversity of

"Methods of research are changing drastically... practically and conceptually"

to speed up the communication of ideas" says Matt Brown, NN online editor for London, UK. "Although NN was set up as a resource for scientists, the blogs are

usually written for general audience. As a happy side-effect, by giving scientists a tool where they can talk freely with other scientists - all over the world and in every field - it hones their communication skills and helps them develop ways of discussing their subject

matter with the wider community.” The beauty of places such as NN is that they connect scientists and people from around the world that would otherwise not meet. The future is bright for online science networking sites, according to Matt Brown: he sees NN becoming “a portal for the public, showcasing all events, articles and media from various sources that might be of interest.”

In January 2007, Dr Kat Austen, a researcher at the University of Cambridge attended a conference on her field of research, environmental pollution. At the conference, her colleagues and she became frustrated with the lack of communication that often resulted in silly confusions, for example, different scientists giving the same phenomena different names. She realised that what they needed was a secure online environment to collaborate and exchange ideas in real time. SciSpace was born. According to Dr Austen, websites such as SciSpace are already changing the way the science is practised. “Throughout



SPORE™ SCREENSHOT

all over the Web. “The emergence of the idea of online peer-review, as is used in Wikipedia, means that our methods of research, collaboration, and publication are changing drastically, both practically and conceptually.” Dr Austen set up SciSpace with scientists and their research in mind. But there is still plenty of public content,

and discuss science in the public sphere is changing dramatically. Science blogging in large online communities such as the science blogs on Seed magazine’s website are effectively translating ‘scientese’ into more approachable language, which the general public can easily understand and relate to. Science blogs, online forums and virtual reality sites allow for democratization of science, allowing scientists to engage directly with the people, sort of like an ongoing, never-ending science festival. Whereas only 100 years ago in Darwin’s time science was still for the privileged few that could read and afford books, today it is becoming accessible to anyone with an Internet connection.

“Science blogs, online forums and virtual reality sites democratise science”

SciSpace people are using the technology to collaborate and produce publications, to analyse results and to forge new collaborative links. Some of our users form international collaborations, using SciSpace as a one-stop-shop to keep up-to-date with each other’s progress.”

And this is just the beginning. Virtual scientific communities are popping up

such as blogs that might interest non scientists. For more educational content one might log into the online virtual reality site called Second Life, a multi-user community with lots of science content to play with.

What everyone directly involved with this field seems to agree on is that how we pursue science and how we communicate

Comments

#1

An article in Scientific American about this topic whose draft version went online

SCILANDS AT SECOND LIFE™ SCREENSHOTS



Science in Virtual Reality

first and received comments from readers, many of whom were active scientists. The actual published article "Science 2.0" then contained some of the comments left on the website by the readers. Many of these comments were concerned with privacy and primacy issues: if scientists make their ideas and preliminary results available on-line how can they ever be sure someone else isn't going to steal them?

Posted by: Anonymous, November 9, 2008 3:56 PM

#2

I blog occasionally, but with scientists already have so little time to spare, taking extra time to write blogs seems impossible for most of my colleagues!

Posted by: SciResearcher November 9th, 2008 4:12 PM

#3

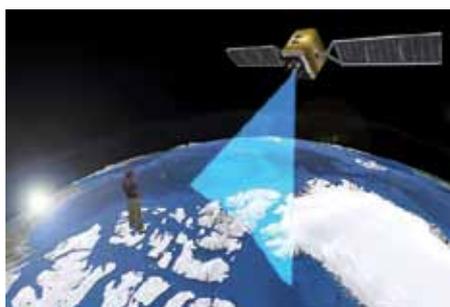
Here's a link to a similar article: Science in Virtual Reality [See Box]

Posted by: Futurist, November 10th, 2008 10:10 pm

#4

Here are some photos I found on Flickr from the SciLands in Second Life.

Posted by: Anonymous, November 10th 10:55



SPORE™ SCREENSHOTS

In current online cyberworlds practically anything is possible. Time travel to 1962: the birth of first virtual reality machine. In the days when TV began to draw audiences away from the cinema, Morton Heiling, a young cinematographer inspired by innovative cinema concepts such as 3D Cinerama (one of the first 3D cinema concepts, that had three screens for surround vision effect), invented the first ever virtual reality machine: he called it Sensorama. Sensorama was fully mechanical, with moving seats, 3D film, wind and scent sensations all working to enhance the virtual experience of the viewer. Heiling's vision was that "the cinema of the future will become the first art form to reveal the new scientific world to man in the full sensual vividness and dynamic vitality of his consciousness."

Teleport to 2050. Virtual reality's representations of people, so called avatars, now have rights equal to those of humans. As electronic clones of people, they are able to learn from the actions and experiences of their human counterparts. They allow people to be in more than one place at a time and work as spokespeople for their human originals. This is the vision of the future that was recently awarded first prize in the New Scientist and Microsoft's writing competition, which suggested that it is virtual technology that will have "the biggest impact on our working lives 50 years from now". Similar ethical issues raised by genetic technology and cloning 10-15 years ago are now being raised by the advance of virtual reality and artificial intelligence.

Back to 2008. Some of the leading popular science magazines write about the phenomenon of online, multiuser, virtual worlds. The French magazine Science et Vie calls one such world, Second Life, "the ultra-real world which offers an excellent test tube to study society", whilst BBC Focus Magazine calls it "the 21st century's laboratory". Several other interactive science and technology games and online communities exist and some people claim that millions of people are spending increasing amounts of time online, living virtual lives. Dr Edward Castronova, an associate professor of telecommunications at Indiana University even wrote a book about the dangers and delights of moving to virtual reality, the Exodus to the Virtual World (2007).

Virtual worlds have the ability to help scientific endeavour. The interactions of real people in these worlds (through the intermediary of their avatars) allow scientists to study human behaviour without intruding or communicating directly with the people they study. So for example it is possible to study behaviour and the efficacy of intervention programmes in the case of an outbreak of health hazards such as deadly viruses without endangering anyone in real life. Also, simulations of real-life situations such as building cities, military fighting in an unknown territory, and social interactions for autistic people all enable better preparation for the real world, through fail-safe practice in the virtual world where nobody gets hurt. Increasingly, these virtual worlds are used in science education as well, since concepts and ideas that may sound boring and that cannot be seen in the real world may be made more interesting by visualizing and playing with them virtually.

Some virtual worlds such as Second Life allow users to interact with each other, and so, for example, teenagers may talk to doctors in an online clinic about their sexual health, bypassing the potential embarrassment they would experience in such a situation in the real world. People from around the world meet online to listen to Cambridge's science radio programme The Naked Scientist and discuss it in real time. Many visit online exhibits set up by renowned science museums and institutions such as Exploratorium and NASA: these exhibits allow for the creation of experiences and exhibits that would be impossible in real life such as a journey through a testis or a human cell, or walking on crater on Mars.

So although Sensorama came short in "revealing the new scientific world to man in the full sensual vividness and dynamic vitality of his consciousness" Second Life and the likes of it are coming seriously close in doing this.

Post a comment:

Preview

Save

Post

CR€DIT CRUNCHED \$CIENCE?

UMAR CHAUNDRY EXAMINES SCIENCE FUNDING DURING ECONOMIC CRISIS.



© RIRA KIM

\$WITCHING THE television on at 11 o'clock on a Thursday evening, I find myself watching a heated discussion between various political parties. It's not about knife-crime, it's not about the war in Iraq, but for the past few weeks Questiontime has been dedicating much of its time to the nation's new number one fear – 'the credit crunch'. Whether it's share prices tumbling, investment companies on the brink of bankruptcy or governments making unprecedented interventions, the financial crisis has got the nation gripped. So, while I was watching last Thursday and as my thoughts turned to the prospect of next morning's lectures, it dawned on me – what will happen to the wonderful world of science in these times of economic meltdown?

The answer is not a simple one. Google "credit crunch science" and one of the first articles you find is by The Daily Mail, which just says that it is "devastating" and "extremely worrying". The Times, however, predicts a significant impact, especially in healthcare. A recent report demonstrates that the charge per prescription, currently £7.10, means that GPs might be forced to make difficult and potentially dangerous decisions for patients who have asked them to cut down the number of medicines they are prescribed. One article in The Guardian also describes how the credit crunch may affect universities: a reduction of as much as £2.6bn to universities in research practice. Although there is no evidence as yet that this will affect funding for scientific research in particular. Nonetheless, if the current economic climate continues, the impact on science might well be very, very worrying.

"The financial crisis has got the nation gripped."

As our disposable incomes fall, many of us will spend more time and effort making sure next month's bills are accounted for. The same goes for companies as they draw up next year's budgets. For example, rising interest rates mean loan repayments are greater: increasing companies' costs. This affects all firms – from house builders to charities. Indeed, The Charities Aid Foundation warns that 88% of bosses believe their charity's income will fall over the next year, one of them being Cancer Research. Other areas of science expect losses as well: healthcare and innovative scientific techniques will be lower down in the government's budget priorities. Pharmaceutical companies are likely to face another turbulent year of patent expiries, slowing sales growth and lower approvals. For example, GSK is worried that they may have lower than predicted sales of its potentially successful anti-diabetic drug, Avandia. It is possible that it might be taken off the NHS

"...the current trend of increased environmentally friendly activities will stop..."

prescription list, which would be a huge blow to the 2 million diabetics living in the UK – who might no longer be able to afford the drug.

Another worry is that the current trend of increased environmentally friendly activities will stop. Individuals, companies, governments will focus more of their energy into keeping costs at an absolute minimum. Hence, still pricier green technology is likely to receive less funding, even though the potential benefits may yet outweigh the costs in the long run. However, it may be a blessing in disguise; if more effort is concentrated on minimising costs, this could lead to an improvement to our environment. For instance, consuming less gas and electricity, reducing the use of cars and wasting less paper all reduce our costs as well as our environmental impact.

"So what does the future hold for science during these turbulent times?"

These are just some of the problems that might be encountered. Key areas of science, which in the long run might prove to be beneficial, should be given priority funding. From a medical perspective, money needs to continue to flow into research so that better management of care can be established. In engineering support should be given to research that improves the efficiency of machines (to make them cleaner) and increases our renewable energy sources. The great importance of these issues needs to be recognised by leaders in order to ensure that funding remains as constant as possible.

So what does the future hold for science, especially during these turbulent times? To be quite honest, it is impossible to predict. The importance of science needs to continue to be appreciated and funding needs to continue. The state of affairs of tomorrow's economy cannot be predicted, and neither can the state of affairs of the healthcare system in a year's time. All we can do is hope. As I watch the politicians on Questiontime ramble on about the economy, I think about tomorrow, and how tomorrow's lecture will just never quite be the same.

A SCIENTIST'S DREAM COMES TRUE?



WELLCOME IMAGES

Jessica Bland crosses the science-art divide to examine how the other half lives.

THIS YEAR I became an arts student and I can't wait. No more 9 o'clock lectures, Labs or copying up the answers to questions I've never read, twenty minutes before a deadline. Just a list of books to read, six essay deadlines and much, much, more time spent in the pub.

But, with only one of the six done, it all starts to fall apart. I woke up at half eleven on a Wednesday morning; there is a half finished Gin& Tonic by my bed, a pile of books and notes on my desk and a deadline in six hours time. Oh dear. You see, if it were a physics deadline, as it would have been up to last year, I could rush to the room of my friend, physics super-brain, beg for their work, copy it and be done in about 2-3 hrs – the time it takes the practised amongst us to copy out the answers to an average-length problem sheet. But instead I have an essay. That means I have to come up with an original way of putting together 1800 words; I have to express an opinion; and, worst of all, I have to argue for that opinion in some coherent fashion. And if I don't, I have to sit face to face with my tutor tomorrow with nothing to say. Or feign a defence of some hangover, incoherent wafflings. See, there is no fallback for the arts student. No way out of the deadline problem.

Even the lie-ins start to feel less like a perk of my new lifestyle. Scrabbling around the kitchen for a suitable vessel for my first caffeine hit of the day, my housemate arrives back from her biology lecture looking fresh faced and smug. She has this particular expression on her face that I recognise from my previous scientist-life; I can just tell that she has been to two lectures already, using the hour in-between to go to the library. She even remembered to pick up the pint of milk she is now handing me. I, on the other hand, haven't even checked my Facebook yet.

Now, I may be the worst kind of scientist: the one who copies work and falls asleep in lectures. Perhaps I am also the worst kind of arts student; drinking heavily the night before an essay is due

might not be a generally accepted practice. So perhaps I am comparing two specific versions of student lifestyle, neither of which can really be said to be typical. And so I am not really comparing arts with science – it's more like comparing arts-me with science-me, me with bizzaro-me.

Nonetheless, there are some interesting basic differences. As a scientist I have seemed ever so eager, running out the door before nine o'clock everyday. But I was just doing what was prescribed

"I have the luxury of spending 40 minutes over my cappuccino..."

by my course. Indeed, the physics handbook uses bold, italic and underline to remind us how "compulsory" lectures were. Without the lectures, I have slept in till hours far beyond what is really acceptable. But, at the same time, I can now often be found in the library an hour or two beyond any decent person's bedtime. I am not a different person. I am still just as lazy and disorganised, and the pressures of work are still just as apparent. They just manifest themselves in different ways.

As a scientist I had a more structured life; I couldn't choose my coffee breaks, they were chosen for me. And there has certainly been something wonderful about my first few weeks of away from that. I have the luxury of being able to spend forty minutes over a cappuccino if I really want. But, I also have to face the dread of perpetual essay deadlines and the unexpected guilt of a less efficient lifestyle. Even in my first few weeks, the sheen has already come off the surface of the arts-student fantasy. Not least that, no matter hard I try, I cannot find nearly as much time, or funding, as my physicist PhD friends manage to spend in the pub.

Genetic cure for cystic fibrosis? Sacheen Nathwani reports.

CYSTIC FIBROSIS is a serious genetic disease. Currently, there are around 8000 sufferers in the UK alone, with a life expectancy of only 31 years. The production of a thick, sticky mucous can increase the risks of dangerous lung infections and interferes with normal digestion. The condition can lead to further complications, such as liver disease and infertility. Due to the life-threatening nature of cystic fibrosis (CF), adequate treatment is essential.

CF is caused by a mutation in the CFTR gene (which is involved in the transport of chloride ions). This mutation can be passed through family generations, although the disease will only present itself when an individual has two copies of the mutant gene (from the mother and father).

Presently, CF patients are treated with a range of available methods. These include a drug that thins the mucous, another that allows the airways to open up, and antibiotics to treat any infections. Friends and relatives of the patient can help trigger coughs to loosen up the mucous by patting them on the back in certain positions. Lung transplants may also be necessary once irreparable damage has been made.

Exciting new progress in DNA sequencing technology is creating hope for new therapies with a more direct approach.

DNA sequencing can be used to read DNA. This technique can be used to identify mutations in the DNA. One such mutation, which causes 10% of CF cases, is known as a 'nonsense mutation' because it stops production of proteins (in this case, the CFTR protein). In this way, patients with this genetic defect can be identified.

With this in mind, scientists at PTC Therapeutics have been working on a new drug that will work to target this nonsense mutation, allowing normal protein production. The drug, known as 'PTC124', could potentially treat a host of other diseases caused by similar genetic defects, including haemophilia and some forms of cancer.

Clinical trials in CF patients with the nonsense mutation were underway in 2006. PTC Therapeutics reported positive outcomes of the trials, although the figures were small, and symptoms were not formally assessed. It should also be noted that these were only phase 2 trials; there is still a way to go before approval. Long term trials must be carried out on larger groups of patients.

Nevertheless, exciting doors have been opened that could lead to a new generation of treatments targeting genetic diseases such as CF at their very core - our own DNA.

Saving the planet with science

Jacob Aron visits the year 2050 to find out how humanity will survive.

The Science of Survival at the Science Museum

CLIMATE CHANGE is arguably the biggest issue facing scientists today. How are we going to cut back on emissions, whilst still providing enough energy for all of our needs? Should we use solar, wind or nuclear generation to power our homes? How might climate change effect the food and water that we consume?

All of these questions and more were examined in The Science of Survival exhibition at the Science Museum, which closed earlier this month. Aimed at children aged between 8 and 12 years old (but easily enjoyable for all ages), the exhibition allowed visitors to make difficult choices about the planet's prospects and see the results play out in the year 2050.

Thanks to an innovative new system, each visitor's experience was recorded and added as a neighbourhood in Future City. Before entering The Science of Survival I was handed a plastic card, and instructed to use it on the various pads dotted around the display. It's very reminiscent of the London transport Oyster card, and just as easy to use.

I stepped into the darkened room ahead of me, where I was introduced to Buz, Eco, Tek and Dug. These four cute characters were sending a message from the future – it was up to me as a citizen of 2008 to change their world. The video was obviously designed for children, but engaging nonetheless.

Going into the exhibit proper, you are presented with a number of different installations each set around a particular topic – be

it food, transport, or a number of others. Each has a display with objects and information, a video to watch, and a game to play.

Here's where the card system comes into use. By placing your card on the reader attached to each game, your results can be used to build Future City. Do well in the game, and a bonus item will show up in your neighbourhood.

The games are simple, but fun. One tasks you with getting enough water, which you do by tapping a button to catch droplets as they fall from a pipe. The rhythm of the drops is actually synced with the music being played around you, which left me in a relaxed and almost trance-like state. Enjoyable, but was I learning anything? Even with some dialogue from my four futuristic friends, the experience felt a little shallow.

In another game, I had to drive around a 3D world to pick up my friends for a party. I chose the largest vehicle available, figuring that the greater capacity would allow me to make the journey in fewer trips, thus doing less damage to the environment. Unfortunately, it seems that the inhabitants of the future haven't quite grasped the concept of car-pooling, as each additional person I picked up decided to avoid the extra seats in favour of all standing on one passenger's head.

The best games were those that let you directly pick what would go in to Future City. One saw you designing your ideal home, in the form of a TV phone-in quiz. I felt this was one of the more informative experiences, especially as Buz, Eco, Tek and Dug weighed in to comment on my choices. I could choose wind power – but would that provide all of my energy needs? Or nuclear, but what about radiation and waste disposal?

It really drove home the fact that there is no easy solution to climate change. Difficult decisions and compromises will have to



be made, and I could easily see how this idea would come across to the children who visit the exhibit – after all, aren't they the ones who will be living in Future City?

Reaching the end of the exhibit, I placed my card on the reader one last time to find out how I had done. My own personal neighbourhood of 2050 was built before my eyes. Apparently I'd done ok, but Eco wasn't too happy about my choice of nuclear power. Sorry Eco. My neighbourhood joined the many others on the screen as part of Future City, a neat little reminder of my visit.

“I could choose wind power – but would that provide all of my energy needs? Or nuclear, but what about radiation and waste disposal?”

I think kids (and maybe even adults) could learn a lot from the exhibit, as long as they take the time to check out some of the less interactive parts to support knowledge gained from the games. It's a shame that it was only open for such a short time, because I think it would make an excellent permanent addition to the museum.

The only trouble is the price. I know that high-def TVs and custom software cost a bit to produce, but at a cost of £6 for an adult, or £22 for a family of four, it's debatably whether the 45 minutes or so I spent with the exhibit provide value for money – especially when the rest of the Science Museum is available free of charge. Perhaps making it permanent could have allowed a more long-term view at recouping the costs?

Although The Science of Survival is now closed in London it recently opened at the Liberty Science Center in New Jersey, and the website (<http://survival.scienceof.com>) promises that more future venues are “coming soon.” keep an eye out, because it's worth a visit.



Stop interferon'

Interferon Force

<http://www.interferonforce.com>

ANTHROPOMORPHISING THE inner workings of the body is nothing new. Remember watching a Saturday morning cartoon in which white blood cells were spaceships that flew around fighting infections? If so, search YouTube for “Once Upon a Time... Life” (in original French version: *Il était une fois... la vie*) for an instant 80's flashback and exciting action cartoon. It's not often seen in comic form however, and certainly not as professionally produced as *Interferon Force*.

Only two issues of the comic have been made, but it's a case of quality over quantity. In the first - entitled *Influenza Attacks!* - the hotpants-wearing Interferon Beta teams up with the ninjalike twins Interferon Alpha-1 and Alpha-13 to fight an invading flu virus, represented by hordes of green monsters.

With their codenames and uniforms, they aren't far from the likes of other superhero forces such as the X-Men. They even have tanks in the form of NK cells. With the flu monsters on the run, Interferon Gamma steps in to finish them off – but not without a quip: “I'm wrangling a pack of angry macrophages, and they're hunting for a midnight snack”

In the second issue, *Cytokine Storm!*, Beta is forced to confront Gamma, who is acting strangely after an attack by the Epstein-Barr virus, thought to have links with the disease multiple sclerosis. The evil “Count Creepy”, interleukin 12, incited

Gamma to dangerously high activity levels and caused her to attack healthy neuron cells.

If you don't know much about the human immune system, *Interferon Force* and its melding of scientific information with superhero action might help you learn a little more. Yes, it's a bit melodramatic and silly, but still makes an interesting read. The comics are available freely online and it even have their own Facebook page!



Do you feel the interferon's force?

Best of Science Radio

Felix Whitton tunes in to some of the grooviest science podcasts on the web.

Dr Karl and the Naked Scientist

<http://www.bbc.co.uk/radio/podcasts/drkarl>

Length: 1hr – 1 hr10min

This double whammy of pop-science is courtesy of Radio 5 Live's Up All Night show, but can be downloaded as a podcast to listen whenever you want. Normally split over two nights, the two shows have very different flavours.

The Naked Scientists – aka Dr Chris Smith and team – hail from Cambridge and consist of doctors, biologists, physicists and an archaeologist. This gives things a reassuringly wide-ranging arc, and allows for a particularly in-depth look at up to the minute science news. The show is split into a news segment – sample stories – and a bulkier interview section. There is also usually a jokeier element to the podcast; Stuff and Non-science (arf) and Kitchen Science are two regular features.

Unfortunately, as much as I try to like the Naked Scientists they come across as a bit too closeted and stuffy, especially Dr Chris who, although engaging, is by no means a radio natural.

At the other end of the media spectrum is Dr Karl Kruszelnicki, who has made a career in Australia as their version of Adam Hart-Davis; wacky shirts to match his personality. Compèred by Rhod Sharp, the show attempts to answer listeners' (often weird) questions, and Dr Karl more often than not does so with a flourish. On rare occasions when his omnipotence is found wanting, he appears rather shamefaced; for a man who holds four scientific degrees and has written umpteen popular science books I find this trait endearing. Best loved for his trove of anecdotes and sly humour, Dr Karl is only let down by his 3am audience, some of whom appear to be on the far side of eccentric.

Science Weekly

<http://www.guardian.co.uk/science/series/science>

Length: 35-45min

The Guardian Science Weekly podcast is perfect for those of you without the time to digest a whole hour of aural improvement. Alok Jha and other Guardian writers take us through the top science stories of the week, together with interviews with top names from science and politics.

Listening, I was more reminded of a radio panel show – along the lines of Start the Week – than a normal podcast, with the whole team taking it in turns to grill the guests. Recent interviewees include mathematician Marcus du Sautoy, new science minister Paul Drayson (a trained scientist himself), and Sir John Pendry of Imperial. This is the only science podcast from a major UK daily newspaper, and its success (178 episodes and counting) highlights the Guardian's above-average coverage in a press atmosphere that prefers scare stories to real science.



Skeptics' Guide to the Universe

<http://www.theskepticsguide.org/index.asp>

Length: 1hr20min

With more than 40,000 weekly listeners and a regular in iTunes' top 10 science podcasts, the Skeptics' Guide to the Universe can rightly lay claim to being the most popular debunker of the pseudo, the paranormal and the downright wrong that is out there masquerading as science.

The Skeptics' Guide has been running for 170 episodes, ably presented by Dr Steven Novella and his team of "sceptical rogues." Each week they take a hard-nosed look at anything vaguely iffy, favourite topics being creationism, homeopathy, 'big pharma' and the paranormal. After a bit of heated discussion – the first week I listened featured a chat about the Michael Reiss/creationism debacle (see feature article) – the podcast centres around fairly in-depth interviews with big names, and occasionally those pseudoscience-practitioners themselves. In the past, guests as diverse as ex-President Jimmy Carter, South Park creator Matt Stone, writer Christopher Hitchens and magician-sceptic James Randi have appeared.

While it can get a bit heavy at times, The Skeptics' Guide is great listening if you want to hear an American perspective on pressing issues, and as one iTunes reviewer succinctly puts it; "learn to spot a logical fallacy from 20 paces."

This Week in Science

<http://www.twis.org>

Length: 60min

With more than 200 episodes under its belt, TWIS has a formidable track record. With their snappy dialogue and radio-chemistry the presenters, Kirsten and Justin, whizz through various science stories in this weekly podcast. This doesn't mean they don't skimp on serious stuff: in the latest show a story about robots triggers a philosophical look at Alan Turing's test to find an artificial intelligence that can fool a human into thinking it was also human.

The pair generally take a more humorous and irreverent approach to science. They cover almost anything, ranging from newly-discovered life forms living in the ocean depths, the US Presidential race and its implications for science, the Nobel (and Ig Nobel) Prize, to a recent special on the Large Hadron Collider.

Part of TWIS's charm is the chemistry between learned Dr Kirsten Sanford (a memory specialist with a degree in conservation biology) and co-host Justin Jackson, an itchy enthusiastic layman who acts as the comedic foil to Kirsten's superior knowledge. The pair even indulge in a bit of bad science-style debunking of lies, damned lies and statistics in media reporting of science. Heartily recommended.

Summer Science X-change: an Insider's View

Maria Hogan visits this year's BA festival in the European Capital of Culture: Liverpool.

BA Festival 2008

<http://www.the-ba.net/the-ba/FestivalofScience/>

THIS SEPTEMBER, hundreds of scientists, including many from Imperial College, descended on the city of Liverpool for this year's BA festival of Science.

On the programme were some well known names of stage and screen such as Adam Hart Davis, and Prof. Robert Winston, to name but a few. Alongside the 'famous' science-bods, a host of exciting, entertaining and engaging scientists answered (and asked) questions we've never known the answer to, or perhaps never asked in the first place; why does the one you love never love you back? Richard Robson, busker, performing artist, author and psychologist claimed to have an answer. Do we have 'Sat Nav' in our heads, and how does it work? Hugo Spiers neuroscientist from University College London explained it all.

"Try saying that after a few drinks!"

There was also no shortage of controversy, when some poorly reported comments from a 'creationism in the classroom' debate lead to the eventual resignation of Professor Reiss from his role as the Director of Education at the Royal Society (see our feature story "Creationist Britain").

My own contribution to the festival was to wear a highly 'attractive' fluorescent pink T-shirt and help organise the 'X-change' event each evening. I'd spotted an ad for "volunteers who are especially interested in the field of science communication" on the BA website a few months before, and, not knowing about the 'lovely' T-shirts, (it might have put me off if I'm honest,) thought it would be a fun thing to get involved in.

After just one briefing at the Dana centre in August, our team of 5 chosen volunteers (ranging from undergraduate students to a post-doc neuroscientist) were thrown into a whirlwind of rushing to as many of the festival sessions as possible, rating speakers, making calls, trying our best to cover most of the events and

hand-picking the cleverest, funniest, most engaging speakers to invite along to the evening X-change.

Held at Liverpool University's Saro Wiwa Bar (try saying that after a few drinks!), the free event was hosted by BBC broadcaster, Sue Nelson. It runs at every BA festival and is billed as "The best of the fest", a chance to catch up with speakers you missed (or just want to see more of!), and X-change views on the hot topics of the day.

"Would the scientific uni-cycling juggler crash into the plasma screen behind him?"

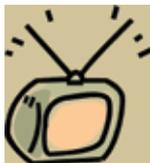
Because the X-change concept is based on a team of people quality-testing and booking speakers on the day and on audience participation, there were a few tense moments wondering if the show would come together, how many speakers we would have and if the people we'd booked would actually turn up! Even then we had no idea from one minute to the next what twists and turns the show was going to take; would the scientific uni-cycling juggler crash into the plasma screen behind him? How would the Scouse audience react to a joke the gynaecologist just made about Liverpoolian teenage mums?

Apart from seeing the festival for free, from a personal point of view it was an amazing opportunity to catch up and network with a variety of speakers (landing me some work experience at New Scientist!), and was also brilliant grounding in event organisation. I got to produce the show on the first night, then try my hand at hospitality and marketing, as well as getting to grips with the technical side of a PA and roaming microphones. I also got to (briefly) meet the man with the moustache, Prof. Winston himself!

Next year, the festival is going to be held in Guildford, at Surrey University- a mere 45 min train ride from Waterloo. The BA are already looking for event proposals, and at some point will be advertising for X-change volunteers. I can't recommend the experience highly enough. No doubt the Surrey festival will be just as packed, as interesting and as controversial. Don't read about it in the press, don't even just go along to the festival- be involved and see it from the inside. It's even worth wearing a naff pink T shirt for.



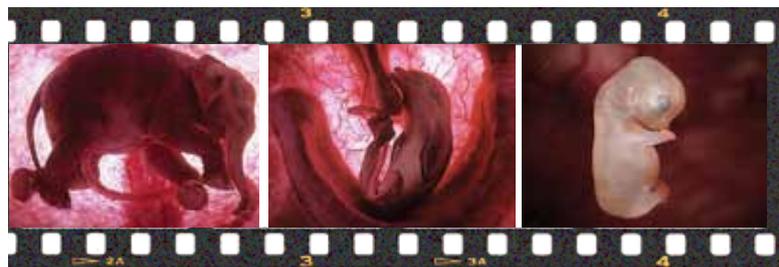
The Wildlife Photographer of the Year Competition is owned by the Natural History Museum and BBC Wildlife Magazine. Images from 2008: Shark Nursery © Brian Skerry (USA) and Snow Swans © Yongkang Zhu (China).



Nature is morally blind

Reviewed by: Jacob Aron

Extraordinary Animals in the Womb
on Channel 4



A FEW WEEKS ago, Channel 4 broadcast *Extraordinary Animals in the Womb*, a sequel to last year's plain old *Animals in the Womb* in which the reproductive process of dolphins, elephants and dogs were investigated in detail. This time it was the turn of sharks, penguins, kangaroos and wasps.

Using a combination of real footage, computer generated imagery, and good ol' fashioned models, the film tracks the baby animals from conception to birth. The effect is stunning; you feel like you've somehow gained x-ray vision and the ability to see directly into the animals' wombs.

The animals really are extraordinary. They might well have chosen to call the documentary "Aren't Animals Pretty Damn Amazing". We learn that male sharks shoot "sperm bullets" into the female to impregnate her, and the fetuses eat their unborn brothers and sisters in order to survive in the womb. Kangaroos leave the womb after just a few weeks gestation and crawl up to their mother's pouch, where they will suckle for a further six months as they continue to develop. The male penguin incubates the egg, not the female who must return to the sea after the stress of laying.

The fascinating facts pour thick and fast, but it's never too much to take in. What some might find too much, however, is the parasitical wasp. This nasty little creature lays its eggs in an unsuspecting caterpillar, and when the larvae develop they eat

their way out of the poor thing whilst it is still alive. It's a genuine "watching through your fingers" moment. What's worse, a "biological weapon" in the form of a virus originating from the wasp's DNA rewrites the caterpillars brain, and it actually sticks around to help it's unwelcome guests as they transform in cocoons.

As the program tells us, when Charles Darwin found out the lifecycle of these wasps, it shook his belief in a benevolent God. They were also (unsurprisingly) the inspiration for the movie *Alien*. The narrator is quick to point out however that "nature is morally blind", and these reproduction strategies exist simply because "they work".

Initially the film roars along, with "24" style transitions between the four species' storylines (sorry, no Jack Bauer though) and intriguing hooks that keep bringing you back for more after the ad breaks. Unfortunately, past the hour mark it begins to feel a little dragged out - a shame, as the majority is thoroughly enjoyable.

It's available to watch online at the Channel 4 website until November 20th, so if you have a spare hour or so, it's definitely recommended. Just be prepared for a slightly meandering ending, and watch out for parasitical wasps!

Imperial's Sci-fi

Zenith Magazine
ICSF fan 'zine

THE IMPERIAL College Union Science Fiction, Fantasy and Horror society, or ICSF as it is more commonly known, has put out its very own fanzine of writings and drawings by the membership. You can pick up a copy at their library.



The 'zine contains both fiction and non-fiction, but kicks off two 'hard' sci-fi tales. *Slow Boat* by Alex Trenchard is a story in which the future promised by science fiction never arrived. Ironically, given the name, it moves far too fast; just as I got into the setting and wanted to know more, it was over. A compliment, rather than a criticism.

Its companion is *The River of Paradise* by David Bartram. Ascension to the afterlife becomes nothing more than routine surgery - if you can afford it.

Next, we turn to non-fiction, with an article on *Left-Handedness in Fictional Characters* by Peter Mabbott. As is pointed out, most

fictional characters are never given an identifiable handedness, and implicitly most are assumed to be right handed. Why then might an author choose left handedness, and how does this relate to sci-fi and other fiction? You may not agree with the conclusions drawn, but it's an interesting read nonetheless.

On the *Methods of Inflicting Exterminatus* is the fanzine's only example of fan-fiction, in which author Daniel Rolph gives a treatise on planetary-wide extermination in the *Warhammer 40,000* universe. It's perhaps a bit inaccessible to the casual reader, but *Warhammer* fans should enjoy it.

Rebecca Mckinlay's *Naroin* is a challenging read. A very convincingly written stream of consciousness makes the narrative hard to penetrate, and it may leave you slightly unsure of what you've just read. Sorry Rebecca, you've left *I, science* a bit baffled!

Rounding off the collection are two stories from repeat authors: *The Shadow of Time*, another from Peter Mabbott, and *The Consequence of Infinity* by David Bartram. Peter makes a fairly generic fantasy setting (names such as "D'Resh the Riddlemaster" come complete with obligatory apostrophe) actually quite charming, with the tale of the great magician Belaphron and his attempts to converse with a dragon, whilst David ponders an alien approach to the infinite universe.

Along with the text there are drawings scattered throughout the fanzine, ranging from elf images to the two page centrefold of a spaceship - complete with engineering specs, if you're into that kind of thing. They're a nice addition, especially the image on the back page: *Dalek in Love with* - what else - a Royal Mail post box.

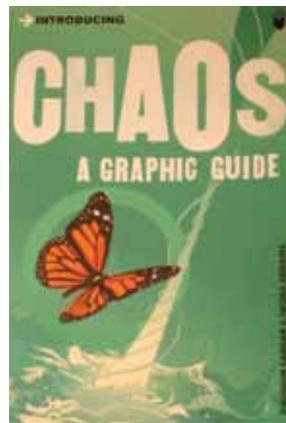
If you're reading *I, science* then you probably have at least a passing interest in student media (or indeed science), so why not check out what your fellow students have produced? JA

A Chaotic Book about a Chaotic Universe

Introducing Chaos: A Graphic Guide

Ziauddin Sardar & Iwona Abrams

ICON BOOKS LTD



THE FLASHY cover didn't fool me for long. As soon as it said "recent developments" in the field of chaos, I raised an eyebrow and turned to the front cover to check out the book's copyright information. Originally printed in 1998 under the title *Chaos for Beginners*, publisher Icon Books has recently re-issued *Introducing Chaos* as part of their *Introducing...* line of pocket-sized graphic guides.

Yes, graphic guide. Pictures take up between a quarter to three-quarters of each page, making this a book that is pretty light on text. Cropping up often is Cordiallia Cauliflower and her fractal vegetable hairstyle, who is on hand to help you make sense of the chaos.

Unfortunately, I found the graphics pretty pointless. They're mostly collages of drawings, photocopies and scientific diagrams, somewhat in the style of Monty Python's Terry Gilliam, and after a dozen pages or so the messiness becomes weary on the eye. By the end of the book I was focussing completely on the text, skipping over the images completely as I felt they added little to the experience.

As for the text itself, the book does a decent job of giving a brief history of chaos and an overview of the ideas behind the theory. Following this introduction, the reader is taken through the uses of chaos and how it is applied to many fields, from physics to biology and even the stockmarket - no surprises there, considering recent headlines. Most of the ideas are broken up into bite-sized chunks over just one or two pages, making it easy to dip in and out of, or just flick to the parts you are interested in, and although there is no contents page the short index suffices.

The book shows its age during a discussion on chaos and the weather, warning against "greenhouse effect" predictions based on "a series of warm winters and hot summers", saying that they do not necessarily mean "long-term permanent change has set in." The consensus amongst modern scientists is of course quite the opposite. Still, if you want any easy introduction to chaos that doesn't ask too much of its reader and you're perhaps more artistically inclined than myself, this could be the book for you. Those wanting to learn a bit more, however, might be better off looking elsewhere.

Super Scientist

Catherine Jones explores science comics

"Understanding Global Warming with Max Axiom"

By Agnieszka Biskup

CAPSTONE PRESS, GRAPHIC SCIENCE SERIES

GLOBAL WARMING is a serious issue, but we can find solutions for our environmental problems. Reassuring words from Max Axiom. Of course, Max Axiom is no ordinary scientist. In this graphic novel for children, the Super Scientist comes to tell the world about the threat of global warming. His impressive powers include super intelligence, the ability to shrink to the size of an atom, x-ray vision sunglasses and a time- and space- travel lab coat.

I was impressed by the excellent visual representation of science, with colourful and clear depictions of the greenhouse effect, carbon dioxide, climate change and green technologies. Cynthia Martin, an ex-Marvel comic book artist, slickly illustrates this graphic novel, with clean lines and a sense of movement.

The implications of climate change were discussed in detail, with both the global effects on weather and ecosystems, and the

personal implications for health. The dialogue was clear and appropriate for a young age group, though teenagers might find it a touch too didactical at times.

My only qualm; from an adult's perspective, I found the dialogue dry and humourless. That is, until discovering the highly amusing pronunciation section at the back of the book. Those reading the book aloud to children can enliven their delivery with American pronunciations of "glacier (GLAY-shur)". Presented simply, and with clarity, it makes an excellent introduction to the topic of climate change. It's part of a series of childrens educational books; other titles cover a spectrum of science topics, from magnetism to adaptation. These books are a great way of engaging children in science issues.



