I,Science

Winter 2009

Inside:
Copenhagen Conference

From the editor

EDITORIAL TEAM

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Felix Newspaper
Beit Quad
Prince Consort Road
London SW7 2BB
T: 020 7594 8072
E: felix@imperial.ac.uk

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Happy New Year and welcome to the first I,Science of the new decade. We have worked tirelessly to bring you the latest news from key science topics, both domestic and international. Discover what methane may mean for microorganisms on Mars and the consequences of the Copenhagen Climate Conference for subsistence farmers in Africa. Also, have you ever wondered what a 'dirty thunderstorm' looks like, well, turn the page and see for yourself.

As it is the end of one year and the beginning of a new, we have brought you our essential New Year's Resolutions, from reducing your carbon footprint to going along to Cafe Scientific. Have a read and you can decide if we have chosen resolutions that are achievable, whether you stick to them or not is another matter. Another bonus we have included (and my personal favourite) is our sexy scientist babes from cinema - I think that is all I need to say on the matter!

Lastly, we here at I, Science hope you have an entertaining and educational trawl through our magazine and I wish to thank all our writing, illustrating and production staff for their contributions. If you would like to voice your constructive comments or criticisms about our first issue or any other questions please send them to **iscience@imperial.ac.uk**.

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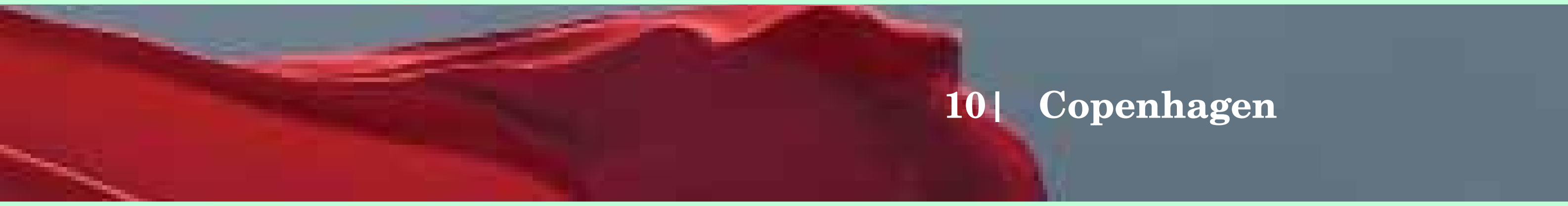
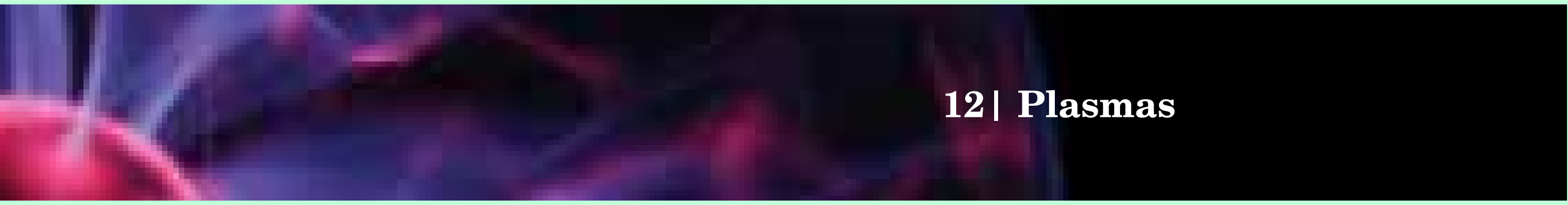
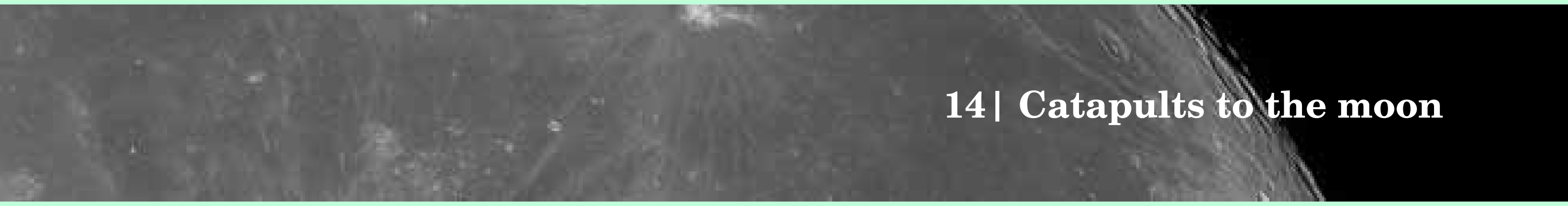






Imperial News

By Ben Kolb

FUNDING BOOST FOR IMPERIAL 'CLOAKING DEVICE'

In November, Imperial researchers developing 'metamaterials' received a £4.9 million boost from the Leverhulme Trust.

This science has received substantial press coverage over the past six months because of the material's exciting properties and potential applications.

The study of metamaterials borders both physics and materials science and with an ability to bend, control and manipulate light and other forms of radiation, they can produce effects unseen in nature.

These properties suggest that metamaterials could have future applications in sensitive security sensors, flat lenses for imaging objects smaller than the wavelength of light and most excitingly optical invisibility cloaks.

This funding boost means Imperial can bring in three top researchers to join the world-class team already involved.

Professor Sir John Pendry, who leads the team with another Imperial Professor, Stefan Maier, believes that since they have shown "an optical invisibility cloak is theoretically possible: the big challenge now is to build it".

MARTIAN METHANE MAY MEAN MICROORGANISMS ON MARS

Research rules out meteorites as the source of methane replenishment on Mars and means it may be the result of microorganisms living in the Martian soil.

Scientists at Imperial's Department of Earth Science and Engineering calculated the annual rate of methane produced by meteorites to be only 10kg, far below the hundreds of tonnes needed to replace Martian methane broken down by sunlight.

Despite this constant loss of methane on Mars, levels are kept topped up and scientists are keen to know Mars' secret.

Previous research rejected volcanic activity as a theory; this leaves only methane being formed as a result of reactions between volcanic rock and water or that there are methane producing microorganisms living in the soil as the most plausible theories.

Dr. Richard Court and Professor Mark Sephton of Imperial tested the meteorite theory by reproducing the blazing conditions a meteorite experiences in Mars' atmosphere.

Professor Sephton is excited by the fact "extraterrestrial life still remains an option" but admits that "the final test may have to be on Mars".

GREEN 'SUPERCAR' TO TAKE ON WORLD'S LONGEST ROAD

If you were wondering what that sports car was doing in the College foyer, I, Science can solve the mystery.

Imperial College engineering students are transforming a petrol powered 'supercar', the Radical SR8, into an electric car that will be a little more powerful than the little REVAis you might have seen around London.

Upon completion the car will hopefully have a top speed of 120 miles per hour and be capable of 0 to 60 mph in less than seven seconds.

The car will need to be powerful as the students ambitiously plan to take on the 16000 mile stretch of road that is the Pan American Highway in May 2010 and become the first to drive an electric vehicle its full length.

The students, part of the Racing Green Endurance Team, are making the car as energy efficient as possible through adaptations such as regenerative braking (similar to the KERS system seen in F1 racing) and energy dense batteries that store even more energy than others on the market.

Now all we need is Jeremy Clarkson driving the world's least energy efficient car and we have the makings of a 'Top Gear challenge'.

News Snippets

NEWBORNS HAVE ACCENT FROM BIRTH - *Christine Lin*

Research shows that babies memorise their mother's voice in the womb and have an accent when they first cry.

Scientists compared the yells of German and French babies aged two to five days and found they took the national accent. The French infants cried with a rising tone while German infants cried loudly in the beginning and gradually quietened, matching the adult intonations.

Furthermore, Scientists have also found that a fetus becomes an active listener in the last three months of pregnancy, especially to the mother's voice. They believe babies start to imitate their mothers' accent while still in the uterus.

PARASITES TRANSFORM ANTS INTO BERRIES - *Jon Primmer*

Central America's Giant Turtle ant has an extraordinary relationship with a nematode parasite, US biologists find.

The parasite must complete its life cycle by infecting a bird, and this is achieved by first entering an ant. Upon infection, the ant's lower abdomen becomes red and swollen, and easily detached.

The ant's behaviour also changes. It waves the 'berry' in the air and is far less aggressive in comparison to its fellows. The result is a treat, impossible for a bird to refuse, and the cycle continues through the bird's faeces, back into the ant's food chain.

TRANSPLANTS THAT ADD UP - *Eleanor Saunders*

An algorithm called a nonogram could predict kidney transplant outcome and improve patient counseling.

Living donor kidney transplants are increasing and in some cases there are a number of potential live donors for a recipient. Physicians are striving to find better predictive tools to help identify the optimum donor.

Nonograms have been shown to derive accurate predictions in oncology. (A branch of medicine that deals with tumours, such as cancer). These equations use a range of patient data and clinician input to predict outcomes. This success could be applied to kidney transplants where a number of factors dictate post transplant renal function and graft survival. Researchers at the Cleveland Clinic Kidney Institute have used nonograms to predict transplant outcomes at 1 and 5 years, helping inform donor selection. Post transplant data can be added to the model to refine the prediction, allowing patients to receive ongoing, accurate counseling.

HOT NEW TREATMENT: CHARCOAL FOR ATHEROSCLEROSIS - *Chris Noble*

New research presented at the American Society of Nephrology's annual meeting suggests that charcoal may have beneficial effects for patients with advanced kidney disease and the associated risk of atherosclerosis (ASVD, also known as Arteriosclerotic Vascular Disease).

Activated charcoal, administered orally, is a preferred treatment for poisonings and overdoses but this new research showed a significant improvement in lab mice with atherosclerosis.

Dr. Valentina Kon, from Vanderbilt University, said that her research was "especially important because there is no effective treatment to reduce the igh rate of cardiovascular mortality in patients with end-stage renal disease."

CLAUSTROPHOBIC CELLS TO PREVENT CANCER - *Hala Elhaj*

A gene that has been protecting naked mole rats from cancer for millions of years has finally been revealed.
The naked mole rat is a small, burrowing rodent that boasts a lifespan of 30 years. Most unusual for such long-living animals, this small wrinkly rat doesn't get cancer; something that has been puzzling researchers for a very long time.

Andrei Seluanov and colleagues at the University of Rochester discovered that the naked mole rat's powerful cancer resistance mechanism is due to a gene called p16 that exerts a claustrophobic effect upon its cells, thus stopping the growth of cells as soon as they reach high density. The effect of this gene is so profound that when researchers tried to induce a tumour in the rat's cells, using the same methods that would turn mouse cells completely cancerous, they failed.

As humans, we have a gene called p27 that prevents the overcrowding of cells as part of our normal tumour-suppressing mechanisms, the naked mole rat on the other hand possesses the p16 gene as an additional barrier that cells must overcome before dividing uncontrollably. It acts at a much earlier stage than its p27 gene, which makes its cells very claustrophobic. This double stage defence system was exposed as the secret to this rat's long, 'cancerless' life.

The findings of this study were presented in the October issue of The Proceedings of the National Academy of Sciences. Seluanov's next move is to see if the mechanism is applicable to humans: "It's very early to speculate about the implications, but if the effect of p16 can be simulated in humans we might have a way to halt cancer before it starts."

Climate Change
A Review

By Henry Lau

Climate change is happening. The scientists who compiled the last IPCC report in 2007 were 90% certain that human activities are causing climate change. But climate change is a vast topic and there are many aspects involved. Changes are seen in physical observations such as sea surface temperature or sea level rises. These changes are driven by greenhouse gases and other aerosols in the atmosphere which affect ecosystems, water supplies and eventually human health. There are two ways to reduce climate change, mitigation and adaptation. This has to happen through a combination of factors including governance, technology, trade and changing consumer preferences.

The surface of the Earth is warming up. Data from between 1956-2005 show an increase of

0.13 degrees
per decade, which is twice the rate over the past 100 years. Sea levels have risen 3.1mm over the past 10 years between 1993 and 2003, compared to 1.8mm between 1961 and 2003. The amount of snow and ice covering the Earth is shrinking. Rain is increasing in frequency in certain parts of the world, but decreasing in other parts such as the Sahel region, southern Africa, southern Asia and the Mediterranean. Furthermore, other variations of freak weather events are becoming more frequent.

Subsequently, all of these physical changes in the climate system have knock on effects. Glacial lakes have been observed increasing in size and arethis process is becoming more frequent. In regions of permafrost the ground is becoming more unstable with rock avalanches occurring in mountainous areas. High latitude ecosystems in the Arctic and Antarctic, where the warming effect is most prominent, have also been affected. This has lead to sensational pictures of 'lonely polar bears' floating on chunks of ice, unable to feed because of a disappearing sea ice.

What is causing the
climate to change and what is mankind doing to change the climate? The strength of the sun varies naturally as it grows up, however it has been slowly increasing in intensity over the past few million years. This effect is insignificant compared to the manmade effects of greenhouse gases. Nitrous oxide (N_20), methane (CH_4) and halocarbons (a group of chemicals containing fluorine, chlorine and bromine) all contribute to global warming. But the largest contributor to global warming is from carbon dioxide (CO_2). Carbon dioxide is released into the atmosphere through the burning of fossil fuels, but also from deforestation and the decay of biomass. The concentration of these gases has been measured from drilling ice cores to look back in time, and analysis has uncovered dramatic increases in recent times. The effects greenhouse gases have on global temperatures are measured using radiative forcing (W/M^2). Radiative forcing measures how much energy is absorbed and how much energy is emitted. A positive value leads to a warming effect. Carbon dioxide has a radiative forcing of 1.66 W/M^2. But anthropogenic (processes that derive from human activity) effects do not only cause warming. Surprisingly, they can also act to cool the earth. Aerosols in the air can reflect sunlight back out into space and cause clouds to form which do the same job. However the net effect is a picture of the Earth warming caused mainly by the man made production of CO_2.

What will happen in the future is a big question that will affect what course of action we take. If the effects are just a natural variation, then there is no need to change our current practices. This is a huge area of debate and this is where the roll of mathematical models comes to the fore. Modelling the climate is extremely difficult due to the fluidic nature of the atmosphere; set on top of a spinning sphere and the huge uncertainties associated with effects such as low-level ozone. The task for model is to predict the past 100 years, where data is available and project their findings into the future. In all of these models, the anthropogenic effects have to be included to accurately model the past 100 years and the future predictions all show a global temperature rise. However,

predictions of the future are never going to be truly accurate because of unpredictable events such as volcanic eruptions and, at the end of day, models are just simplifications of reality and can never match up to real life. But they can reveal insights which can guide progress towards curbing the effect of climate change.

If left unchallenged climate change would wreck havoc on our globe. Ecosystems would be severely damaged with probable extinction for some species; food production capacity could be reduced, populations would be forced to relocate due to rising sea levels and there would be an increase in severe weather events. The health of millions of people would be affected through malnutrition. There would be increased diseases and death from extreme weather, and an increase in respiratory diseases from the increased pollution and ozone depletion. Climate change is going to put as yet unseen pressures on the world water supply as the world will struggle with more unpredictable precipitation and a shift in the distribution of natural water abundance.

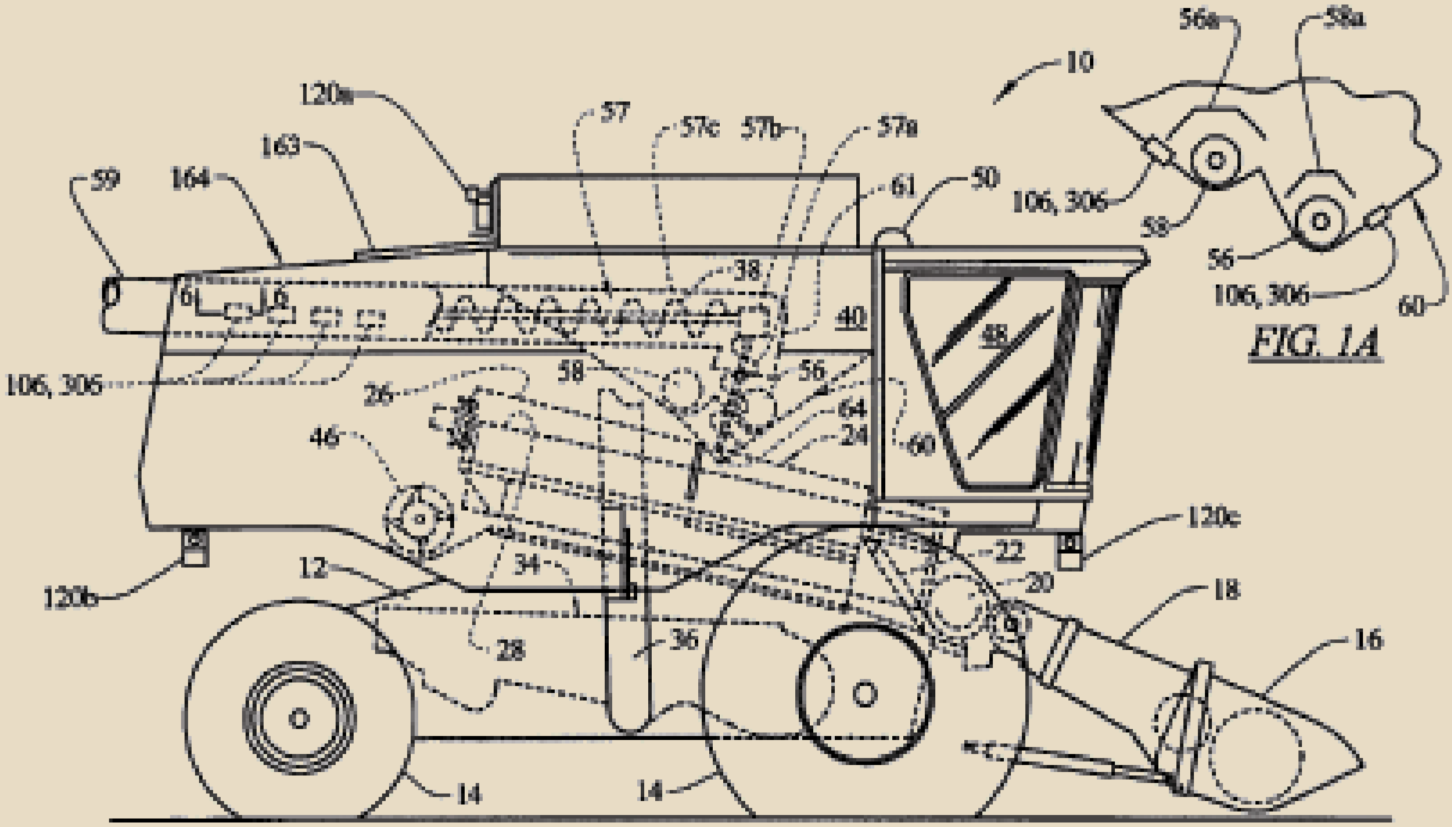
But all is not lost; technology is providing part of the solution to the climate change problem. Hybrid cars are becoming more widespread as manufacturers begin to include them as production models. The technology of electric cars is proven and is just awaiting the commercial infrastructure to allow them to enter into common usage. Solar panels are becoming more and more efficient with multilayered cells almost reaching the efficiency that would allow them to become commercially viable. Also, wind, wave and tidal power are all beginning to make their contribution to the renewable energy scene.

Political change is vital in tackling the challenges posed by climate change. From making the right choice for the next generation of power plants, to implementing severe weather plans, it is clear that climate change must be present in political considerations. The government has a responsibility to act on behalf of the public and ensure their decisions combine "economic prosperity, national security and environmental integrity" according to Lord Browne of Madingley, president of the Royal Academy of Engineering. Communicating the issues behind climate change is also one challenge confronted by the scientific community, which I am sure the reader is all too aware of. A greater public awareness of what the public can do and the science behind climate change will lead to more effective political persuasion and united action for climate change policy. Communication is also needed to negate the effects of climate change sceptics funded by companies such as ExxonMobil, as recently reported on by Bob Ward of the Grantham Institute for Climate Change. It has recently emerged that ExxonMobil were found to be funding lobby groups that campaign about the reality of the effects of climate change in 2006, and Bob Ward, then at the Royal Society, received confirmation that ExxonMobil would cease their funding to these groups. However, a document in 2008 showed that ExxonMobil were still funding lobby groups that question the validity of climate change and according to Ward, produce "misleading and inaccurate information about climate change."

Societal change in another element involved in the solution. Green wheelie bins and orange recycling sacks are becoming common place in the UK. Vegetarianism is gaining its advocates including Dr Pachauri, the current chair of the IPCC. And consumers are becoming more aware of the carbon footprint and green credentials of the products they buy.

This is accompanied by economic reform in the shape of carbon trading. Carbon trading works by limiting the amount of carbon an industry is allowed to produce. The industry then has to lower its emission to the limit set or buy credit to allow it to emit more than the limit. But carbon trading has its critics including James Hansen, director of Nasa's Goddard Institute for Space Studies claiming it "is analogous to the indulgences that the Catholic church sold in the middle ages. The bishops collected lots of money and the sinners got redemption. Both parties liked that arrangement despite its absurdity. That is exactly what's happening," he said. "We've got the developed countries who want to continue more or less business as usual and then these developing countries who want money and that is what they can get through offsets [sold through the carbon markets]."

So, climate change is here. It is real and it is a problem for our generation. Fortunately, we have the skills, expertise and technology needed to solve the problems of climate change. But this is not enough on its own. We need the combined efforts of politicians and the public all over the world to implement changes not only physically, but socially and economically too, and guided by the knowledgeable hand of science and technology. The right steps in the right direction will allow the human race to overcome the forthcoming challenges of climate change.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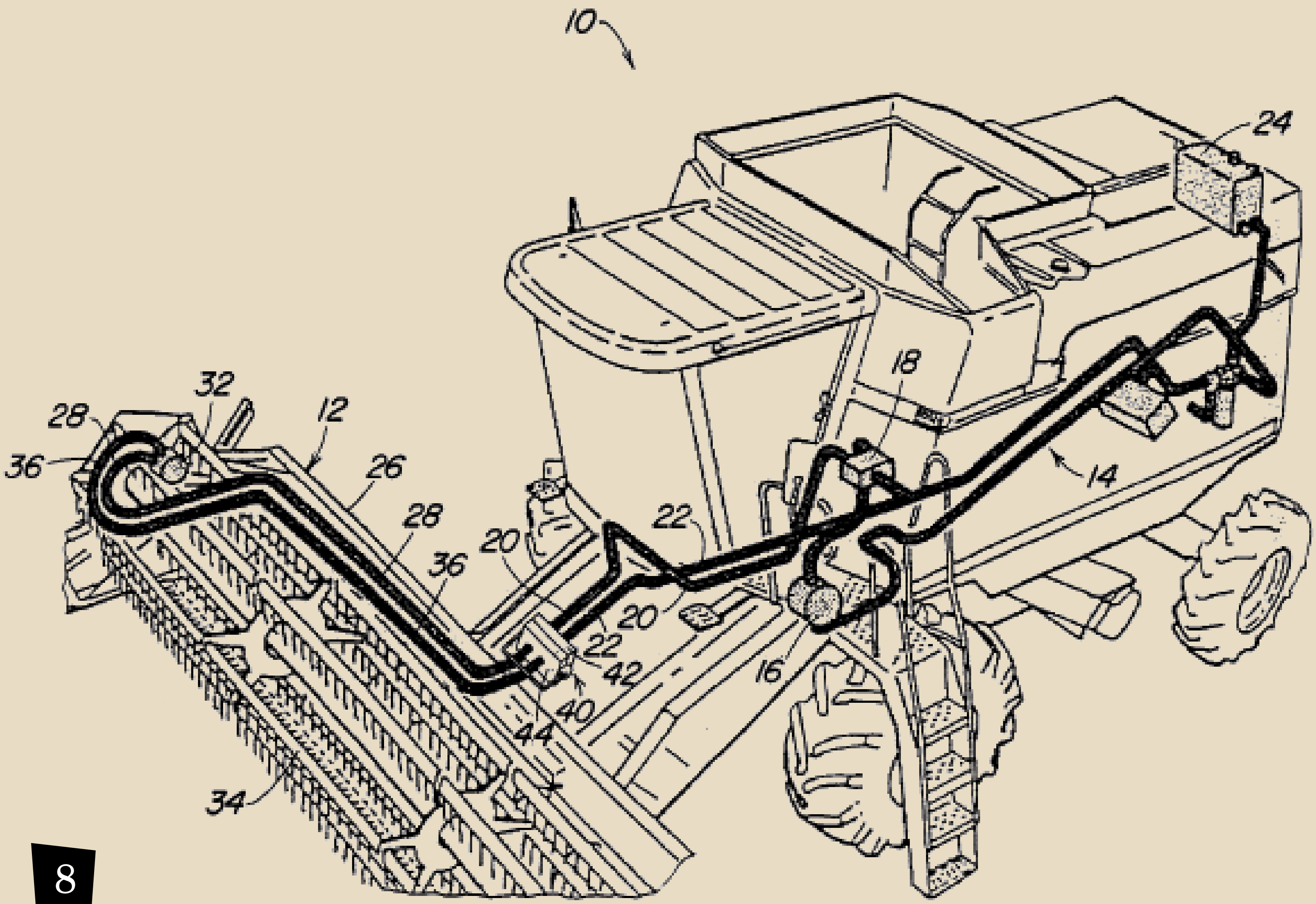
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Agriculture and Climate Change

By Rhiannon Smith

Although we all know plenty about the science behind climate change and we've all heard about the catastrophic predictions, it can sometimes be difficult to imagine how climate change will affect our daily lives. However, there is a particular group of people who will undoubtedly have to make radical changes to their livelihoods and daily routines if they are to weather both the real and metaphorical storms of climate change. This group comprises of the 1.5 billion people in the developing world who rely on agriculture to make a living. The uneasy notion is that such people will be hit the hardest by climate change, despite the fact that they have made the least contribution to greenhouse gas emissions (sub-Saharan Africa, for example, produces less than 4% of the world's greenhouse gases). Somewhat surprisingly then, agriculture was almost entirely ignored in the initial discussions of the UN framework Convention on Climate Change (UNFCCC) Copenhagen summit. Fortunately, worldwide, sixty agricultural scientists signed a statement highlighting this omission and as it currently stands, therefore agriculture was now on the agenda for the slow and laborious talks underway at Copenhagen.

In developing countries ninety five percent of their water is used in the irrigation of farmland. Further to this, one third of people in Africa currently live in drought-prone areas. Climate change will reduce water supply in these regions and make water storage more difficult. Rising temperatures will compound the problem by increasing the amounts of water needed by crops. The loss of productivity which will inevitably ensue will equate to a large loss of income, potentially causing the devastating loss of lives and livelihoods for a further 75-250 million people in the next 10 years. On the other hand, flood prone regions in parts of Southern Africa can expect more severe floods more regularly, with damage to homes and crops demanding resources which are desperately needed for development. Additionally, farmers in the developing world have grown accustomed to the sequence and rhythm of their occupation and rely on local expertise determining when to harvest and plant crops, or how to control pests. Moreover, they will now have to contend with the seasonal unpredictability forecasted by climate change scientists. There will also be delayed rainy seasons, earlier plant maturity, salt stress of the soil, weather variability, shorter growing seasons and different types of pests.

In order to tackle such problems urgent action must be taken in planning strategies of adaptation to a new and variable climate, and implementing agricultural technology to secure farmers livelihoods. Improved rainwater capture and storage facilities should be considered, along with better water management, to mitigate against the increasing demand and decreasing supply of water in drought prone areas. Varieties of crops which can withstand the climatic variability and increased temperatures must be researched. These 'climate proof' crops will also need to be adapted to withstand the new pests and diseases which may attack them. Unfortunately, such adaptation strategies require a great deal of technological and economical support which is simply not available in the poorest parts of the developing world. Thus, the developing countries which will be hardest hit will also face the greatest struggle to adapt to climate changes. This is why it is crucial for policy makers to extend their backing to agriculture. Failure to include agriculture in the Copenhagen discussions would have been a terrible oversight and so we can thank the 60 scientists who took a stand to prevent such a crucial and far reaching problem from being overlooked.

In fact, the recent outcome from Copenhagen was a draft agreement to form an "international working group" to mitigate the global warming emissions from agriculture (with its contribution to global greenhouse gases ranging from 14 - 31 percent) and adapting current farming systems to global warming. The byword of "food security" was utilised to highlight the facilitation of access for poor nations and their people to adequate food resources. This is an important step in tackling the potential food crisis in light of the projected world population of 9 billion people by 2050. The Food and Agricultural Organization of the United Nations estimated a 70 percent boost of food production is required by this time.

To conclude, the conflicting goals of emission reduction and increased food production were a point of major contention at the Copenhagen conference. As Olivier De Schutter, United Nations Rapporteur on the Right to Food stated, "Climate change is a ticking time bomb for global food security." The scientific consensus is that foreseeable rising temperatures will lead to lower crop yields, affecting the world's poorest nations, especially small scale farmers and indigenous peoples the most severely.

Copenhagen

Success or failure?

By Rhiannon Smith

On December 7th 2009 environment ministers and officials from 192 countries gathered in Copenhagen in an event which was billed as "a historic opportunity for the world to tackle climate change". The two-week long 'Copenhagen conference' was to be an attempt at an agreement to succeed the Kyoto protocol which was signed in 1997 and partly expires in 2012. Unsurprisingly, as each country attempted to negotiate their way to a more sustainable future, whilst still looking after their own interests, several controversies arose. Despite this, a deal (of sorts) was struck. So, what was actually achieved at Copenhagen? Was it a success or a failure? And what happens next?

WHAT WAS THE AIM OF THE CONFERENCE?

Originally the conference aimed to conclude with a comprehensive, legally binding international agreement to tackle climate change. In doing so, the conference would address four key questions; firstly, to what degree will developed countries commit to reducing their emissions? Secondly, what will developing countries do to limit their emissions? Thirdly, where will financial and technological support for developing countries come from? And finally, how will these finances be managed?

The inescapable fact is that climate change is a global problem. Hence, any measures taken to combat climate change, which are realistically going to be effective, require the backing and cooperation of the entire international community. This is why it was considered highly important that the leaders and officials attending the Copenhagen conference reached an agreement which could be legally enforced, allowing decisive and urgent action to be taken in tackling climate change.

WHAT WERE THE CONTROVERSIES?

One of the greatest controversies of the Conference centred upon China's apparent strategy of blocking negotiations, which Mark Lynas writing in the Guardian, claims forced a "closed-door deal", making it appear that the West had "failed the world's poor once again". Ed Miliband, the Energy and Climate Change Secretary, accused China of trying to obstruct progress by vetoing an agreement on a 50% reduction in global emissions by 2050 and an 80% reduction by developed countries. China's Foreign Ministry Spokeswoman, Jiang Yu, retorted that "certain British politicians" were trying to "shirk responsibilities...towards developing countries".

Further to this, even though Chinese premier, Wen Jinbao attended the conference, he did not personally attend the meetings, instead sending a "second-tier official" to take his place. This is suggested to have demonstrated not only as a diplomatic snub to other countries but also to have disrupted the discussions as the Chinese official regularly left to make telephone calls to his superiors. Such non-cooperation would suggest that China is not committed to tackling climate change. On

Conference

the contrary, China has thriving wind and solar industries. However, as a rising economic and political superpower, China depends heavily on the availability of cheap coal, a resource clearly under threat from reduced emissions targets.

China was not the only nation facing accusations of 'unfair play'. The host country, Denmark undercut the traditional negotiation process and drafted a document primarily representing the position of the developed nations. The document was only shown to a select number of "important countries" and hence seemed to marginalise and anger those countries not included. The climate policy advisor for Oxfam International, Antonio Hill, said that this draft document "highlights the risk that when the big countries come together, the small ones get hurt".

WHAT ACTUALLY WAS ACHIEVED AT COPENHAGEN?

In brief, the summit ended without the 192 nations reaching a legally binding agreement. Instead a decision was made to acknowledge what is being referred to as the 'Copenhagen accord', an agreement which was drawn up by the heads-of-state of the US, Brazil, South Africa, India and China. The Copenhagen accord suggests that global temperatures must rise by no more than 2°C, that developed countries will commit to cutting greenhouse gas emissions and developing countries will limit the growth of their emissions. There is promise of finance for developing countries; $10 billion per year for three years, extending to $100 billion per year by 2020.

WAS IT A SUCCESS OR A FAILURE? AND WHAT HAPPENS NEXT?

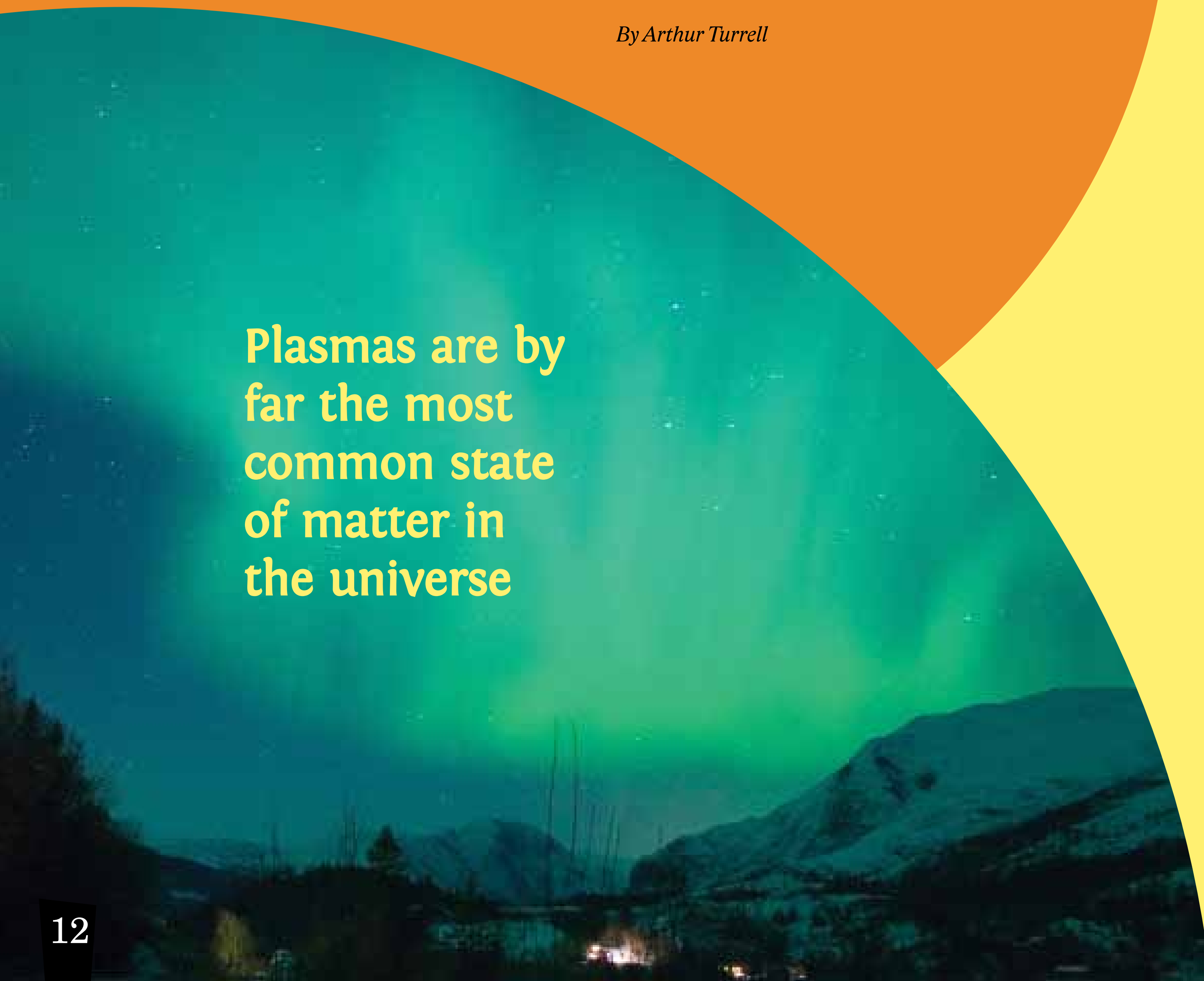
As I stated earlier, the aim of the conference was to 'conclude with a comprehensive, legally binding international agreement to tackle climate change'. To this end, Copenhagen can largely be considered to have been a failure. Firstly, the 'Copenhagen accord' is certainly not comprehensive. There is no mention of any long term targets for reducing emissions, there are no quantifiable targets and there is no timescale set for when emissions should be cut by. Secondly, the deal is not legally binding and there is not even a suggestion of when it could become legally binding. Thirdly, the accord is not 'international', since agreement was reached not through negotiation, but through the majority of countries simply agreeing with proposals drawn up by the five nations led by the US. Contrary to the hope for international action, the emphasis of the Copenhagen accord appears to be on national strategies, in which individual countries are only answerable to themselves, not the international community.

However, certain successes can be said to have been taken from the Copenhagen conference. For example, the conference demonstrated that the support for action is present globally, and confirmed that climate change is a massive political issue for every country, developed or developing. Akin to this, the notion that tackling climate change is bad for the economy was destroyed as low carbon technologies were accepted as the way into the future. What is more, in the lead up to Copenhagen public awareness increased hugely, putting the issue of climate change firmly at the forefront of the public mindset.

In terms of what the future holds, Ed Miliband amongst others has said that upcoming climate talks will attempt to make the Copenhagen accord legally binding, and Ban Ki-Moon, UN Secretary General asserts that this should be done by next year. President Obama on the other hand has simply stressed that he is "confident" that we are moving in the right direction. Whatever the next step taken by our world leaders is, I think that we can safely conclude that the Copenhagen conference was merely the first step on what will be a long and difficult road in tackling global climate change.

Plasma: your hottest friend

By Arthur Turrell



Plasmas are by far the most common state of matter in the universe

Forget solids, liquids and gases; plasmas are by far the most common state of matter in the universe. You may have never knowingly come across one, but they are everywhere from stars to rocket exhausts, televisions to lightning. So what is plasma? We know that solids are rigid, liquids adopt the shape of their container and gases expand to fill a volume, but what characterises a substance as being a plasma?

A plasma is a gas of partially or fully ionised particles, that is particles whose positive and negative charges have been disassociated and are able to move independently of one another. In the case of atoms this means that the electrons have been stripped off. The freedom of the individual charged particles to move allows them to conduct current, similar to how a metal conducts current with free electrons. So plasmas have the conductivity properties of a metal but the volume filling propensity of a gas. The measure of how many particles are available to conduct current is the conductivity.

Incredibly, at just 0.1% ionisation, a plasma has reached half of its maximum conductivity. At 1% ionisation a plasma will have reached the maximum. The forces between the particles in a plasma are dominated by the electromagnetic force that causes like charges to repel and opposite charges to attract. This means that if there is any charge imbalance in a plasma, an area of net positive or negative charge, forces are applied internally to counter-act the imbalance. As electrons are so much lighter than the nuclei in atoms, it is usually the electrons that carry charge around the plasma and cancel out the imbalances. This process happens throughout the plasma so that, as a whole, it becomes neutral with negative and positive charges, perfectly balanced out on large length scales.

The correction of imbalances is not instantaneous though, it depends on how many charge carriers are available to flow to the affected area and how long it takes them to get there. The time in which these imbalances are neutralised is one of the most important quantities of a plasma and it can have dramatic consequences.

As space shuttles re-enter the Earth's atmosphere the shock they impart to gases in the lower atmosphere and the heating of the shield that protects the nose-cone of the shuttle creates a plasma. The time for this plasma to rearrange itself internally is less than the characteristic time associated with the communications, transmitted via electromagnetic waves, between ground control and the shuttle. As the electromagnetic waves create imbalances in the plasma, the plasma acts to cancel them and because the plasma acts quicker, it effectively stops the message getting through – this is known as a communications blackout and it is why astronauts cannot talk to ground control during re-entry of the Earth's atmosphere.

Space shuttle plasmas may seem pretty removed from everyday life but there are many examples closer to home; plasma televisions and plasma lamps have been around for years and flames are a type of plasma. The aurorae at the Earth's poles are caused when the positive nuclei of plasmas in the ionosphere regain their electrons and emit light. The interstellar and interplanetary mediums are also considered to be plasmas, albeit extremely sparse ones. Neon signs, fluorescent lighting and arc welders are all manmade plasmas. Recently they have been proven to be effective at killing superbugs like MRSA and so are finding applications in medicine too.

Additionally, the example that everyone will be familiar with is the Sun and other stars, which are huge, dense balls of plasma. In the middle of these giants the densities reached allow fusion reactions to take place, a nuclear process in which two positively charged nuclei fuse together to form a new nuclei, often accompanied by the release of an enormous amount of energy. These fusion reactions, enabled by the charge disassociation in a plasma, are what creates the sunlight that powers almost everything indirectly on Earth.

Research is ongoing to try and replicate the way that the Sun produces energy on Earth. There are many difficulties; most plasmas are so hot that they burn through any surface that they are in contact with and the gravity of a massive object like a star normally compresses the plasma to fantastic densities. Scientists on Earth do not have that ability to create such densities yet and so are having to compensate by heating up the plasma to temperatures many times higher than those found at the centre of the Sun as well as finding novel ways to contain the plasma, such as magnetic or inertial confinement techniques.

With new applications being found all the time and fusion power offering a greenhouse-gas free method of power production, there is no doubt that plasma's star will keep on rising.

Catapults to the moon

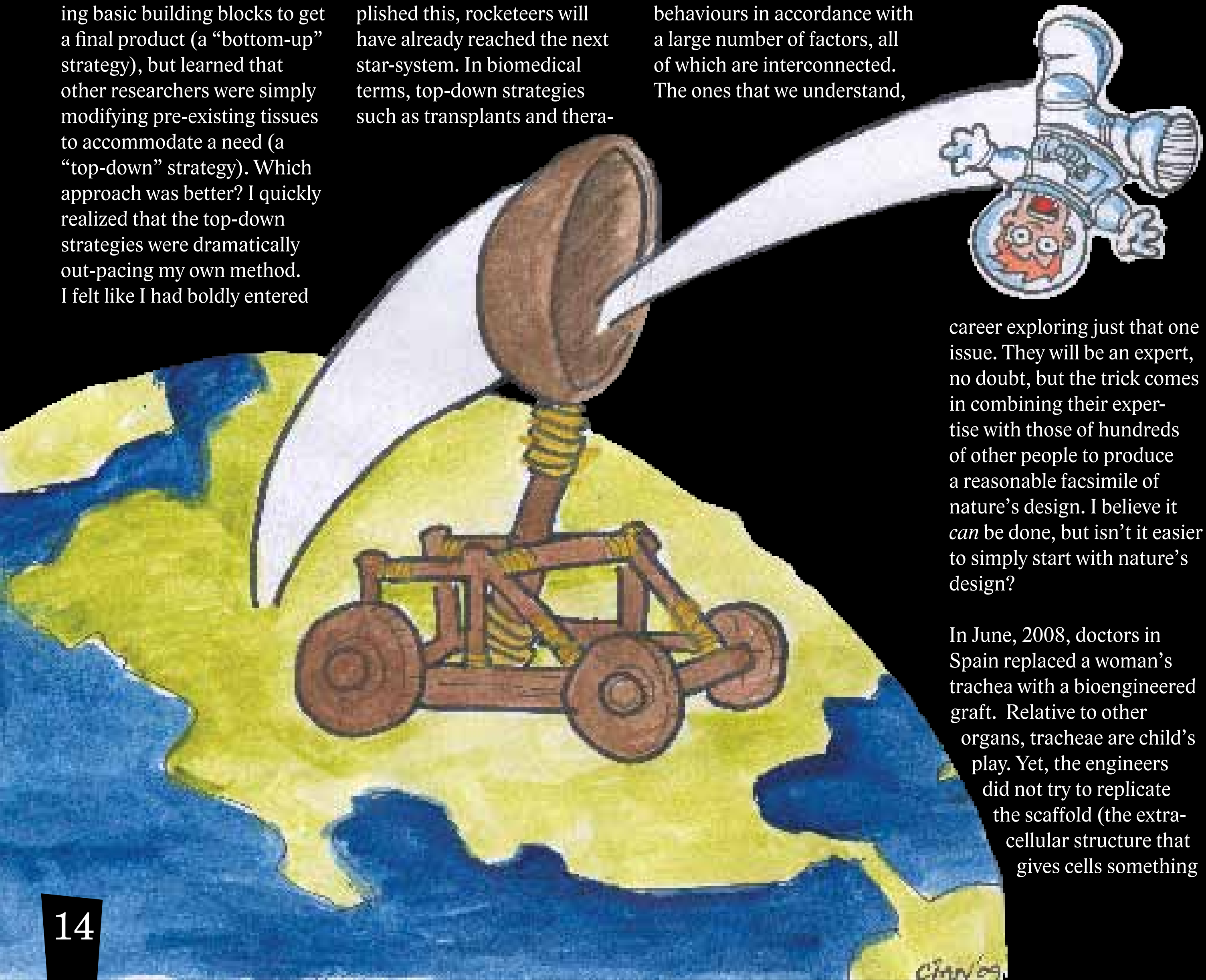
My realizations as a novice bioengineer

By Greg Szulgit

I got into bioengineering so that I could build really cool stuff. I don't mean robotic spiders or mutant clone armies, but synthetic tissues and artificial livers. But how should I have proceeded? I had joined a lab that was attempting to manufacture organs from scratch, combining basic building blocks to get a final product (a "bottom-up" strategy), but learned that other researchers were simply modifying pre-existing tissues to accommodate a need (a "top-down" strategy). Which approach was better? I quickly realized that the top-down strategies were dramatically out-pacing my own method. I felt like I had boldly entered the space race, but was building a catapult to launch people to the moon.

I'm not suggesting that catapults are useless or that they could *never* be designed to reach the moon. Indeed, they could. But, by the time the catapulteers have accomplished this, rocketeers will have already reached the next star-system. In biomedical terms, top-down strategies such as transplants and therapies will probably save far more lives than manufactured organs ever will.

Building organs is difficult. Building them *well* is still science fiction. This is because they are really, really, really complicated. The cells that comprise tissues alter their behaviours in accordance with a large number of factors, all of which are interconnected. The ones that we understand, we mimic poorly. The ones that we don't know about... well... there's a problem. We think like humans, not like cells, and trying to imagine and subsequently measure everything that affects cells is nearly impossible. When a new factor is discovered, a scientist can spend their entire career exploring just that one issue. They will be an expert, no doubt, but the trick comes in combining their expertise with those of hundreds of other people to produce a reasonable facsimile of nature's design. I believe it *can* be done, but isn't it easier to simply start with nature's design?



In June, 2008, doctors in Spain replaced a woman's trachea with a bioengineered graft. Relative to other organs, tracheae are child's play. Yet, the engineers did not try to replicate the scaffold (the extracellular structure that gives cells something

If building artificial livers will take 50 years, then why are we doing it? Won't liver disease be curable by then?

to climb on) from scratch, as many other researchers have. Instead, they took an existing trachea, removed the cells, and replaced them with the patient's cells because currently, on a molecular scale, the scaffold is far more complicated than can be created in a lab. So why are people still attempting to do this? What's the worth in building catapults? Actually, there is *great* worth, and we need catapulteers.

As a novice bioengineer, I became frustrated with the slow pace of research and the bottom-up approach. But, as a self-avowed catapulteer, I realized that there were at least three ways in which I was contributing to medical science:

1) Catapulteers work to understand a system. Even if they don't build rockets, they discover new things about the concepts of construction, design, and function. Most bioengineering labs are simultaneously involved with an array of projects, and diverse insights (including those of catapulteers) are required for their successful completion.

2) The moon should not always be the goal. Replacing a patient's damaged organ is important, but there are plenty of other useful outcomes from bioengineering including 'spin-off' technologies. Currently, biologists usually test the effects of drugs and other chemicals on cells that are grown and maintained in Petri dishes, which are very unnatural environments for cells. With advances in cell-biology, imaging, nano-technology, and three-dimensional printing, however, these cell cultures are becoming increasingly sophisticated. Developing cell cultures in more physiologically realistic conditions should promote more realistic responses accordingly, which will provide better and more efficient data, saving time, money, and lives.

3) Rockets are not always available. Even if medical science overcomes organ transplant rejection, there will probably still be a dramatic lack of donors. Presently, thousands of patients die each year because organs are not available to save them. Unless presumed consent ("opt-out") laws are enacted, this may always be the case. Even if bioengineers cannot make a perfect organ, several products (liver substitutes) have been made that act as "bridges", helping a patient survive temporarily until a more permanent solution can be found. In cases where the whole organ does not need to be replaced, surgical repairs can be supported by synthetic products that can be grafted into a wounded site to promote healing.

Research may be slow and laborious, but novice bioengineers should not become disheartened if they discover that their products will never be used clinically. Bioengineering is a huge and rapidly expanding field, and there is plenty of room for further research and innovation. As these disciplines are interconnected in complex ways, nobody can predict what combination is required to stimulate the next big medical advance. And remember, that for every person who rockets to the moon, there is a legion of unsung heroes who didn't build the rocket, but without whom the moon would have remained just a dream.

These are pictures of the Chaitén volcano erupting in Chile and creating a “dirty thunderstorm”. Dirty th

hunderstorms are caused by the incredible amount of static electricity generated in a volcano's ash plume

The I, Science guide to: Modern Animal Research

By Shapaula Dass

1881 Louis Pasteur proposed the 'germ theory' of disease using silk worms and sheep

1898 Ronald Ross discovered the cycle of malaria through studying birds

1902 Lucien Cuénot was the first scientist to use mice in genetics research.

1914 Vitamin A is discovered by studying the diets of rats and mice.

1922 James Collip and a team of scientists isolate Insulin from a cow's pancreas to treat diabetic patients.

1940 Howard Florey and Ernst Chain provided definite evidence that penicillin could protect against infection, which lead to the mass purification and production of it.

1955 Successful development of the Polio vaccine using mice, rats and monkeys.

1967 First successful human heart transplant after years of animal transplants in cats and dogs.

1982 Using the armadillo, scientists are able to develop a vaccine against leprosy.

1996 'Dolly' the sheep is born, the first animal to be successfully cloned.

2002 The mouse genome is published in Nature

2008 The first whole organ transplant, using tissue engineered from stem cells, is carried out by researchers in Barcelona. Mice and pigs were used in pre-clinical studies to ensure it would be successful in humans.

Animal research has been used by humans for more than a hundred years to improve general health and develop new medicines. Resistance to this method of experimentation has been marked globally, with many regulations now surrounding it. As a consequence, animal research has undertaken an entirely new approach in regards to ethics. Yet many people still hold the old myths of animal experimentation as truth. Our guide aims to address these myths and expose the reality of animal research in the modern world. Firstly, we will take a brief look at past research which has taken place in this field.

It is clear that animal research is rooted deep within many aspects of biological science. Without these past discoveries, we would not have acquired the knowledge we have today. However, organisations such as the People for the Ethical Treatment of Animals (PETA) and the British Union for the Abolition of Vivisection (BUAV) have been using moral implications as an argument against this scientific progress, raising questions over poor welfare, pain and the necessity of such research. Below we size up these arguments and show whether these concerns can be at all sustained.

THERE IS NO POINT TO ANIMAL RESEARCH FOR HUMAN ADVANCES. THEY ARE DIFFERENT TO US.

Yes there are minor differences between animals and humans. But there are also important similarities. Humans have ancestors in common with other mammals: all are biologically alike, with the heart, lungs, liver, etc being regulated by a circulatory (blood) system and a nervous system.

Research into the role of vitamin C in guinea pigs led to our understanding of its action in humans. Also, we can use animal hormones in humans, such as thyrotropin from cows or oxytocin and vasopressin from pigs.

ANIMAL RESEARCH IS CHEAP. SCIENTISTS ONLY USE IT AS A COST EFFECTIVE OPTION.

Contrary to this belief, it is more expensive to use animals. This is because large numbers of staff need to be employed, including vets on 24-hour call to oversee the animals' welfare. Specialists also need months of training to work with animals. If researchers wanted a cheaper and safer option, they would not work with animals.

LAWS AND REGULATIONS ARE NOT IN PLACE FOR ANIMAL WELFARE. ANIMALS ARE MISTREATED.

Globally, modern animal research is highly regulated. National and international legislation, local laws and ethical groups are committed to maintaining the welfare of animals used in research. In fact, the UK is the only country in the world that must obey national regulations and submit its research proposals for ethical review.

Researchers are concerned about the welfare of their animals. Their research needs to be humane: healthy and calm animals are better than unhealthy and stressed animals because their state of well-being improves the reliability of the results. Researchers ensure that the animals are well-fed, well-housed and are kept free from illness or infection. Thankfully, for those who take advantage of animals in research through abusive means, there are laws in place to punish them accordingly. So scientists can continue to use animals for research in a humane manner.

THE ANIMALS FEEL PAIN AND STRESS. THEY GO THROUGH SO MUCH.

Animals may undergo many different types of procedures including blood tests, injections and changes in diet. Sometimes invasive procedures are carried out. If this is necessary the animal is given an anaesthetic or pain relief. As mentioned before, animals that are stressed will produce less reliable results. Therefore it is in the interest of the researcher to keep the animals' pain and stress to a minimum. Furthermore, Home Office inspectors, who are doctors or vets, ensure that welfare standards are adhered to. The law requires that if animals feel pain or stress, it must be reduced. If it cannot be reduced, the animal must be put down.

WHY DO THEY MOSTLY USE CATS, DOGS AND MONKEYS?

A recent research statistic showed that 80% of the animal research carried out is on rats or mice. Use of a cat or dog occurs in one in every 500 cases. Dogs are used because the size and similarity of their organs and system are comparable to that of humans. Cats are used for studies on hearing and brain function and are specifically bred for this purpose. It is against the law to use stray animals for research in the UK.

Primates are used in laboratory research in approximately one in 800 instances. They are used to study diseases such as AIDS and Alzheimer's. Apes are not used in the UK or anywhere else in Europe.

I HAVE HEARD THEY ARE USING ANIMALS IN COSMETICS RESEARCH. IS THIS NOT MORALLY WRONG? IT IS NOT HELPING FIGHT DISEASE.

Testing cosmetics on animals has been banned since 1998 in the UK. It will soon be illegal in Europe when this ban comes into force in 2010.

So there you have it: modern animal research. Using mostly rodents, strict rules are in place to ensure the welfare of all animals. Any pain or stress must, by law, be alleviated.

Although using animals is an expensive endeavour, the benefits surpass the costs. We now have effective vaccines, a further understanding of some biological processes and an insight into the genetics we share with other mammals.
Today, animal research is used to study a wide range of diseases including breast and cervical cancers, Parkinson's, Alzheimer's, diabetes and leukemia to name a few. But by law, it must be noted: 'animals are not to be used to obtain information that is obtainable by other means' (Animals Act 1986). Therefore even if animals are desired for certain testing, they will not be used if there is another method available. It seems there is no hard evidence of poor welfare, pain, or unnecessary experimentation that justifies the concerns associated with this field of study. If you ask me, modern animal research is not so bad after all.

The I, Science guide to:

By Henry Lau

I have to say two months ago I was a twitter critic. I didn't see the point of constantly writing pointless stuff about yourself like a hyperactive facebook addict. The only reason I joined twitter was to try and enter a competition to win a telescope. I didn't win, just to let you know.

The tipping point for me was coming across a post about 32 "scientwists" that have more than 2000 followers. And I thought for a bit, if these people had a fairly large following it was because the community thought what they were saying was important. And this brings me to what twitter is. Twitter is an information network. As well as being used for status updates, Twitter is a way of spreading news and giving a community a voice to a listening audience. If you have something good to say, people will listen and you can listen to the good things people say.

The list of 32 scientwists included people in fields that I wouldn't consider interesting, but some caught my eye to me so I started following them, causing their posts to appear on my feed..

Now, I have to admit, I'm a bit hooked. I love having semi-customised news that suits my interests delivered to me.

The only other piece of information you need to know about twitter is some of the terms used in the posts, or "tweets" as they are known. The @ symbol is used when you want to refer to someone else, much like a citation. This same thing has now been incorporated into facebook. This can be used to grab their attention or show thanks to someone. "RT" stands for retweet and shows the trail of users who have posted a certain snippet of news. And lastly hashtags, which use the # symbol, are used to note the topic of a tweet.

There are lots more stuff involved with twitter which I don't really know about, but I still enjoy using it. And without further ado I present a selection of twitterers worth following if you're interested in science news.

NatureNews – News from the prestigious science journal Nature.
lorddrayson – Minister For Science and Innovation at BIS
newscientist – News from new scientist.
SpaceFellowship – Spacey news
WiredScience – Science news from the American magazine wired
ImperialSpark – News from Imperial
Guardianscience – Science news from the guardian
NASA – NASA type stuff
bbcscitech - Science and technology from the BBC
I_science_mag – That is us!
Feliximperial – Student newspaper, Felix

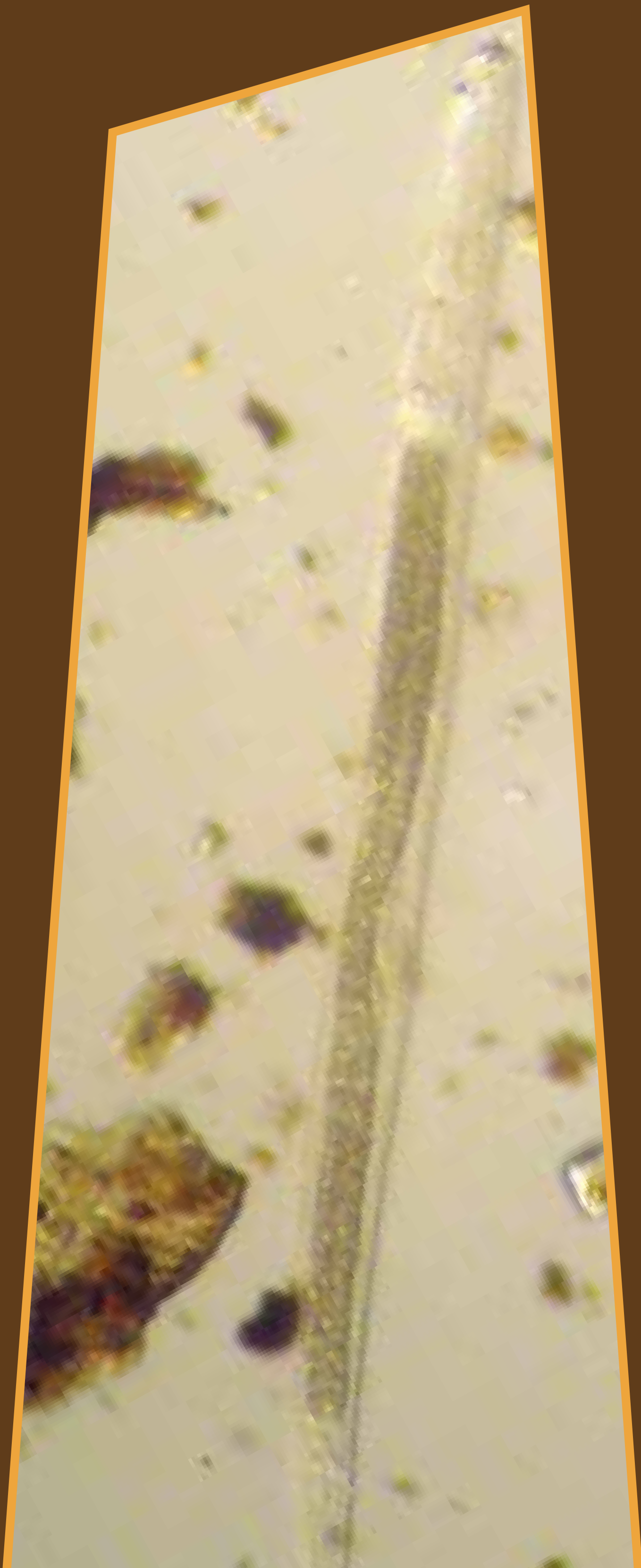
And here the original post where I found out about the 32 scientwists who have more than 2000 followers

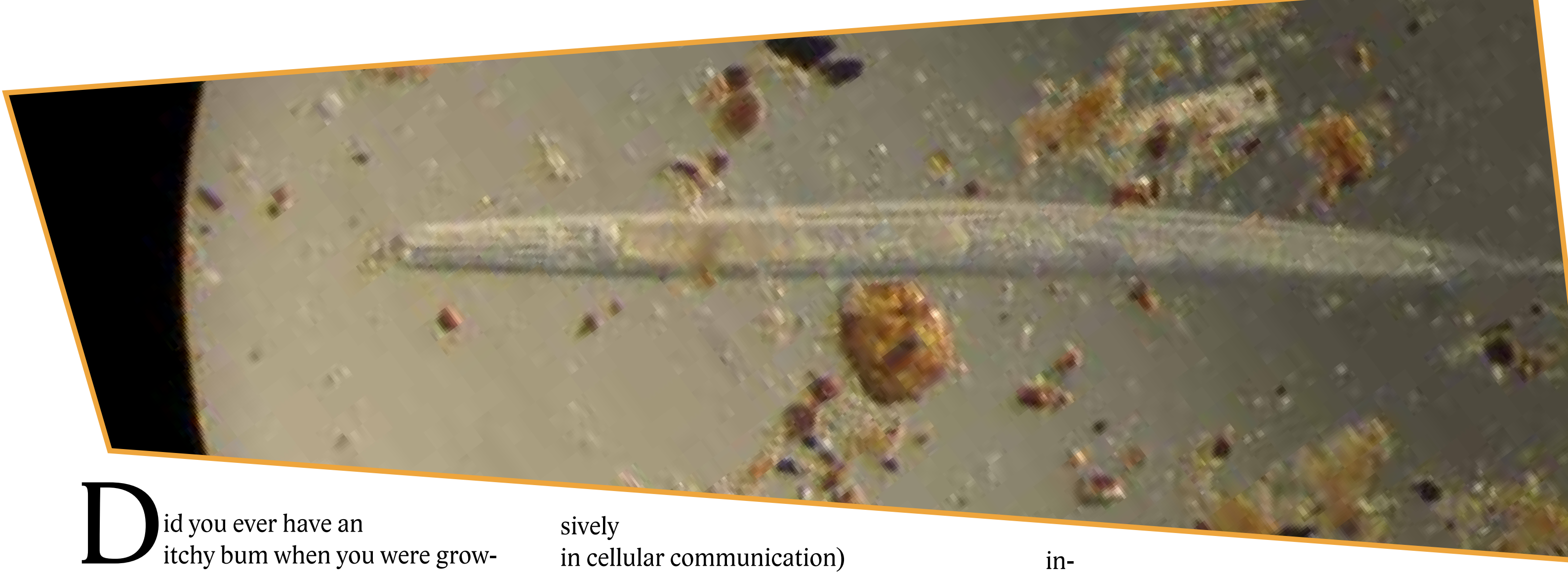
http://bit.ly/3ZuMcB

Old Worms, New Medicines.

Parasites: friend or foe?

By Dom Rees-Roberts





Did you ever have an itchy bum when you were growing up? If you did, the chances are you had pinworm (*Enterobius vermicularis*). This little parasitic nematode (roundworm), which lives in the gut of its host, is still quite prevalent in developed countries, despite improved hygiene and healthcare regimens. As disgusting, or intriguing as this sounds, depending on how you feel about sharing your gut with these creatures, they may be of some benefit if you suffer from allergies. An increase in allergy in the developed world has been broadly reported, but a definitive explanation for this increase seems to be elusive. Leading parasitologists are becoming more confident that a group of parasites might hold the key. There is mounting evidence that they might reduce the risk of inflammatory disease.

The organisms involved are what parasitologists collectively term helminthes; consisting of tiny parasitic nematodes like the pinworm, trematodes. These are more commonly called 'flukes' such as schistosomes which cause 'swimmers itch'. Lastly, cestodes or tapeworms, which reside in the host gut, can grow upwards of 30 metres. The helminthes are the groups of parasitic worms most relevant to humans in terms of disease and infection of livestock.

The increase in allergy in the developed world coincides with improved hygiene and a decrease in the incidence of parasitic helminth infection. Towards the end of the 20th century the 'hygiene hypothesis' was developed to explain this observation. It suggested that children growing up in hygienic conditions would not be exposed to enough pathogens to develop a healthy immune system. The human immune system has many multifaceted branches. One such branch consists of a set of T-cells that secrete certain signalling molecules called cytokines (They are a category of signalling molecules that are used extensively in cellular communication) in response to particular environmental signals, and help shape an appropriate immune response. The Type 1 T Helper Cells (Th1) secrete interferon gamma, which in turn activates macrophages, the cells adept at tackling microbial and viral infections. The Type 2 T Helper Cells (Th2) make interleukin 4 and 5 (IL-4 and IL-5) which promote the expansion of eosinophil (parasite and infection fighting) cell populations and the production of the antibody IgE. This response is associated with parasite clearance, but is also the same immunological profile found in allergic individuals. With allergy, the immune system mounts a full-blown immune response against an ordinarily harmless antigen, like peanuts or pollen.

The 'hygiene hypothesis' works on the assumption that the Th1 arm negatively regulates the Th2 arm and vice versa. If the Th1 arm of the immune system was not stimulated by enough bacteria and viruses it would not be strong enough to balance the Th2 arm, resulting in strong allergic reactions. But this hypothesis is problematic: numerous epidemiological studies have shown that people suffering from Th2 type diseases like asthma, can also suffer from diseases caused by a Th1 environment like Type-1 diabetes. Therefore, the Th1/Th2 paradigm is too simple, and a third element, a regulatory circuit was suggested.

Here's where it gets interesting. Multiple first hand studies have discovered that people in developing counties, infected with helminthes are less likely to exhibit allergy. These individuals have a strong Th2 immunological profile but without the pathology of allergic disease. The helminthes appeared to be having an effect: when they were cleared from the population using standard medication, the individuals became sensitive to allergens. When the helminthes were allowed to re-infect, the allergic response did not occur. Parasitologists believe that the parasites have evolved a mechanism that interacts with the host immune system, signalling it to attenuate its response. This allows the parasites to live in the host untroubled for prolonged periods of time. However, the effect is systemic; not only does the parasite modulate the strength of the immune response against itself, but also against other bystander antigens, explaining the reduced incidence of allergy in developing countries.

There has been a considerable amount of research over the past ten years investigating how these parasites modulate the immune system. It is apparent that the many different species of parasite have evolved slightly different mechanisms honed to their individual life cycle. However, most parasites appear to interact with the immune system at some point, inducing regulatory immune cells that mediate the immune response. Some of these parasites are particularly effective at controlling the immune system which has led scientists to consider harnessing this ability to treat inflammatory disease.

Infecting yourself with parasites for personal gain is not an original idea: as urban legend goes, people seeking a quick fix weight loss solution would turn to tapeworms. However, it's not quite the myth many would take it to be. The theory is pretty simple: as the worm establishes itself in your gut, it absorbs some of the nutrients you eat, you take on board fewer calories and subsequently lose weight. The hitch is that the effect is not the same for everybody, and there is a substantial health risk. Although most tapeworm infections are symptomless, complications can include abdominal pain, nausea, and diarrhoea; in particularly bad cases, convulsions or stroke-like episodes caused by stray parasites migrating to the brain.

It may surprise you that there are a number of websites offering this treatment, even though they are banned in the US by the Food and Drug Administration, the regulatory body on these matters.

Weight loss is not the only *potential* benefit a tapeworm can provide. Biologist and broadcaster Lyall Watson was an ardent explorer, but became tired of the diarrhoea, enteritis and dysentery that often plagued him on his exotic adventures. Armed with the hypothesis that tapeworms promote an exclusive environment in the gut, preventing other parasites from infecting the host, he persuaded a specialist at the London School of Hygiene and Tropical Medicine to give him *Taenia saginata*, a bovine tapeworm. Lyall continued his travels, eating what he wanted, even drinking water straight from the Ganges, with no ill effect. When he returned to London, the worm was purged with quinacrine, emerging intact at 10 meters long.

If you find the idea of a giant worm nestled in your gut unappealing then you might consider the more discrete hookworm. These small nematodes latch onto the gut wall and feed on host blood. Consequently, a high burden of hookworms can cause anaemia, as well as diarrhoea and nausea. These nematodes have an unusual lifecycle. The infective larvae migrate through the skin, causing intense itching, in order to reach the bloodstream. When they arrive at the lungs, the larvae migrate out of the blood into the alveoli (small nodules where oxygen enters the blood). During this phase the host can experience chest pain and wheezing. The tiny parasitic worms are then coughed up and swallowed, eventually making their way into the gut, where the larvae develop into adults.

Prof. David Prichard and his lab at Nottingham University have endured this process in the name of science. Following the epidemiological studies from developing countries, Prichard and his team are investigating whether the hookworm, *Necator americanus* can alleviate allergy first hand. They first proved that ingesting a controlled dose of hookworms was safe for humans, and subsequently secured ethical permission to start clinical trials. An initial randomized, placebo controlled trial, in which individuals with hay fever were dosed with just 10 larvae or histamine and this did not show any beneficial effect. The chances are that more hookworms are needed. This obviously has to be carefully balanced: just enough worms to regulate the immune system, but not too many that you suffer anaemia and diarrhoea.

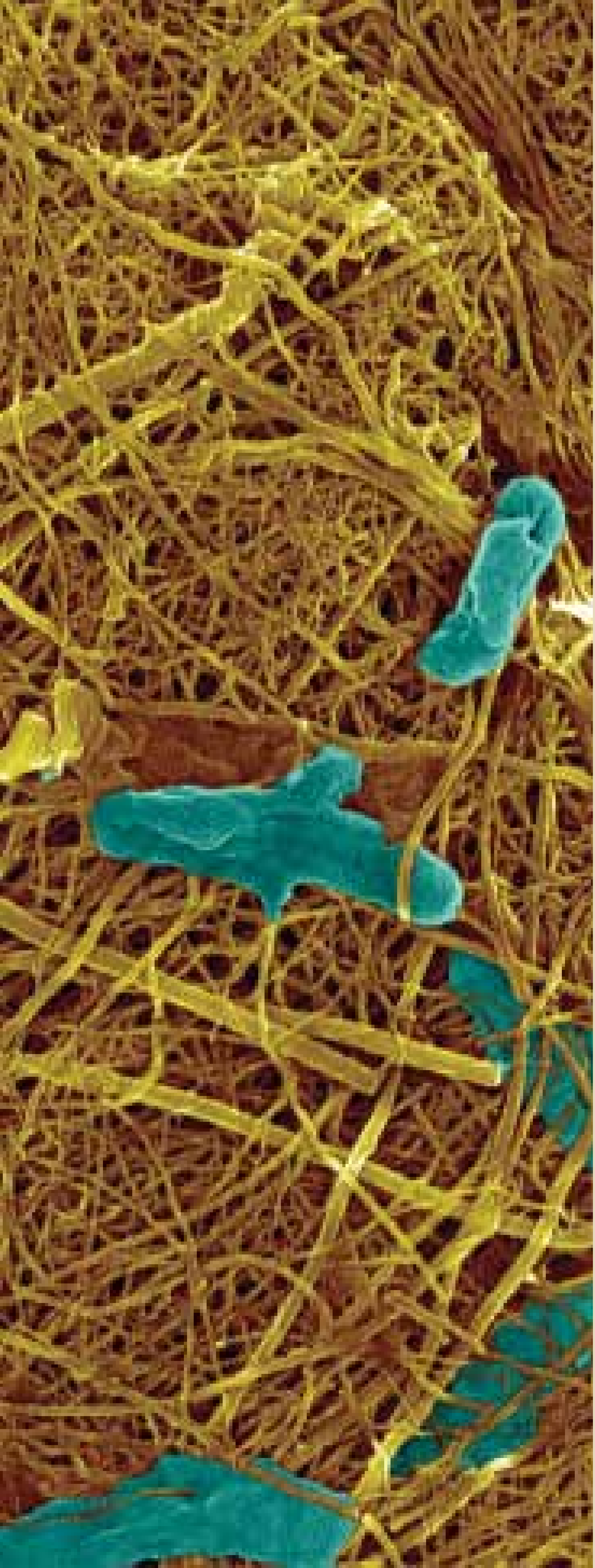
Encouragingly, Dr. Joel Weinstock at the Tuffs New England Medical Centre, Boston, has found that whipworms, which colonize the large intestine of their host, can improve inflammatory bowel diseases, such as Crohn's. Weinstock has dosed individuals suffering from Crohn's disease or ulcerative colitis with eggs from a pig whipworm (*Trichuris suis*) and achieved impressive results. All patients improved with many reaching remission, and larger trials are now underway. Unfortunately, pig whipworm doesn't establish a long-term infection in humans, and is rapidly expelled. As a result the beneficial effects are short-lived, and the patients need to be re-infected periodically.

Although *Necator* (parasitic hookworm) naturally infects humans, and can be sustained for prolonged periods, potentially imparting its beneficial effect for many years, there are negative issues associated with other chronic nematode infections. For instance, chronic whipworm infections have been associated with enhanced gut bacterial infection and have been linked to an increased incidence of cancer in the intestine. To avoid these problems, parasitologists are investigating the molecules parasites secrete, aiming to identify how the parasites influence the immune system.

Studies have shown that parasite secretions can manipulate the immune system, alleviating lung inflammation, Crohn's disease and rheumatoid arthritis in animal models of disease. But isolating the specific molecules involved from the complex cocktail of parasite proteins is difficult. Even if the effective compounds were successfully extracted to be administered to sufferers of allergic disease, alleviating the need for ingestion of live worms, their synthesis and the scaling up of production to make a commercially viable medicine is likely to be fraught with problems. The amazing anti-inflammatory properties of parasitic worms are unlikely to be available any time soon.

Whilst some scientists are attempting to explore the benefits of parasites, others aim to rid the world of parasitic infection. Although the parasites discussed here are rarely fatal, high infection rates in developing countries result in a significant number of deaths as well as a high morbidity rate. In addition, the number of people within continents such as Africa and South America incapacitated by high parasite burdens has a negative impact on the economy. Furthermore, the occurrence of drug resistance within parasite populations makes treating infection even harder. Scientists are now looking for possible vaccines to protect against parasite infection, and hope that in combination with improved education and hygiene, helminth infection can be controlled and possibly eliminated.

So, has that pinworm infection you had at the age of 5 protected you from developing allergy? Well, the jury's still out on pinworm. There is evidence to suggest that an active pinworm infection can protect from allergy, but other studies have shown that worm-free individuals with a history of infection have a higher likelihood of displaying some sort of allergy. In any case it seems highly likely that we have evolved a close relationship with parasitic worms. There is a strong possibility that our immune system has developed to normally function in the presence of parasite infection. In certain individuals, the absence of a worm might lead to unwanted allergic reactions, whilst those who had a worm infection but had it cured might also become prone to allergy. So, if you do decide worms are for you, you'd better prepare for the long haul.



By Ben Kolb

BACTERIAL 'SHIELD' DEFENDS AGAINST ANTIBIOTICS

A bacterium linked to hospital-acquired infections is able to produce a 'killing shield' that destroys white blood cells (WBCs).

Researchers at Copenhagen University and the Technical University of Denmark report that Pseudomonas aeruginosa can generate a molecular shield that covers the bacterial biofilm.

When P. aeruginosa detects nearby WBCs, the 'quorum sensing' communication system warns other bacteria in the biofilm. This triggers an increase in the production of molecules called rhamnolipids that sit on the biofilm's surface forming a shield.

Scientists hope the research will play a vital role in the molecular 'arms race' between us and bacteria.

BACTERIA: WHAT IS QUORUM SENSING?

In the late '60s scientists discovered that some bacteria could 'talk' to each other. This changed our general perception of bacteria and many other simple organisms which share our world.

Bacteria do not communicate with each other as humans do; instead they release signalling molecules into their environment. This process is known as quorum sensing (QS). These bacteria can also detect levels of the molecule, making it possible for them to measure the concentration within a population and sense the number of bacteria present.

Just as people speak different languages, different bacteria use different signalling molecules; one bacterial species cannot necessarily communicate with another species and not all bacteria can communicate with QS.

QS allows bacteria to coordinate their behaviour so they can then respond quickly to environmental changes. If there is sudden change in the levels of nutrients or another microorganism arrives that might be a competitor then a swift response aids survival. QS is particularly useful for pathogenic bacteria as a successful infection is aided by coordinating their virulence to evade a host's immune system.

BACTERIA: WHAT ARE RHAMNOLIPIDS?

Rhamnolipids are molecules made up of carbon, hydrogen and oxygen. They are naturally occurring glycolipids: a combination of one or two sugars called rhamnose and fatty acids.

These molecules are natural surfactants, antibiotics and fungicides; this makes them a very useful defensive tool for bacteria.

Rhamnolipids are also useful for us. They are used as a natural, environmentally friendly surfactant in cosmetics, detergents, soaps and shampoos and are ideal because they are only needed in low concentrations.

Science Babes &

By Ben Kolb

What image do you have of scientists? Often the scientists on screen are stereotyped as geeks and/or comic relief such as Doc Brown in Back to the Future or Q in James Bond. Rarely do we get to see sexy heroic scientists but when it does happen it is something to celebrate. I, Science have devoted this space to the valiant efforts of the beautiful scientist who despite working for hours in a lab and sometimes spending more time with the dead than the living, still manages to look a million dollars. Here are our top 5 sexy female scientists in cinema:

DR. DANA SCULLY / GILLIAN ANDERSON - X FILES

Sci-Fi's hottest sceptic, Dana Scully, has been around for over 15 years now and despite 2008's horrendous X Files: I Want to Believe still holds a special place in I, Science's heart (that's right, a university science magazine can have a heart!). As a forensic pathologist on the show, Scully is mainly considered a medical scientist but she did do a Bachelor's in Physics before becoming Mulder's calming influence.

DR. CHRISTMAS JONES / DENISE RICHARDS - THE WORLD IS NOT ENOUGH

Dr. Christmas Jones is one of the few scientists who dismantles nuclear warheads in nothing more than a vest and some shorts and for that she can only be commended. Despite all the risks, this scientist knows the value of aesthetics over practicality. Nuclear physics has never looked this good.

DR. EMMA RUSSELL / ELIZABETH SHUE -THE SAINT

Perhaps not an obvious choice Dr. Russell makes it into the top five by virtue of her integrity as well as her good looks. Elizabeth Shue's character represents the morality and utilitarian nature of science; she has discovered the formula for cold fusion and wants to give it away to the world. Let us not forget Shue also contributed to turning Kevin Bacon invisible but she would not want us to mention that.

DR. SUSAN MCCALLISTER / SAFFRON BURROWS - DEEP BLUE SEA

A subject in science that is rarely discussed is that when researching cures for Alzheimer's, the very real risk of creating genetically modified super intelligent sharks. Thankfully the makers of Deep Blue Sea were brave enough to bring it up. Dr. McCallister makes the list despite her dubious ethics because of her realisation that the most effective way to kill a shark is in your underwear.

DR. ELLIE SATTLER / LAURA DERN - JURASSIC PARK

Dr. Sattler is a Paleobotanist chosen to come to the island along with several other specialists and inspect the Park before it opens. Commendably, Sattler still looks hot even when up to her elbows in dino-poo. This scientist manages to get 'The Fly' and that guy from Dead Calm fighting over her. Dern's character also saves everyone's favourite childhood dinosaur, Triceratops. Clever girl!

& Science Hunks

By Natalie Mills

It's alright for the boys, they have it easy to find a fit female scientist in films these days. How else would Hollywood get bums on seats without Keira Knightley 'typing' save the day with their science powers? For us girls, it's a bit harder. Our choice generally consists of Jeff Goldblum or someone who looks like Einstein. No thanks. However, here at I, Science we have toiled tirelessly to bring you the five fittest male scientists in cinema. Sit back and enjoy.

ICHABOD CRANE / JOHNNY DEPP - SLEEPY HOLLOW

Ok, it's a bit tenuous but Johnny Depp is seriously gorgeous so we couldn't help ourselves. In Sleepy Hollow he's a city detective that likes to use forensic evidence and autopsy to solve crimes. Hurrah for medical science! However, the magic and mystery of the Headless Huntsman does sort of go against the whole idea that science has the answer, here it definitely doesn't. But at least he tried and managed to look strangely sexy throughout.

TONY STARK / ROBERT DOWNEY JR. - IRONMAN

Tony Stark, millionaire and genius, invents a super suit to save his life and fight some bad guys. At first, he stands for everything we hate in weapons development until he comes to his senses. He somehow manages to make tinkering in the lab entertaining when he's experimenting with rocket boosters and such. Not to mention the fact that Robert Downey Jr. is delicious, it makes us all want to work for Stark Industries by the end.

REED RICHARDS OR MR FANTASTIC / IOAN GRUFFUDD - FANTASTIC FOUR

Perhaps one of the worst movies ever made, but Mr Fantastic is definitely Mr Tasty. The film doesn't make any scientific sense, after all it's not like they're just dishing out mutations to make us all super-stretchy or invisible these days. However, Ioan Gruffudd does add something to the usual image of boring scientist in a lab coat. He is very hot, he saves people's lives and he's married to Jessica Alba. So that's got to count for something.

ROBERT NEVILLE / WILL SMITH - I AM LEGEND

The last man on Earth (who's not infected by zombie disease that is) is always going to be an attractive prospect but even more so when he is Will Smith. The loneliness and desperation that his character feels just adds that human dimension that is usually lacking in Hollywood scientists. It makes us just want to get him out of there and set up a research group with him. Or maybe, something a little bit more fun.

DR. JONATHAN CRANE OR THE SCARECROW / CILLIAN MURPHY - BATMAN BEGINS

We had to have an evil scientist in here somewhere! This one just happens to be really fit as well. However, that only counts when he is not wearing that bag on his head as the seriously creepy 'scarecrow'. Most of the time he just your typical, everyday mad psychiatrist; who we can't help but feel secretly attracted to. After all, none of us can help but fancy the bad guy, especially when he is a scientist too.


HAPP
NEW YE

Science New Year Resolutions

By Ben Kolb

The New Year provides a natural marker for turning over a new leaf or changing your lifestyle for the better in some way. The standard New Year's resolutions often involve personal health: commitments to lose weight or give up smoking for example. Perhaps in these tough economic times, more people will resolve to save more money. Others might decide to do more for charity in 2010.

The possibilities for resolutions are limited largely by only our imaginations. This year, however, if you cannot come up with a good one, I, Science has drawn up a selection of resolutions for scientists and non-scientists to consider:

REDUCE YOUR CARBON FOOTPRINT. I, Science will not insult you by suggesting how to do this but for 2010 why not give it a try? If you do need tips though, check out http://actonco2.direct.gov.uk/

STOP EATING YOUR LUNCH AT THE WORKBENCH. Firstly, it is kind of dangerous and secondly, be social and eat with some human beings!

LEARN A NEW SCIENTIFIC TERM EVERY WEEK. Or if you are really ambitious, every day! Maybe you could post a little entry about it on a blog so others can access this ever-expanding resource.

THINK SCEPTICALLY. Just because someone who appears knowledgeable asserts something, does not make it true, even Stephen Fry!

GET CURIOUS. Do not take the world around you for granted. Try to start wondering how things work and why they are the way that they are. Curiosity leads to experimentation and, before you know it, you'll be doing things you never thought you would.

STOP FALSIFYING YOUR RESULTS. It is tempting to make a few minor changes to results, make some graphs look a bit neater, but don't! What would the philosopher of science Karl Popper say?! Karl meant falsify your theories not your results!

GET YOURSELF A TELESCOPE, DO SOME AMATEUR ASTRONOMY. There is nothing like looking up at the night sky and seeing infinite stars to get some perspective. Who knows what you might see? If you want any advice, why not try http://britastro.org

CHECK OUT SCIENCE MUSEUM LATES. The Science Museum's worst kept secret is a great night out whether you think you like science or not. Once a month, grown-ups are let loose in the museum and get the chance to use all the kids' exhibits without looking like a weirdo. There are also talks, experiments, a silent disco and much more. Do remember to arrive early though to avoid the queues. Try http://bit.ly/E1f6m for more information.

GO ALONG TO CAFE SCIENTIFIQUE. There are Cafés all over the country so find out your local one and head along for an evening. These events are a great opportunity to meet people and discuss science in a relaxed and fun environment. http://www.cafescientifique.org/

JOIN YOUR LOCAL WILDLIFE TRUST. There are Wildlife Trusts all over the country and they are dedicated to the UK's wildlife habitats and species. Apart from doing your bit for nature, you can learn a lot about the species we share these isles with. http://www.wildlifetrusts.org/

STAY CALM ABOUT THE LARGE HADRON COLLIDER. After all these months waiting for it to be nursed back to health, it would be too much if it broke again!

TRY TO HAVE A COFFEE WITH A SCIENTIST FROM OUTSIDE YOUR LAB. When working in close-knit groups, it can be all too easy to socialise in small circles of colleagues. Perhaps in 2010 you will meet some new people and discuss other areas of your science. If you are feeling really brave, why not go crazy and have a coffee with a scientist from another building?!

START A SCIENCE BLOG/TWITTER FEED. Whether you know nothing about science or you are Albert Einstein, you can write a science blog or start a science twitter feed. Perhaps this blog could describe your journey into science or, for the more experienced, tell the world about the science you do and the science you love.

ENGAGE WITH THE PUBLIC. It does not matter what your peers say, you will probably even enjoy it. And no, your scientific papers do not count! If someone asks to interview you or offers you the chance to do Café Scientifique, give it a try in 2010!

STOP READING SCIENTIFIC PAPERS AT THE GYM. I, Science has seen you at Ethos on the cross trainers and the treadmills! If you have to read, try reading a novel, not a scientific paper!

Tell us what you think of the new I, Science

I,SCIENCE IS <u>YOUR</u> STUDENT SCIENCE MAGAZINE. WE WELCOME YOUR COMMENTS, SUGGESTIONS AND CONTRIBUTIONS. IF YOU'D LIKE TO WRITE FOR I,SCIENCE, PLEASE CONTACT US AT I.SCIENCE@IMPERIAL.AC.UK.

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Behind the scenes - meet the team

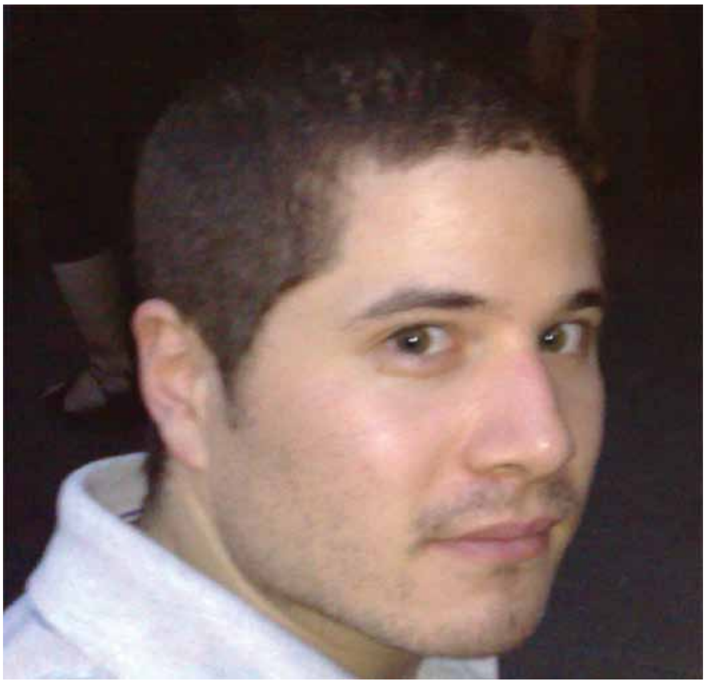
ADRIAN GIORDANI - EDITOR IN CHIEF

Hello, I'm Adrian G, Editor-in-Chief of I, Science.

I am currently doing a MSc in Science Communication here at Imperial and it has been great going so far. Imperial was my first choice for this masters as it is one of the most renowned institutions in the country, if not the world. Before I made the conscious decision to rejoin academia I was working for five years. This has given me indispensable experience of the commercial sector and allowed me to get a taste of the real world.

My hobbies include fencing, handball and tango dancing, but I also love trying out new things. Imperial is a fantastic place if you want to take part in extracurricular activities and are able to balance work and play.

So that's me in a nutshell, if you recognise me on campus come and say hello, I'm very friendly.

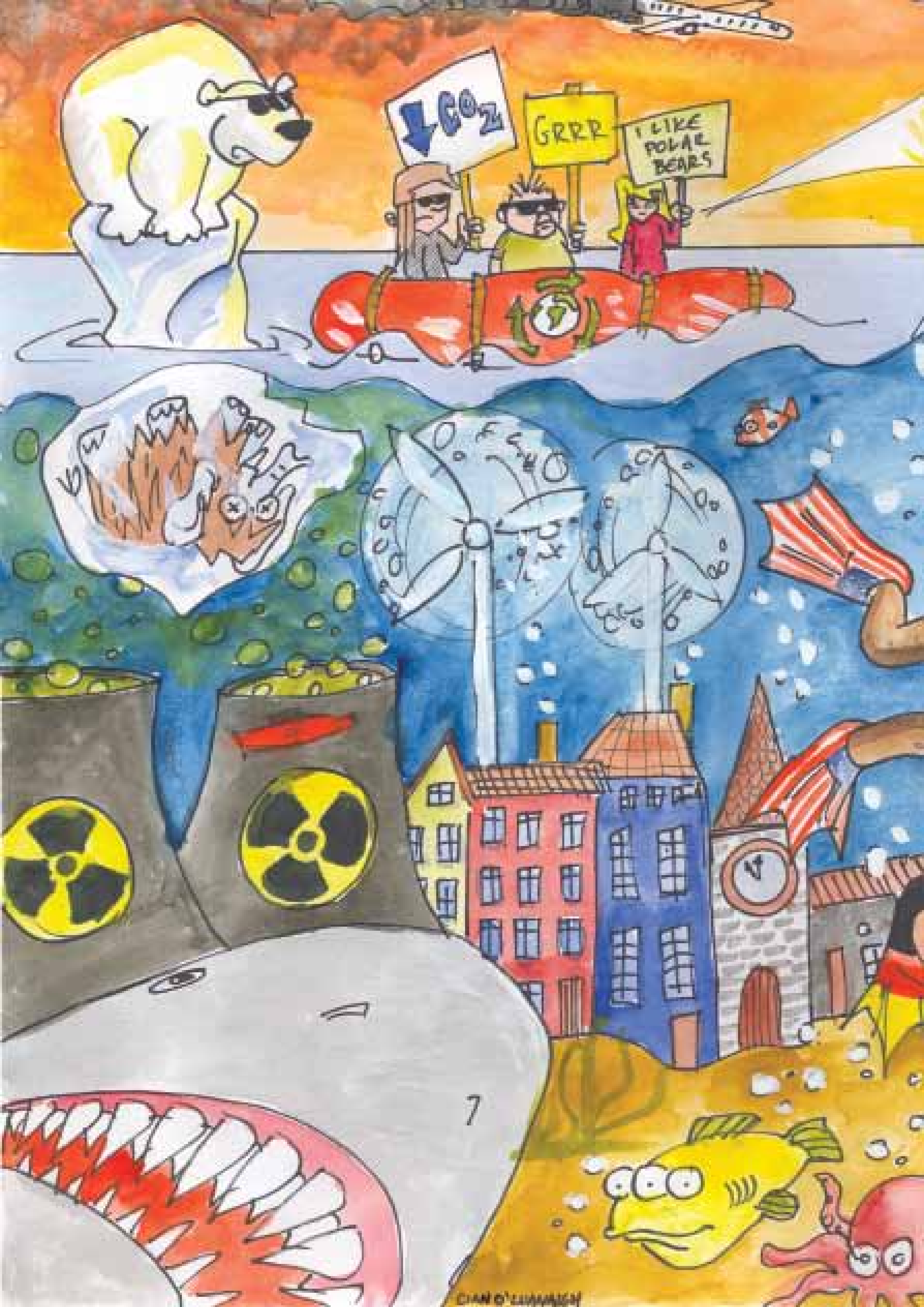


HENRY LAU - PRODUCTION MANAGER

Hi, I'm Henry and my job at I, Science as production manager is to put everything together. This involves getting all the articles, putting them into a fancy program, shaking vigorously and hey presto - out comes the beautiful I, Science magazine you are holding in your hands.

I too am on the same MSc as Adrian, but I did my undergrad in physics with astrophysics. As part of my degree I went abroad and studied in France for a year. I was fortunate enough to be placed in Nice on the Cote d'Azur. It was hard learning physics in French with my barely-existant French, but the palm trees on my campus, rolling mountains, the Mediterranean, sunshine and French bread made up for it. And the best part is I can now speak French.

I'm play ultimate frisbee with the Imperial team, Disc Doctors. It's a lot of fun, good exercise and you look so cool when you getting the trick throws out come summer. Anyway hope you enjoy I, Science.


CO2
GRRR
I LIKE POLAR BEARS