I, Science (Print) ISSN 2044-2114
I, Science (Online) ISSN 2044-2122

I, Science

Spring 2010

Inside:

Is Chocolate actually good for you?

From the editor

EDITORIAL TEAM

EDITOR IN CHIEF
Adrian Giordani

PRODUCTION
Henry Lau
Aurelie Perthuison

CONTRIBUTERS
Sarah Barker
Anne Coleman
Jamie Condliffe
Miriam Frankel
Adrian Giordani
Ben Kolb
Natalie Mills
Cian O'Luanaigh
Cecilia Rosen
Rhiannon Smith
Chanin Suriyakul
Harriet Vickers

PHOTOGRAPHY
Jonathan Primmer

I,science is produced and published in association with Felix, the student newspaper of Imperial College

I, science (Print)
ISSN 2044-2114
I, science (Online)
ISSN 2044-2122

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

Printed by Indigo Press
Cambridge Road, Southampton
S014 6TB, 023 8023 1196

Happy Belated Easter and welcome back from a well deserved break. Whatever you were doing; revising, eating chocolate, catching up with old friends or making new ones, get ready for an exciting new edition of I, Science! We are a little late in reaching you this term, but as the saying goes; better late than never.

While it's been a few weeks since Easter I thought it important to enlighten you with a range of special features, before the exam stress sets in. Find out about what caused Easter Island's demise, the top sci-fi TV shows as voted by you, what the El Salvadoran Environment Minister had to say about climate change and what the three R's are all about. Our exciting main stories include London's Swingers and the human story behind the Royal Society. We also have an exclusive, in which we interviewed British doctor and 'Bad Science' author Ben Goldacre – read on to see who came out on top in 'Ben versus Ben'. So take a break from revision, pick up our magazine, and let us entertain and educate you with the latest science news and features. Otherwise you can just have a dabble with I, Science Sudoku.

Check out the latest in science communication on our website at http://dougal.union.ic.ac.uk/media/iscience/. If you would like to voice your constructive comments or criticisms about this issue or for any other questions please email **i.science@imperial.ac.uk** or post them on Twitter: **http://twitter.com/I_science_mag**.

I also wish to thank our sponsors for making this issue possible and all our proof-reading, illustrating, production and writing staff for their energetic contributions. This may well be the last issue of the academic year; hopefully we'll be able to get one more out in the summer so keep your eyes peeled. But if we don't, it's been a pleasure, and from me and the rest of the current team – it's been emotional.

Spring 2010

Contents

News and Events

Features

Top News

CONCLUSIVE, 'GIANT ASTEROID' DEALT THE FINAL BLOW - *Ben Kolb*

An asteroid collision, and not extreme volcanic activity, is the cause of the dinosaurs' extinction according to a recent review of all the evidence.

An international panel of experts, including scientists from Imperial College, London, have published a review in the journal, Science of the evidence gathered over the past twenty years.

The Cretaceous-Tertiary (KT) extinction wiped out more than half of all species on the planet, including the dinosaurs.

The review indicates that a massive fifteen kilometre asteroid struck the Earth, in Mexico, with a force one billion times stronger than the atomic bomb at Hiroshima.

Evidence suggests that the super-volcano explanation would not have been damaging enough for the rapid KT mass extinction.

Dr. Gareth Collins, of Imperial's Department of Earth Science and Engineering, who co-authored the review said: "The asteroid was about the size of the Isle of Wight and hit Earth 20 times faster than a speeding bullet."

Source: http://www3.imperial.ac.uk/newsandeventspggrp/imperial-college/newssummary/news_5-3-2010-8-44-7?newsid=86001

'GENERAL RELATIVITY' PREDICTIONS OBSERVED AT COSMIC SCALES - *Chanin Suriyakul*

The theory of gravity, proposed in Albert Einstein's 1916 'General Theory of Relativity', explained the more complex motion of large objects in the universe.

Recently, Reinabelle Reyes and her colleagues, from the Department of Astrophysical Sciences at Princeton University in New Jersey, studied data from more than 70,000 bright, elliptical galaxies.

They found that galaxies, located up to 3.5 billion light-years from Earth, are pulled together by gravity, making them cluster. This finding supports the predictions made by general relativity theory that some celestial bodies move as if they had more mass than observed.

By measuring the clustering, movement, and the way the galaxies bent light relative to one another, Reyes' team calculated an EG, (a quantity used when looking at an object's expected interactions) of 0.39, close to General Relativity's prediction of 0.4.

This study suggests that dark matter and dark energy are not just the dreams of physicists!

Source: http://www.princeton.edu/main/news/archive/S26/84/06S95/index.xml?section=topstories

Paper: http://www.nature.com/nature/journal/v464/n7286/full/nature08857.html

IMMUNE CELLS 'KILLER TETHER' - *Ben Kolb*

Scientists at Imperial College London have discovered that some immune cells use a bungee-like nanotube to 'lasso' dangerous cells that could otherwise escape.

The research, published in the Proceedings of the National Academy of Sciences, is a step towards showing how natural killer (NK) cells work.

NK cells are the first line of defence against bacteria, virus-infected cells and tumour growths inside the body.

Researchers hope to harness the cell's abilities, in order to improve drug treatments in the fight against cancer.

Previously, scientists thought NK cells only killed by attaching themselves to the unwanted cells and releasing toxins through a connection with their target, called an 'immune synapse.'

Co-author of the study, Professor Daniel Davis of Imperial's Division of Cell and Molecular Biology, said: "It's a very new research area and we need to learn how the process works precisely so that we can then think about ways to design drugs that help immune cells kill."

Source: http://www3.imperial.ac.uk/newsandeventspggrp/imperial-college/newssummary/news_9-3-2010-10-47-8

Paper: http://www.pnas.org/content/early/2010/03/03/0910074107.abstract

BLUE MOON - *Miriam Frankel*

The past year has been exciting for lunar scientists, who have discovered both ice water and water vapor on the Moon. Now, they have found water ice in over forty craters at the lunar North Pole.

The ice-filled craters are permanently shadowed and cannot be observed from Earth. Instead, it was the NASA radar instrument 'Mini-Sar', aboard India's lunar mission Chandrayaan-1, that picked up their ice-like radar characteristics.

The craters are between two and fifteen kilometers in diameter and should contain at least a couple of meters of ice. Scientists think there could be as much as 600 million metric tonnes of water ice on the Moon's North Pole.

This discovery is important as it might facilitate future space travel. Astronauts could melt the ice into drinking water or split it into its components of oxygen and hydrogen, to provide breathing air and rocket fuel for launching interplanetary missions from the Moon.

Source: http://news.bbc.co.uk/1/hi/8544635.stm

EVENTS NEWS

My Technology Can Save the World

Geo-engineering technology could change our environment and tackle climate change, but which project is worth the money? Help the 'dragons' quiz the experts presenting different ideas and vote to decide who'd get your cash.

Wednesday 19 May 2010
19:00 - 20:45

SPEAKERS:
Tim Fox IMechE
Nem Vaughan, geo-engineering PhD student UEA

The Three R's

By Natalie Mills

Spring is all about the three R's: Revival, Rejuvenation and Rebirth. And I don't mean a revival of dodgy 90's boy-bands either. Spring is the time of year that life comes back to the world around us, from flower buds to cutesy lambs. But what does science have to say? Here are some of the extreme ways that scientists are exploring the three R's.

Even cryogenically preserved human embryos have been frozen for as much as twelve years before being used

REVIVAL

We've all heard of cryogenics and you probably view it as a crazy science fiction idea. Yet it is a legitimate tool in scientific research. Liquid nitrogen has been used for decades to preserve biological samples at temperatures as low as -196˚C. Even cryogenically preserved human embryos have been frozen for as much as twelve years before being used, still leading to a healthy pregnancy. However, going one step further; having your body cryogenically frozen doesn't guarantee you'll wake up at the other end.

To be preserved, all the water in your blood is replaced by anti-freeze solution or 'cryoprotectants', to prevent the formation of ice crystals in your cells, which damage them. They then place you in liquid nitrogen at -130˚C and the cryoprotectants in your body harden like glass in a process called 'vitrification'. Your body is now relatively safe from damage, with only toxicity from the cryoprotectants to worry about.

You then wait for science to develop a way to revive and cure you of whatever disease that killed you. Needless to say you will be waiting a while. The closest to reanimation that scientists have come so far is cooling dogs and monkeys to 0˚C with the use of cryoprotectants and reviving them days later.

REJUVENATION

Do we have a better hope with rejuvenation?

In 2009, the Nobel Prize for Medicine was awarded for research on 'telomeres'. These are the protective ends of our chromosomes –like the tabs at the end of shoelaces. An enzyme called telomerase keeps the telomeres replenished. However, in adults this enzyme is no longer expressed and so the telomeres get shorter with every cell division. This eventually leads to the cells aging and dying. The loss of telomeres has been implicated in the aging process.

The loss of telomeres has been implicated in the aging process

Understandably a lot of interest has surrounded telomere research. Some companies have used this work to develop telomerase-activating products, like TA-65, an extract from the Astralagus herb used in Chinese medicine. This is associated with telomerase activation. As it is a supplement, it has not yet been scientifically tested via drug trials. But if this or any other future telomerase activation drug were to be successful, there is the risk of some serious side effects. High levels of telomerase activity are associated with tumours, because cancer cells are long-lived and proliferate fast. One thing they don't need more of is telomerase.

REBIRTH

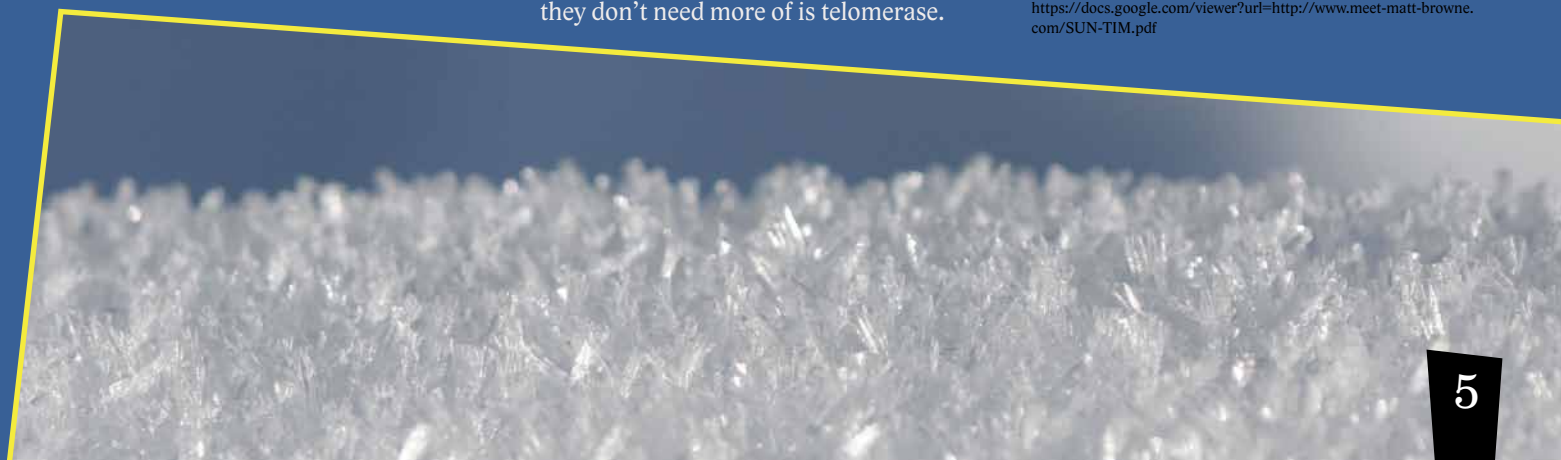
Perhaps science has a better chance with rebirth?
The closest science gets to rebirth is with an unusual type of fertility treatment. Banned in the UK, a new procedure in IVF could provide a way to be born again. That is if you are an identical twin, like our Editor. The new process, intended for women with low egg production, involves the separation of cells from one fertilised embryo. With four identical embryos created, one could be implanted and the rest cryogenically frozen. If successful first-time round, the mother could have another embryo implanted years later. This could result in an identical twin being born years after the first. Similar events have already happened with non-identical twins; Charlotte and Emily Hinch. If this procedure works, children of the future could witness themselves being born again.

If any or all of these extreme steps in science are possible or even ethical, they show us how far we could to go. Whether we should venture there is another matter entirely...

References:
TELOMERES:
http://www.worldhealth.net/news/first-genetic-variant-linked-biological-aging-huma/
http://www.scientificamerican.com/article.cfm?id=anti-aging-pill-targets-telomeres

CRYOGENICS:
http://www.alcor.org/Library/index.html#scientific
http://www.cryonics.org/prod.html

REBIRTH:
http://www.questia.com/googleScholar.qst;jsessionid=LCjTQ4pj4yq1y4qkB1MnXjWLxYSBvnpXL5fr9Cvvg111chg8YT0P!811041904!131650410?docId=5002204840
https://docs.google.com/viewer?url=http://www.ama-assn.org/ama1/pub/upload/mm/code-medical-ethics/2145a.pdf
http://news.google.com/newspapers?nid=1755&dat=19931026&id=3rkcAAAAIBAJ&sjid=B3wEAAAAIBAJ&pg=6769,267578
https://docs.google.com/viewer?url=http://www.meet-matt-browne.com/SUN-TIM.pdf



El Salvador: Climate, Politics, Science

By Adrian Giordani

The recent catastrophe in Haiti at the start of 2010 has emphasised the very real and current vulnerability of developing countries to unexpected climate change. Only last December, the world's leaders met at the Copenhagen Climate Conference. The world looked on to see whether an international and legally binding agreement would be reached that established quantifiable targets to reduce members' carbon emissions. Some have criticised that the conference was a failure and dictated by the developed world. How are developing countries reacting to the outcome of the conference and what are they themselves doing to combat the threat of climate change?

One such country, the small Central American state of El Salvador has recently elected a new government, one of whose many major tasks is to bring climate change strategies to the top of their agenda. A 2007 World Bank report states that at the end of the nineties, El Salvador made significant improvements to its legal and institutional framework for environmental protection. Environmental issues have gained increased traction due to the negative effects brought on by natural disasters and environmental degradation. The Government has also put in place a number of national scale policies to tackle specific issues, therefore raising the importance of environmental issues within the national agenda and civil service, and also, most importantly escalating accountability.

On January 25th 2010, El Salvador's Minister of the Environment, Mr. Rosa Chavez was in London to meet with UK officials to discuss future climate change strategies and I, Science managed to catch him during his busy schedule for an interview. Mr. Chavez's fifteen year experience as an engineer gives him a unique perspective and distinct advantage in his new role. He worked at the Applied Research Centre for Environmental and Developmental Issues, looking particularly at how both areas intersect, not just in Central America, but in Asia and Africa as well.

WHAT ABOUT CLIMATE CHANGE?

On the role of the international community and the outcome of the Copenhagen Conference he believed that even though the level of awareness amongst the international community has increased greatly in the last fifteen years, there were significant problems of 'power relationships'. He elaborated that in an 'unequal world' some parties tried to set the agenda and force an agreement for only a limited number of countries, separate from the formal negotiations. He finished with; "damage control is necessary" and "I hope what happened in Copenhagen will not repeat itself."

The minister stated that climate change in El Salvador is "a source of conflict" and one of the tools he uses to combat the effect is 'preparedness'. This could be, for example, identifying areas where there are high concentrations of people at risk from potential hazard zones where soils could liquefy due to tectonic stresses or landslide regions susceptible to earthquakes. Serious micro-level mapping work is needed to construct a permanently updateable 'risk-atlas', allowing his team to quickly identify target areas so families can be moved out of danger, thus saving lives.

Mr. Chavez thought that the rest of the world should not see environmental issues in isolation, and that there are no 'national borders' from this real and current threat. For instance, his country is currently paying significant economical

Reference: http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/ELSALVADOREXTN/0,,contentMDK:21495616~pagePK:141137~piPK:141127~theSitePK:295244,00.html

costs due to heavy rainfall which occurred for only a few hours in November, but was equivalent to the entire rainfall in the previous month of September. This phenomenon was unheard of by his colleagues in Government, which is why he strongly thinks sincere actions are needed at the international level. Especially from consumer orientated countries like the US who have an energy per capita emission level that is five to twenty times higher more than any other country in the world. Developed countries also have a historical responsibility to make the greatest efforts for change in their lifestyles and policies.

WHERE DOES SCIENCE FIT IN?

Science plays a vital role in convincing people, especially climate sceptics, that climate change is a major threat. Through scientific evidence, Mr. Chavez now has the 'ammunition' to persuade the political establishment to act, neutralising the voice of sceptics; although he has pointed out that it is not science's sole responsibility to muster political will. He thinks a country's citizens must also apply pressure to their governments to take the necessary steps. Communication is a huge challenge and Mr. Chavez has noticed a direct correlation in developed countries, "between the level of awareness of a population and how advanced these countries are in the decisions they're making." In regards to his own ministry, science also plays an important role in monitoring natural disasters as the meteorological and seismic departments also fall under his office. People rely on his ministry for the 'hard facts'. Ironically, their website tends to collapse because of traffic overload when there is a major environmental incident. Moreover, he elaborated that beyond data you need analysis, so that data can be turned into information and knowledge to help people make decisions.

> Through scientific evidence, Mr. Chavez now has the 'ammunition' to persuade the political establishment to act

When asked about how he persuades Salvadorans to accept policy changes, he responded that, "transparency and the rule of law are essential, which had not been the norm." Subsequently, the process by which his department evaluates grants for building work is by requiring the presentation of environmental impact studies or structural works. These in turn are hosted on their website for review by the public. There is also a mechanism where people can present arguments if they feel they are affected; audits are commissioned and the results are publicly displayed.

> transparency and the rule of law are essential, which had not been the norm

As his government has only been in office for eight months, Mr. Chavez feels things are not moving fast enough and capacity building needs to be started seriously. By 'capacity building' he explained, "for instance, I'm part of the energy commission, and as a minister I have a voice in determining in concrete ways how energy policy should be defined." In turn, significant projects and recommendations are his top priority, requiring him to assemble a team of experts within the ministry who specialise on energy issues and who can fully integrate social and environmental criteria. He concluded by stressing the importance of; "training this group so that they are at the cutting edge of how these issues are being discussed."

HOW IMPORTANT IS POLITICS?

Politics tends to be short lived by nature when compared to the long-lasting effects of climate change. We finished by asking how he thought policy could work in an environment of constant personnel turnover. The minister replied that what is needed is a governance scheme that goes beyond national boundaries; a body such as the European Union which controls directives. An international governance scheme is required to enable all countries to commit themselves to doing certain things. That's why; he thinks it is very important that negotiations continue under the United Nations conventions for climate change. An international forum where rules are defined would protect governments and politicians to agree to fulfil international agreements, even if there is a change of government.

El Salvador has a number of considerable hurdles to overcome; one of Mr Chavez's revelations was that; "even deforestation at present is driven by urbanisation, not agriculture." Promisingly, it sounds like they're mindful of the necessary steps that will facilitate real change. Will the rest of the developed world wake up and realise that partial agreements and half-hearted attempts will only hinder progress in forming a unified framework. Sincere efforts and collaboration are needed, ensuring countries are made accountable to the international community against the increasing frequency and threats of climate change.

PROFILE: EL SALVADOR *by Cecelia Rosen*

El Salvador means "The Saviour" in Spanish and is the smallest and most densely populated country in Central America with some 7 million people. Around 90% of the population is considered of mixed indigenous and Spanish extraction; virtually all of the habitants speak Spanish.

Located between Honduras and Guatemala, El Salvador lies on the Gulf of Fonseca. They achieved independence from Spain in 1821and from the Central American Federation in 1839. A twelve-year civil war, which cost about 75,000 lives, was brought to a close in 1992 when the government and leftist rebels signed a treaty that established military and political reforms.
Mauricio Funes is the current President. His election victory in March 2009 marked the first time in 20 years that a left-wing leader had come to power in the country.

Despite being the smallest country geographically in Central America, El Salvador has the third largest economy with a per capita income that is roughly half that of Costa Rica and Panama, but double that of Nicaragua. The US dollar became El Salvador's currency in 2001.

On environmental issues, El Salvador is party to the following treaties: Biodiversity, Climate Change, Climate Change-Kyoto Protocol, Desertification, Endangered Species, Hazardous Wastes, Ozone Layer Protection, and Wetlands.
The new government redesigned the environment policy in 2009, which takes priority to governance, an active citizenship and transparency.

The Mysteries of Easter Island

By Rhiannon Smith

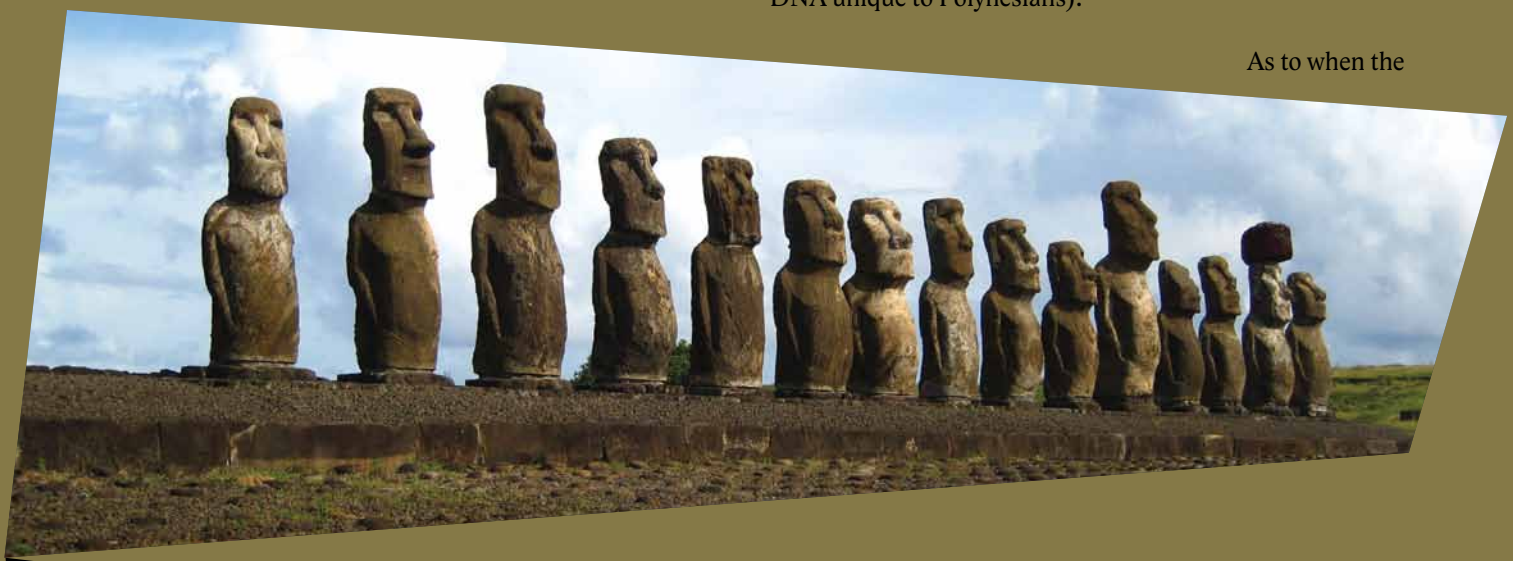
Easter Island, or Rapa Nui as it is known by locals, is one of the most isolated places on the planet; a tiny volcanic rock in the South Pacific. The island's inhabitants are over 2,000 miles and a five hour flight from their neighbours on the Chilean mainland. The name "Easter Island" was given by Dutch explorer Jacob Roggeveen who landed on Easter Sunday in the year 1722. As the island's first recorded visitor, Roggeveen must have been fascinated to discover a highly sophisticated society and in particular, hundreds of (now famous) monumental statues, known as Moai, lining the coast.

islanders themselves caused the collapse of the island's ecosystem by drastically overexploiting their natural resources

The rich and mysterious cultural history of Easter Island includes slave raids, epidemics and civil war. More importantly, in what some believe to be a haunting premonition into our future; islanders themselves caused the collapse of the island's ecosystem by drastically overexploiting their natural resources. The population crashed considerably from over 12,000 to just 111 by 1877. Today, due to immigration, the inhabitants are all of Chilean heritage, and consequently much of the legend and history of Easter Island has been lost forever. Now we must rely upon science to piece together mysteries such as; who were the original inhabitants of the Island? How did they erect such massive statues? How did their lifestyle cause the collapse of a whole ecosystem?

Given the extreme isolation of Easter Island, the question of where the original inhabitants came from is intriguing. In the 1950's there were two theories, one proposed that the islanders came from South America while the other suggested that they came from the opposite direction, Polynesia. Both theories were hotly debated until geneticists were able to examine DNA extracted from skeletons on the island. They found a genetic marker called a 'Polynesian motif' (a characteristic stretch of DNA unique to Polynesians).

As to when the



islanders first arrived, archaeology was called upon. Carbon dating was conducted on artefacts found on the island, and most scholars agree that the inhabitants settled around 700 AD. What is established is that once they had settled, the new inhabitants flourished. The population grew rapidly and the society's success is still visible today in the hundreds of spectacular Moai around the island.

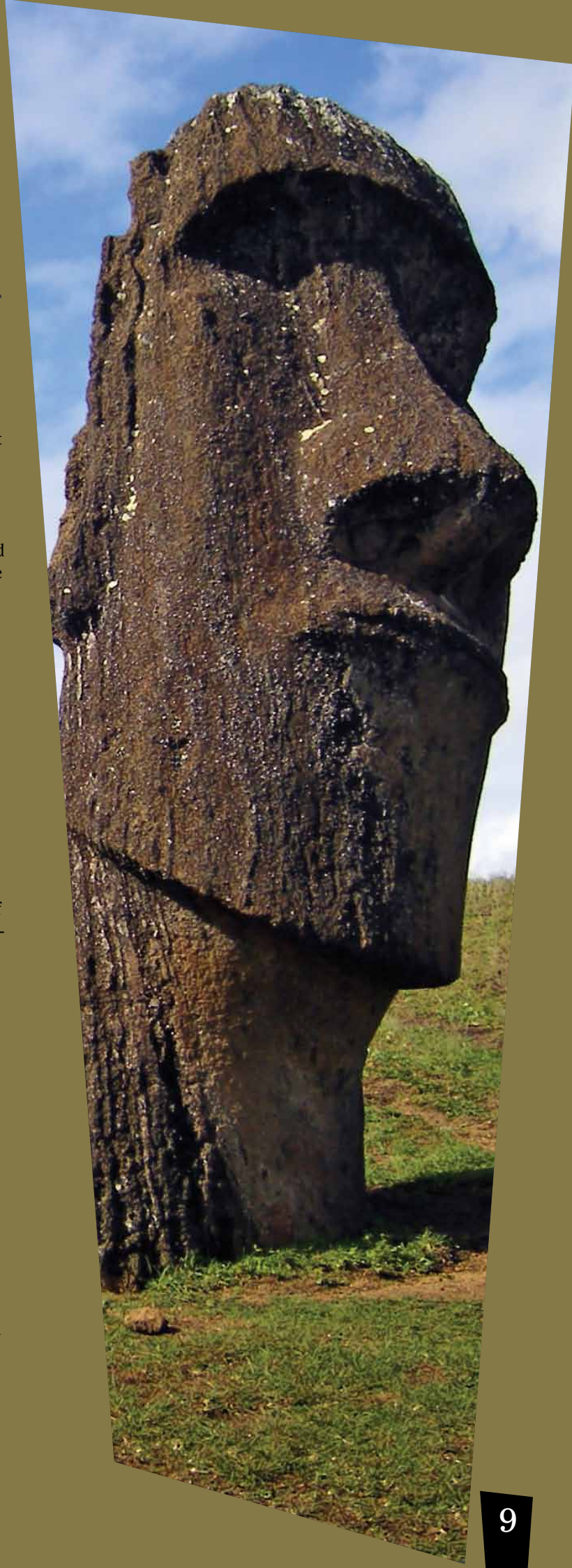
They found a genetic marker called a 'Polynesian motif'

Consider for a minute the time, effort and technology that it must have taken islanders to construct and transport the Moai, some of which weighed 80 tons. The Moai, which are believed to have been used in ancestor worship, may have been walked or moved on log rollers to the coast where they 'protected' the islanders. Archaeologists suggest that the statues were placed on 'Y' shaped wooden frames and pulled by ropes made from tough bark. Stone hand chisels found in a quarry were, unbelievably, the only tools used to sculpt the statues, and scientists have predicted that it would have taken five to six men around a year to complete each statue.

Unfortunately, this incredible practise contributed to the island's rapid decline into chaos and the eventual destruction of the island's ecosystem. Fossil pollen found on lakebeds, and tree moulds preserved by lava flows confirmed that the island was once covered with palm trees, shrubs, ferns and grasses. However, in transporting the Moai and supporting their increasing population, islanders depleted their forests severely. Soil erosion followed and areas used for farming were devastated. Fossil evidence also indicates that several species of land birds became extinct at this time, probably because of over-hunting, or a loss of nesting sites. Due to widespread deforestation there was no material with which to build canoes. The islanders could not fish, nor escape from the midst of an ecological disaster.

Chickens and rats became the basis of the islanders' diet, and human remains discovered near to cooking sites hint that people may have turned to cannibalism in their desperation. Examinations of skeletons note the appearance of marks on the bones consistent with that from spear tips. The islanders had turned on each other. Jared Diamond, author of 'Collapse: How Societies Choose to Fail or Succeed' believes that Easter Island represents the "most extreme" example of forest destruction in the Pacific.

Looking to the future, the Royal Botanic Gardens at Kew and Göteborg Botanical Gardens in Sweden are involved with a program to reintroduce the toromiro tree to Easter Island. We will sadly never be able to revive the once thriving culture of the original Easter Islanders; we can only continue to apply scientific techniques to learn more about their incredible history and learning from their catastrophic demise.



REFERENCES:
http://www.netaxs.com/~trance/rapanui.html
http://www.independent.co.uk/news/science/secret-to-a-longer-life-lies-on-easter-island-1738055.html
http://www.audleytravel.com/Destinations/South-America/Chile/Places-to-Go/Easter-Island.aspx?gclid=COeg3KfOp58CFYQU4wodkie91A
http://www.bbc.co.uk/science/horizon/2003/easterisland.shtml

http://www.bbc.co.uk/science/horizon/2003/easterislandtrans.shtml

The I, Science

A couple of months ago the I, Science team were 'geeking' out in the pub, arguing over the respective merits of *Babylon 5* and *Deep Space Nine* and whether the reimagining of *Battlestar Galactica's* the best science fiction series ever? After much debate and before the situation became violent, we decided to take it to the people and put up a survey on the I, Science website (http://www.union.ic.ac.uk/media/iscience/) and this is the result. Have a look and tell us what you think via i.science@imperial.ac.uk or tweet us at http://twitter.com/I_science_mag.

By Ben Kolb and Adrian Giordani

10 BABYLON 5

A groundbreaking and thought provoking show, Babylon 5, in my opinion represents the greatest sci-fi series to come out of the US. The faultless and complex over-arching storyline is seamlessly woven into five seasons and four TV movies. The show's focal point is the Babylon 5 space station where intergalactic diplomacy, politics and conflicts unravel.

B5 included larger than life characters, believable future governments and technologies (humans are one of the youngest space faring races) and a rich selection of alien races and mythologies. The 'cool' CGI ships (for its time) and space action made it a Sci-Fi spectacle. The multi-award winning television series was created, produced and written by J. Michael Straczynski and Christopher Franke's musical score greatly enhanced the visuals. Even though it's at number 10 in the list, I dare you to watch the show and make up your own mind about where it belongs!

maybe our editor's a Cylon

9 THE TWILIGHT ZONE

First broadcast in the late 1950's, The Twilight Zone is the oldest series to make it into the Top 10 and an early example of using TV science fiction for social commentary. The series was not solely Sci-Fi but combined elements of fantasy and horror to keep audiences on the edge of their seats. Look out for a revival in 2010 narrated by none other than Jude Law.

7 LOST

Whether you love it or hate it, Lost has certainly had a big cultural impact. Lost was event TV; the pilot episode was network ABC's most expensive ever and the first season was a critical and commercial success. Fans have been intrigued, confused, angry and confused again by the twists and turns in the plot. As the series heads towards its final episodes and hopefully some kind of answers, let's hope we aren't all left wondering: what was the point?!

8 STAR TREK:THE NEXT GENERATION

Spanning seven seasons and four movies, TNG is the longest running Star Trek series and its success led to Deep Space Nine and Voyager. With the benefit of improved make-up and special effects TNG brought us the comedic Ferengi, , revelations about the devious Romulans and most importantly the introduction of the relentless Borg. TNG gained mainstream popularity thanks to a great cast and improved writing after the first season and it paved the way for highly successful careers for many of the actors; Patrick Stewart, Jonathan Frakes, Brent Spiner and Michael Dorn. TNG will remain one of the most revolutionary sci-fi series of the last few decades. The show also greatly expanded and enriched the lore of the Star Trek universe.

6 HEROES

Probably even less Sci-Fi than Lost (Chandra Suresh's book is not yet a set text for genetics students), Heroes was another big commercial success that gripped audiences from the get-go. After an impressive first season the later seasons partially suffered because of the 2007 US writers' strike but largely due to a lack of the first season's focus and pace. The series now appears to have limped to an end with no talk of a return.

Sci Fi TV Survey

1

THE X-FILES

So here it is, number one, The X-Files. A series that until Stargate SG-1 was the longest running science fiction series in US broadcasting history! The series was a massive success and has had a big influence on popular culture. If you watch it again now, some of the effects may look a bit 'ropey' but you'll be just as terrified and intrigued as you were the first time round. Part of its success lies in the paranoid story-lines of untrustworthy governments and corporations, but a lot of it is the on-screen chemistry between the two leads: Mulder and Scully. That wasn't enough for Richard Dawkins though who compared the triumph of Mulder's paranormal theories over Scully's rational ones to a cop show where the black suspect is always guilty, while the white suspect gets away scot-free.. Chill out Richard, it's just a TV show!

undoubtedly represents the 'Best of British' sci-fi and comedy

2

RED DWARF

'Smeg' - Red Dwarf undoubtedly represents the 'Best of British' sci-fi and comedy, having gained a cult following over the years. Rob Grant and Doug Naylor's team-up created a superb show lasting for eight seasons with a big-budget film never quite materialising. The comical interactions between Lister, Rimmer, the Cat and Kryten on Red Dwarf and Starbug created unforgettable TV moments and sci-fi phrases. Personally, I think season's three to six demonstrate the show's peak in character development, humour and storylines.

3

QUANTUM LEAP

Perhaps a surprise entry at No. 3, it's the ever-young Scott Bakula and his Quantum Leap. The series is of course a lesson to all scientists who want to mess around with time travel, as an experiment gone "caca" leaves Bakula's Sam stuck 'leaping' through time. Thanks to a hologram of best friend Al (Dean Stockwell), Sam is not completely alone wherever he ends up. Each week viewers were treated to great chemistry between the two leads, occasional glimpses of historical figures and were left wondering if the next leap would take Sam home. The series finale had Sam meeting an implied God!

4

FUTURAMA

This poll is a timely reminder that Futurama is coming back (to the US at least) in June 2010. Thankfully, the original cast has been retained for what was one of the sharpest and funniest series on TV. Although some episodes were hit or miss the series benefited from great writing and a wealth of hilarious characters whose adventures were tragically under-appreciated the first time round. In no other series can you enjoy a kleptomaniac, alcoholic robot; a crustacean doctor severely lacking in medical knowledge and a hot cyclopic mutant. What more could you want?!

5

BATTLESTAR GALACTICA (REIMAGINING)

Fifth?! What the frak?! I hear you cry. BSG is arguably the most successful and best of recent TV reboots. The reimagining lasted for four seasons, included two TV movies and an introductory miniseries. Battlestar's success lies in its combination of action packed episodes, relevant social commentary and of course, super-hot Cylon: Six played by Tricia Helfer. Despite lasting for four seasons, ratings were never very high and this lack of viewership may have influenced its position in this countdown or maybe our editor's a Cylon. Controversially, fans of the 1970s version dislike the reimagining of the new show.

After a little harassment on Twitter, Ben Goldacre, the practising doctor, *Guardian* columnist, author and 'nerd cheerleader' took some time out to chat on the phone to *I, Science* about journalism, science communication and what's next for *Bad Science*.

Despite criticism, stories about homeopathy working well are still common in the media. Why do you think this is?

I think that for journalists, it's really nice to have what feels like a sort of transgressive story. I think that's why 'alternative' therapies are very attractive. I think it's also why scare stories are attractive to journalists because it's very difficult to write critical, investigative journalism in the UK at the moment. Firstly, because it costs quite a lot of money to employ people to go out and do quite labour intensive investigations. And secondly, you've got libel laws that allow people with money who are often the people you're going after in an investigative journalism story [...] to suppress criticism. Health scares come along and they solve both of these problems for journalists, because a health scare allows you to have the appearance of doing something really transgressive, challenging authority but you're free to just basically make stuff up in the way that journalists sometimes do or at least massively distort the truth because the truth doesn't suit you. When you say MMR causes autism or when you write some ridiculous load of 'tittle-tattle' about how fish-oil pills improve school performance and behaviour in 'mainstream' children. When you produce these superficially transgressive and authority challenging stories, it's taken no time and effort to do it because you've rewritten a press release from some crazy anti-MMR campaigner or some fish-oil pill retailer and there's no risk because nobody can sue you. You're not defaming anybody, you're just writing things which are untrue.

You're helping out with City University's new Science Journalism MA by offering internships and I was wondering...

...Am I?

Did you hear that, sorry?

Yeah, yeah, it's just basically, it's just very surprising news. I didn't think I was.

Did you not know that? OK, it's on their website.

Is it?!

Yeah. And so I was just curious...obviously you're not...

I mean I'm always, I'm always very keen to help people out, especially if they're kind of out there doing stuff. You know I've got that sort of weird English peculiarity of always championing the underdog so I'm always really keen to help out anyone I can see, whether they're a blogger or a student who's doing something fun and interesting. You know, I'll always try and pimp it.

So are you not? I was just asking because I was curious to know what a typical intern would get from an internship with you.

Hahaha.

But if you're not offering it then...

No, you're right, how on Earth could they possibly profit?!

> I mean it's really, really, really worth spending a lot of time on getting yourself into a position where you enjoy your work

I wondered because you're a doctor obviously, as well as a science journalist and I wondered how...

There's one girl who's on the City University science Master's who was a biochemist and I'm kind of supervising her dissertation, she's collecting data on the expression of risk in mainstream media and we're working on that together so I suppose actually that's probably what they mean isn't it?

That might be it. I was wondering if you'd give us a few quick tips though, for what I, Science readers might have to do if they wanted to be the next Ben Goldacre?

Ahhh, I mean I dunno ...well I suppose the thing that's, I think the thing that's worth doing is ...I mean I'm not really a science writer am I? I mean I am and everything but I'm not a science journalist. I've never sort of set out thinking I'd really like to get a job as a science journalist. So...I don't, I don't know... I think I'd automatically feel like a bit of a pompous cock, giving words of advice to young people. Do you know what I mean?

I think that's a pretty good answer.

Actually, in all seriousness, I don't know if it'll make you money but one thing that's really, really worth considering is, I think it's very, very dangerous for writing to be your only income because that's how you get into a situation where you think well, I've gotta write this completely shitty story because my Editor has told me that he wants it. I really need this job cause I've got to pay the mortgage or get food on the table or repay my student loan or repay the career development loan that I took out to do the Master's in Science Communication. That is a very, very dark path to go down, you know, I think putting yourself in a situation where you have to write something because somebody else wants you to or you have to write something because you need to get some money from writing that month. That's kind of a path to problems.

So you obviously believe in keeping to your principles wherever, as strongly as possible even if it means...

...keeping to your principles makes it sound really pompous though doesn't it? I mean, I think what I also mean is, if you've got two or three different things that you do, that can get you a survivable income. And they're enjoyable to you, then you're never in a situation where you're doing something that you think is dodgy or that you think is boring just to get money. I think you know, time spent getting yourself into positions where you won't have to do work that you don't like is time that's really, really, really well spent. And I don't necessarily mean that from a personal and reflective perspective.

BEN KOLB v

I mean it's really, really, really worth spending a lot of time on getting yourself into a position where you enjoy your work but then I suppose there are people who want to make money and that's no help. I don't know. I wish I had really great careers advice. I'm sure you've got great teachers and stuff and I'm sure you meet people who work in newspapers and stuff, I mean I've literally never set foot in the Guardian offices in King's Cross.

Oh really?

I've never been there, are they nice? Have you been?

No we haven't either.

If you go, let me know!

But do you see the future of journalism as more of a free-lance thing? Would you rather it was that way if it meant people didn't have to compromise their principles?

No, no, no, I think there's lots of really good stuff done by science journalists and there's

lots of stuff where it needs to be a full-time job. There is one thing that I have a bit of problem with and that is: I've got a bit of a problem with the idea that science writers are necessarily the people who should write about science. Because I think, I worry that it might be driven partly by the ego of the science writers, I mean, I'm now talking myself into a situation where you're just going to write about what a massive bastard I am for saying this...

No we're not going to do that to you. You've got a whole community that could come back at us and destroy us, it's fine...

Oh, no, I wouldn't worry about that. See I think in an ideal world often the best people to write about science are people who work in that field, people who are working scientists. And what I'd really like to see is fewer science writers and more science editors. More people who see it as their job to help scientists communicate about their own work or about work in their field - in their own words. If you ever do go in and work on maybe a features desk in a newspaper, you'll find that people who regard themselves as 'features' journalists really do email in some of the most appalling, disorganised bullshit, that then has to be fixed from top to bottom by the editors on the features desk - that happens in

s BEN GOLDACRE

every publication. There are book publishing operations where book editors have to rewrite books for people. What I think is bizarre is why do you bother having science writers? Why don't you just have really good editors who can help people who work in a field to chorale their thoughts, to get a good structure to their piece, to express themselves clearly? Why not help them do that? Because people who work actively in a field of science, they know that field backwards. Their distractions and the nuances of their language and the diversions they drift off in as they write, and their ability to spot the flaws in somebody's case will be head and shoulders above somebody who's just come to it, spending four or five hours working on it, on that one day. I think a really good model of this is Radio 4 Science, cause Radio 4 does popular science better than pretty much anywhere else. If you listen to a Radio 4 Science documentary about 70% of the words in it are spoken by the scientists themselves. But that's not to say that they're making these programmes by themselves. Their words are edited down, they're cut down, they're reordered, they're organised in presentable ways by the people who are producing the show. There are people there who are saying: "well I'm not sure the people quite get that, could you explain that maybe in another way?". But they're not insisting that they write and present the whole of the show. They're not insisting that they mediate the ideas to the public. And I think that's really crucial and I think that's why in all honesty, for mainstream reporting and also for comments on science issues, I think scientists communicating themselves about their own field, but assisted by very able science editors could well be a much better model for science communication than science writers. I'm surprised by how resistant science writers are to that idea.

And what about scientists' resistance to the media itself, being willing to do this in the first place and then be edited?

I think scientists are cautious with very, very good reason about talking to journalists. They see stories, like when Jonathan Leake from the Sunday Times misrepresents somebody's research and then they can't even a get a correction or letter printed. I think you can allay a lot of the concerns if you say well, you're writing the article. There's a lot less to be scared of in that case.

Do you think it's a realistic foresight in the next few years or do you think what you've just said was more idealistic than the realities of the industry?

It's like any other change in culture, if people start doing it and people see that it produces good content, then other people will follow their lead. I think the Eureka magazine from the Times for example, although some of it's fairly dull, a lot of the good stuff in there is where they've got working scientists in to write about work in their own fields, so that's I guess an example of people cracking on and doing that. I find it's the stuff that interests me, especially if it's areas that I know nothing about, I'm always much more interested in reading a scientist talking about that themselves, than I am in reading the opinion of some random person who's decided to be a specialist for six hours in it.

Sure, cause it authenticates it for you, doesn't it?

No, it's not about trust. It's just that I find it's better written and I find that it's being written by somebody who has a depth of knowledge that allows them to develop new metaphors or to be more imaginative or expressive in the way that they describe things. Or they can identify similarities with other areas of their own field or of other people's fields. Or they can spot the shortcomings in a given experiment which doesn't necessarily destroy it; blow it out of the water, but the interesting methodological limitations that you need to know about when you're thinking about something. It just feels like a much better ride.

So what's next for you? Are you planning Bad Science II or Worse Science perhaps?

Hahaha, cool man, you should be in Marketing, that's for sure. Well I don't know. There are a lot of "Bad..." books now aren't there? There's 'Bad Ideas' by Robert Winston, a man who I regard as laughable.

I don't know if we'll be allowed to print that. He's Professor of Science and Society or something...he's got a powerful position here at Imperial.

> what I'd really like to see is fewer science writers and more science editors

Yeah, he collects powerful positions and makes very, very boring TV shows and also personally endorsed a commercial product containing fish oil and appeared in all their adverts. Adverts which were subsequently banned by the Advertising Standards Authority because they breached their conditions on truthfulness and accuracy...I'm starting up a web TV project and if there are people around who are interested in knocking films together, helping out on that, or editing stuff down, anything like that, then I'm always really up for hearing from people.

So, can you tell us a little bit more about this project? What you're hoping to show on it? Is it going to be something like Bad Science, but televised?

Yeah, it's going to be really, really amateurish, it's gonna be lots of really long, quite boring interviews with senior academics mixed in with short funny silly films. And you know, it's not a very grand project but I don't have very strong, you know, do you know what I mean? I'll give it a go. I'll see what happens. If it's funny, it's funny. If it's not, I'll move on.

And unfortunately he did when we ran out of time, but for even more of what Ben had to say visit the I, Science website! Get in touch and let us know what you think of his opinions via http://twitter.com/I_science_mag or email us: i.science@imperial.ac.uk. If this has given you the taste for Goldacre, check out his column in the *Guardian* or visit his website http://www.badscience.net.

The Royal Society:

By Rhiannon Smith

To mark its 350th anniversary this year, the Royal Society has made public a collection of letters and documents in an online archive - http://trailblazing.royalsociety.org/. The name - "Trailblazing" - is a reference to Newton's famous comment; "if I have seen a little further it is by standing on the shoulders of giants".

While 'Trailblazing' documents the progression of science since the formation of the Royal Society in 1660 and places this progress in a historical context, it does not give any idea of the human side to the Royal Society. The Society has been touched by chance events, eccentric characters and tempestuous relationships.

THE ROYAL SOCIETY TODAY

The Royal Society's motto; 'Nullius in verba' can be loosely translated as 'take nobody's word for it'. First coined in 1663, this phrase sums up the original fellows' resistance to authority and commitment to empirical evidence. The motto is still applicable; the Society remains independent, relying largely on private funding and a belief in experimental evidence holds firm. Lord Rees, the current President, believes that global warming cannot be solved unless politicians are guided by science, and that everyone must "have a feel for science".

The eminent Royal Society of today is almost unrecognisable from its beginnings at Wadham College in Oxford.

THE FORMATION OF THE ROYAL SOCIETY

From the mid-1640's, a group of friends including Christopher Wren, Robert Hooke and Robert Boyle met to discuss science and perform experiments.

At the same time, at Gresham College in London, free lectures were given on subjects such as geometry and medicine. Here, in 1660, after a lecture from Wren, the friends decided to found 'a college for the promoting of ... experimental learning'.

Oil on board by Rita Greer 2004.

It took until 1662 for the Society's role and purpose to be officially recognised.

THE ROYAL CHARTER

Several fellows were influential men and in 1662 the Society gained a Royal Charter from King Charles II. This provided a legal formation, and the 'Royal' part of their name. Also, the Society was afforded the right to publish without having to submit manuscripts for censorship, allowing them to publish quickly. Rapid dissemination of scientific information is taken for granted now - but in the 1660's this was a revelation.

The first issue of the Journal 'Philosophical Transactions' was published in 1665; it is the longest running scientific journal in the world. The man credited with establishing it was especially impressive, if eccentric.

HENRY OLDENBURG

Henry Oldenburg was the first secretary of the Royal Society. He spoke several languages and was obsessive about documentation. He was almost wholly responsible for establishing 'Philosophical Transactions'; single-handedly funding, editing and proof reading the first editions. Oldenburg would also send his manuscripts to other experts to check before publishing them. He inadvertently started the practise of peer-review. Without Oldenburg's devotion to recording the Society's actions and disseminating them via his journal, we would have a much sparser knowledge of the Society's early history.

In 1666 however, Oldenburg narrowly avoided a catastrophic loss...

THE GREAT FIRE OF LONDON, 1666

The fellows stood outside Gresham College, the Society's home at the time, watching the fire approach. At the bottom of the road, unbelievably, the wind changed direction and the fire never reached them. As the rest of London lay smouldering, Oldenburg's painstakingly collated documents were saved. If the fire had made its way as far as Gresham College, the Royal Society would have been forced to disband and the loss of experimental records would have set science back many years.

The Human Side

ROBERT HOOKE AND ISAAC NEWTON

As a Surveyor to the City of London, and an eminent architect, Hooke was instrumental in the rebuilding of London after the Great Fire. Hooke had also been Curator of experiments for the Royal Society since 1662, and was an impressive polymath. He is credited with Hooke's Law of 'elasticity', and for coining the

The Society has been touched by chance events, eccentric characters and tempestuous relationships

word 'cell'. He is thought to have been responsible for the observations that led to Boyle's Law of Gasses, he deduced the theory of combustion and is said to have had a better grasp of gravitation and planetary motion than Newton.

Why is Hooke still relatively unknown and underappreciated, and why are there no pictures of him?

Hooke was an unpleasant person - his biographer described him as "melancholy, mistrustful and jealous". Hooke used ciphers and guarded his ideas fervently. He was responsible for demonstrating others' experiments to the fellows, and has been accused of stealing these ideas and claiming credit himself.

Newton himself had a reputation for being ill-humoured and bearing grudges deeply. The two men had a particularly vicious dispute over credit for work on the theory of gravitation. The year Hooke died (1703) Newton became President of the Royal Society and subsequently, the only known portrait of Hooke - which had hung in the President's office – disappeared. As too did many records of Hooke's work. Newton actively tried to erase Hooke from history.

Since Newton's time there have been many fascinating events, characters and disagreements in the Royal Society. The few mentioned demonstrate how the Society was shaped, in its infancy, not only by science, but by chance events, and by the fellows themselves; their eccentricities, foibles and relationships.

Statue of Newton at the Oxford University Museum of Natural History

REFERENCES

In Our Time, The Royal Society and British Science: Episode 1. BBC Radio 4. 4th January 2010.

In Our Time, The Royal Society and British Science: Episode 2. BBC Radio 4. 5th January 2010.

In Our Time, The Royal Society and British Science: Episode 3. BBC Radio 4. 6th January 2010.

In Our Time, The Royal Society and British Science: Episode 4. BBC Radio 4. 7th January 2010.

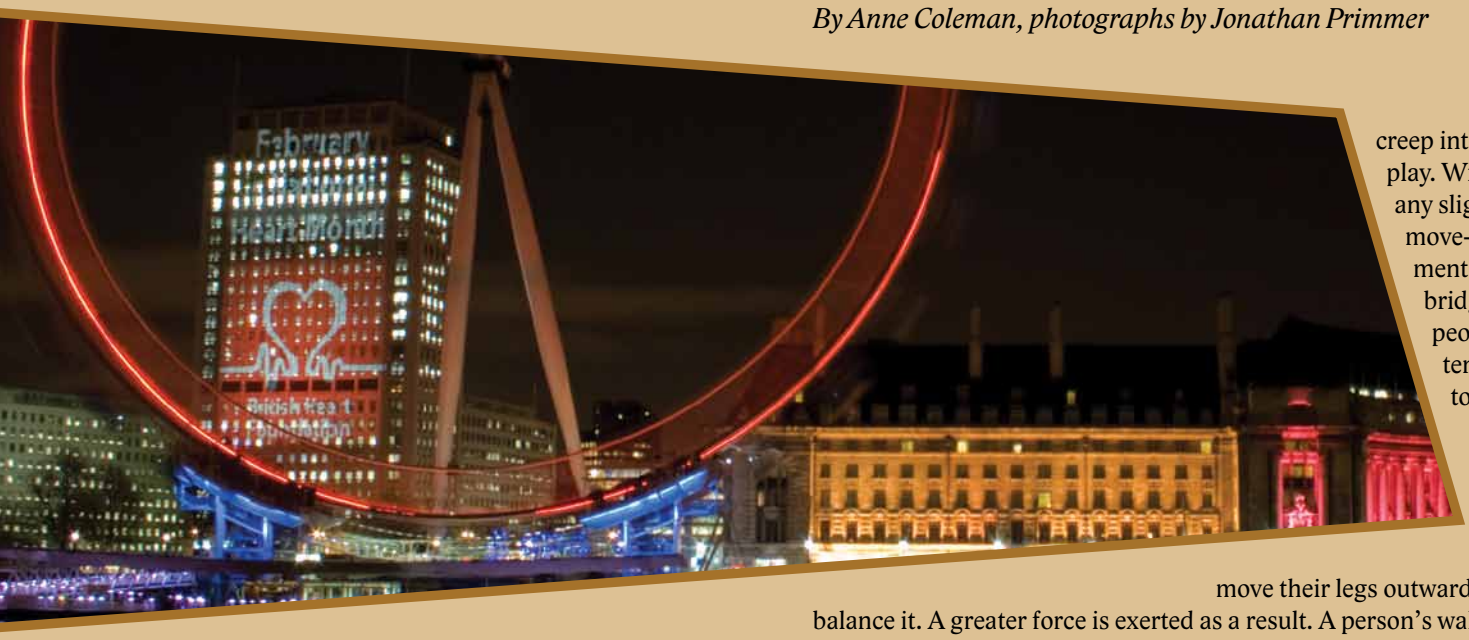
The Royal Society. The Royal Society, Celebrating 350 years. [Online]. Available from: http://seefurther.org/ [Accessed 30th January 2010].

The Royal Society. The Royal Society. [Online]. Available from: http://royalsociety.org/ [Accessed 30th January 2010].

The Royal Society. Trailblazing. [Online]. Available from: http://trailblazing.royalsociety.org/ [Accessed 30th January 2010].

London's

By Anne Coleman, photographs by Jonathan Primmer



We are all familiar with London's sprawling skyline, or rather river-line. Dotted with structures such as the London Eye, the Millennium Bridge and Canary Wharf, which are all household names, it is hard to picture a London without them. They represent our culture, our heritage, and our message to the world that we are a buzzing city with much to offer. It is almost inevitable that every few years another iconic structure will pop up on the banks of the Thames and before we know it, it will be as if it had always been there. But how do these buildings stand the test of time, how are they built to support us safely and what happens when things go wrong?

THE MILLENNIUM BRIDGE

All structures are exposed to the forces of nature. Be it the battling winds, torrential rain, or just the lengthy process of decay, engineers are forced to think about how to defy the elements. But it is not only these that have to be taken into consideration. The structure itself has to compensate for the force of the many people who seek to enjoy it.

The Millennium Bridge, a 320-metre long suspension bridge, was built as the result of a competition in 1996. It opened to the public in 2000 to showcase London's design and engineering capabilities, and was dubbed the 'blade of light'. Through its carefully measured construction, the bridge was able to support the downward forces of the 80,000 people who crossed it during its opening day. However, what engineers had failed to anticipate was the magnitude of the horizontal, or lateral, forces exerted by those people.

When we walk, the rise and fall of our bodies create a repeating pattern of forces. "One of these is a sideways force, known as a lateral force." This is caused by the sway of our mass as we walk with our legs slightly apart. Our weight shifts from left to right, as we place our feet on the ground. This is only about one-tenth of the vertical force we create, so one would not think it enough to be a serious consideration. However, other factors creep into play. With any slight movement in a bridge, people tend to move their legs outwards to balance it. A greater force is exerted as a result. A person's walking pattern echoes that of the swaying bridge, and soon every footstep of every person on the bridge is in unison. This synchronized lateral force causes the bridge to sway even more and the cycle becomes unbreakable.

The bridge moved 7cm from side to side before it was deemed unsafe and was closed for modifications.

WHY WAS THE MILLENNIUM BRIDGE IN PARTICULAR AFFECTED?

In a paper published in Nature in 2005, Strogatz, a scientist who studies collective behavior of biological oscillators, tried to explain why: 'It was by design, a flexible structure, and its natural frequency is close to that of human walking.' What this means is that the time that it takes for the bridge to resonate from side to side matched that of the pace of the walkers. Just like when you push a child on a swing from its highest height you give the swing more energy, so the people on the bridge gave it more and more momentum.

Subsequent tests on the bridge revealed startling results. Only 160 people, walking in unison with the same natural frequency of the bridge, would be needed to cause the same effect as on the opening day. There were actually 2000 people at any one time crossing the Millennium Bridge the day that it was closed.

"What the Millennium Bridge needed, and what many other structures in London depend upon to support us, was dampers."

WHAT ARE DAMPERS AND WHY ARE THEY SO CRUCIAL?

Just as the Millennium Bridge vibrated its way into a quandary, other structures, such as the London Eye and Canary Wharf, can be nudged into swaying uncontrollably. What stops this from happening and keeps us nice and stable is a principle known as 'damping'. Damping can happen on its own. A violin string will vibrate when plucked, but if left to oscillate alone will slowly die down until it is stationary again. This is due to natural damping,

Swingers

as the energy of the string dissipates. When excessive force is continually applied, natural damping is no longer effective. This is why such structures need added dampers. The London Eye, a 2,100 ton structure on the South Bank, has a total of sixty-four dampers situated round the wheel that help to absorb motion created by the wind. Each damper consists of a spring attached to a mass that has the same natural frequency as the wheel. However, the dampers vibrate in opposition to the direction of the wheel to counteract unwanted swaying.

And it's not just bridges and wheels that need a helping hand. Buildings with over forty floors have the tendency to move quite dramatically in response to the wind. A remarkable form of damping in place at Canary Wharf, known as 'slosh' damping,

> Skyscrapers are built to withstand a deflection that could occur if the worst winds in a fifty-year period were to strike

uses a pool of water to balance out the natural swaying. The water, placed at the top of the building, is forced to slosh in opposition to the movement. "Ideally, one could combine the damper with a swimming pool so that the businessmen could relax at the end of a hard day." Sadly, the damping efficiency relies heavily on the shape, size and depth of the pool, meaning that the end result isn't much fun to swim in!

'THE SHARD' - THE FUTURE?

Come 2012, 'The Shard' will be the newest landmark to grace the banks of the Thames. Once completed, it will be the tallest skyscraper in Western Europe, covered from base to tip in tiny glass mirrors reflecting the mood of the sky. With exciting designs come new engineering challenges, and the slender nature of 'The Shard' means that it is easily susceptible to wind. "Skyscrapers are built to withstand a deflection that could occur if the worst winds in a fifty-year period were to strike." Engineers calculate this deflection by a general rule of thumb: the height of the building divided by 500. Towering at 310 meters means 'The Shard' could potentially sway 0.6 meters to each side – not particularly comfortable for the residents in the luxurious top floors of the 72-storey building.

Incredibly, the material make-up of the building can be used to dampen its own motion, caused by complex forces produced by the wind flow. A central concrete core and a steel framework with enhanced concrete floors have damping characteristics. Most importantly, the weight at the top keeps 'The Shard' firmly stable. The energy from the wind is absorbed into the framework, through the post-tensioned (enhanced) concrete floors and core, and carried down into the foundations of the building.

THE THREAT OF TERRORISM

The potential threat of terrorism cannot be ignored when cities are erecting sky high buildings; these buildings are statements of western culture, society and economic prowess. With the collapse of the World Trade Center's Twin Towers in 2001, it would be naïve to presume that architects and engineers alike do not take these events into consideration when creating iconic structures. Evacuation routes and robust construction are tantamount to design, with engineers having to consider how a substantial impact on a building would affect its subsequent collapse. "'The Shard' only gained planning permission by the skin of its teeth, having been proposed a few months after the fall of the Twin Towers."

CONCLUSION

It is clear that London is a canvas full of engineering triumphs and lessons learnt. As structures dare to be more bold and ambitious than their predecessors, we can only hope that the science behind them stands the tests of time, nature and human impact.

God's Manna

By Rhiannon Smith

Imagine the scene: its Easter Sunday 1995, I'm seven years old and running around in a frenzy trying to hunt out Easter eggs before my brother finds them. Back then, I couldn't care less about whether chocolate was healthy, I only cared how much I could fit in before breakfast without being sick. Now I'm older, wiser and watching my waistline, I do care about whether or not chocolate is good for me. Unfortunately, I know the answer, and it's predictable. Chocolate is not too bad if it's dark and eaten in moderation...but not if you stuff your face with milk chocolate!

I apologise in advance that I won't be able to alleviate your guilt over gorging on that chocolate rabbit. But you will find out where those attention grabbing "chocolate is good for you" headlines come from, and perhaps you won't get your hopes up next time you see one!

According to ancient Mayan texts, cocoa was of divine origin; the plant was called "The Food of the Gods". Mayans crushed cocoa beans to make a bitter drink which was sometimes flavoured with chilli and was thought to impart health and wisdom. Later, the Aztecs thought that cocoa pods symbolised fertility and life, and that the beans were aphrodisiacs.

Today, we don't expect to gain wisdom or fertility from chocolate, yet we buy over eighty million chocolate eggs at Easter. This is unsurprising given that a British person will eat, on average, nine kilogram's of chocolate a year. Since chocolate is a guilty pleasure, where do claims that chocolate is healthy come from?

Currently, most research focuses on the potential for chocolate to protect against heart disease. This is because cocoa - along with red wine, green tea and fruit – is rich in polyphenols (a group of substances found in plants). The class of polyphenols found in cocoa are called flavenols, and they are thought to have an antioxidant effect; increasing blood flow and improving cardiovascular health. One study, published in 2006, investigated long-term cocoa intake in 470 men. Researchers found that men who ate more cocoa were less likely to die of heart disease. An older study by the Harvard School of Public Health, conducted in 1998, found that men who ate a moderate amount of chocolate lived almost a year longer than those who ate none. This prompted a story on the BBC news website stating "Chocolate is good for you – official".

Research also argues that eating chocolate releases endorphins which create a 'happy' mood and a pain relieving effect. This is what makes chocolate so addictive.

Furthermore, the Journal of Nutrition published a study in 2000 identifying chocolate as a good source of copper and zinc, which are important for optimum functioning of biological systems.

There are several reasons why we should not take these studies or headlines at face value and why we should not start happily eating five portions of 'fruit and nut' a day.

It is common in nutrition research to experiment on food fractions. For example, experiments may demonstrate that cocoa contains a lot of polyphenols, but the results could be different for chocolate; with its milk, fat and other ingredients. Also, polyphenols can be destroyed during processing, so though cocoa contains polyphenols, these may be lost during the chocolate manufacturing process. High quality dark chocolate, typically used in research, is high in cocoa and contains only cocoa butter, a fat naturally occurring in cocoa beans. Milk chocolate on the other hand (which is what the majority of people eat) has less cocoa, therefore less polyphenols, a great deal of sugar and fat from the milk. Milk chocolate is extremely calorie heavy and can lead to blood sugar problems and obesity, negating any beneficial effects of the polyphenols on cardiovascular health.

a British person will eat, on average, nine kilogram's of chocolate a year

As mentioned, eating chocolate releases mood-boosting endorphins. Yet, in a study where people ate capsules of pure cocoa, endorphins were not released and so the participant's cravings were not satisfied. This suggests that the undeniable endorphin rush results from all of the other 'bad' ingredients in chocolate (sugar, fat, etc). Becoming addicted to a combination of such unhealthy ingredients is perhaps not worth the temporary endorphin high.

Moreover, suggesting that chocolate may be good for you because it is a source of vital minerals, such as copper, is paradoxical since copper inhibits the action of polyphenols, therefore removing any beneficial influence of cocoa on cardiovascular health.

A final point to consider is the potential for bias when researching chocolate's effect on health. The area is dominated by industrially funded research and to compound this, journals are less interested in publishing null results, creating apparent skewing of data in favour of positive results. We must be careful not to labour this point too heavily. Most of the research upon which headlines have been based, has been published in peer reviewed journals and so we must trust that the studies are reliable.

Whilst we must trust in research upon which claims of chocolate's health benefits are based, we must also understand this research does not translate so smoothly into real life. Remember that people don't eat chocolate in the same way as researchers test it. Most of us eat milk, not high quality dark chocolate. People also usually don't eat chocolate in moderation; they 'binge'. The main problem with chocolate lies in the combination of ingredients: the cocoa is rich in beneficial polyphenols but the minerals (which are so often praised) negate cocoa's healthy properties.

Chocolate should be enjoyed for what it is, rather than the subject of a search for justification for enjoying it. Now where's that Mars bar I was eating...

REFERENCES

Cooper, K. A., et al. (2008). Cocoa and health: a decade of research. British Journal of Nutrition, 99, 1-11.

http://www.guardian.co.uk/science/2004/nov/25/thiswekkssciencequestions3

http://www.msnbc.msn.com/id/7339594
http://news.bbc.co.uk/1/hi/health/237652.stm

Lippi, D., (2009). Chocolate and medicine: Dangerous liasons? Nutrition, 25 (11-12), 1100-1103.

Steinberg, F. M., et al., (2003). Cocoa and chocolate flavenoids: Implications for cardiovascular health. Journal of American Diet Association, 103, 215-223.

http://www.thebeautybiz.com/97/article/food/chocolate-health-benefits

http://www.acu-cell.com/choc.html

http://jn.nutrition.org/cgi/content/abstract/130/11/2838

Stigmata

By Sarah Barker

Well as Easter has past, were you the traditional type, looking forward to the most important date in the Christian calendar. If you were not so religiously inclined, you were probably wondering if your mum remembered to give you an egg this year. Whichever describes you better, the chances are you'll already know that Easter is the time when Christians celebrate the resurrection of Jesus Christ, three days after his crucifixion.

While some may attend church services to contemplate the suffering of Jesus on the cross, others claim to find the suffering much closer to home. A small minority believe they have experienced Jesus's pain first hand, with bodily marks, sores or other pain sensations collectively called '*Religious Stigmata*'.

Often experienced near Easter, the severity of stigmata differs from case to case. Some people experience pain in the palms of their hands, others claim to actually bleed from the wrists, ankles, sides of the torso or forehead i.e. the 'five holy wounds'. Others believe they have cried tears of blood, or dripped beads of bloody sweat. What all sufferers have in common however, is the belief that their symptoms are religiously motivated.

But could this possibly be true? Is this in any way scientifically sound?

Although there's little chance of verifying the Stigmata of St. Francis of Assisi in 1224, there have been more recent cases and some published reports attempting to explain this phenomenon. A number of cases of stigmata have been attributed to self-mutilation. It is possible that someone suffering from a dissociative mental state, as a result of severe trauma for instance, may unconsciously self-harm. Some sufferers of extreme anorexia nervosa, starvation or ritualistic obsessive-compulsive disorders, have been known to harm themselves unwittingly. If they have no recollection of such actions, it is feasible that the resulting marks or scars may be interpreted as stigmata.

> A small minority believe they have experienced Jesus's pain first hand

But there are cases where self-harm does not appear to be a valid option. For example, in the US an "intensely religious" ten-year old girl periodically experienced lesions in the three weeks leading up to Easter in 1972 . "Closest possible scrutiny" ruled out the possibility of self-mutilation and the researchers concluded that the girl suffered from psychogenic purpura, or mentally induced bleeding. She had literally thought herself stigmatic.

> others claim to actually bleed from the wrists, ankles, sides of the torso or forehead

As for sweating blood, or hematidrosis, there have been cases as recently as 2008 where a 14-year old girl repeatedly bled from her palms and scalp. Such cases have been attributed to severe mental anxiety or intense levels of stress or fear that cause the vessels supplying the sweat glands to hemorrhage and extrude onto the skin surface.

It is perhaps interesting to note that the majority of purported sufferers of stigmata are female. Does this mean that women are more attuned to the suffering of Jesus? Or perhaps, they are more easily susceptible to psychological dispositions that may lie at the root of the condition?

Either way, it looks as though people really can sweat blood and can even mentally induce lesions of the skin, and this is staggering. Perhaps the staunchly religious would refute these as authentic cases of stigmata, reserving the term for spiritual episodes unexplainable by modern medicine. The incredible power of the human mind to induce the body to bleed is truly incredible, whether Jesus is involved or not.

References

Loretta F. Early, MD; Joseph E. Lifschutz, MD (1974) A Case of Stigmata, *Arch Gen Psychiatry*, 30(2):197-200.

Manonukul J, Wisuthsarewong W, Chantorn R, Vongirad A, Omeapinyan P. (2008) Hematidrosis: a pathologic process or stigmata. A case report with comprehensive histopathologic and immunoperoxidase studies, Am J Dermatopathol, 30(2):135-9,

Review

I, Science Sudoku

By Anne Coleman

Solve the sudoku puzzle by filling each blank square with the correct symbol.

Every row must include all the symbols in any order.
Every column must include all the symbols in any order
Every 3 by 3 subsectino of the 9 by 9 square must include all the symbols.

The symbols you need are:

$$c, e, g, \hbar, i, N_A, \pi, \infty, \varphi$$

	e				∞		π	g
		π			g	∞		
								i
i	N_A		g			$\hbar$		
π			∞		i			φ
		φ			e		N_A	c
c								
		i	φ			g		
N_A	∞		c				e	

Sixty years of t
Computin

Lusting after an iPad? Wondering whether to opt for a Hero or Nexus phone, or just get a notebook? Or simply want to upgrade to a newer, shinier laptop? Well you and your personal computer(s) have come a long, long way. Just 60 years ago PCs were only a twinkle in Alan Turing's eye and no one had an inkling of just how intimate our relationships with them would become.

Turing was the first to put together a (mostly) complete design for a stored-program computer, spawning modern computing and providing the pre-cursor to many modern gadgets. His technological vision was first realised as a prototype for his Automatic Computer Engine: the Pilot ACE. This was built at the National Physical Laboratory (NPL) in Teddington, after Turing and other scientists involved were released from WW2 work and its secrecy. The first program was run on the Pilot ACE on 10 May 1950, and at this time the computer was the fastest in the world with its basic clock rate of 1 megahertz. Today a Mac Pro can reach 2.8 gigahertz; 2,800 times faster.

After the Pilot ACE was built, Turing went on to look at building the full scale ACE. But NPL realised how potentially useful a computer could be and put it into operational service; hiring out the time of the machine and its staff to do calculations that previously were done monotonously and slowly by hand. Tom Vickers – conveniently my Granddad – managed the Pilot ACE at this time. As we near its 60th anniversary I talked to him about introducing the computer to industry and academia, the reception it got, and the impact it had.

HV: So I guess you were the operations manager for the Pilot ACE.

TV: Yes, that's as good a term as anything.

HV: And how did it come to be in your department, how did you get involved with it?

TV: In the department, well, the Maths Division of NPL was established in 1945. And one of its functions was to develop new machinery, and electronic machines had become thought about following the end of the war. There were one or two others being developed in this country, one or two in America. And ours came into being in 1950. I'd had my earlier training in developing mathematical methods on desk calculators, and so I was told to move over to use my expertise in exploiting the Pilot ACE.

HV: Were you there when that first program was run on 10 May 1950? Do you remember that?

TV: Well I was in another building. I heard about it, I knew about it. Of course the press were brought down and so we heard about all of this.

HV: And then what happened to the computer, I heard it was nearly scrapped?

TV: Yes, well, having established that we could in principle make a computer and that it could do some kinds of sums, the original idea of Turing was to build a much larger machine. So one of the suggestions was that we should get on with building that.

HV: Could you just describe the Pilot ACE for us? I've been to see it in the Science Museum and it's so far removed from what we consider a computer today. It's a monstrosity as well, absolutely enormous.

TV: Yes, well, it's about three or four meters long and a couple of meters tall. The full scale ACE was absolutely enormous; it needed an old, large wind tunnel to house it. But these days machines are incredibly small.

HV: I find it mindboggling - something that I'm so familiar with and I guess people of my generation are too, having these neat little desktop computers or laptops. And then going into the museums and seeing these enormous things stuffed with valves, with an entire desk at the end, it's crazy just the size of them.

TV: That's right.

HV: So did you have a particular remit when the Pilot ACE came to the Maths Department, did they know what they could do with it? Or was it more kind of 'here's a computer; we're not quite sure what it can do but go away and have a play with it'?

TV: We had to think what we could do with it. One of my first jobs was to look at the traditional methods of solving problems and seeing whether they could be adapted to working on the Pilot ACE. So we had to build up a library of subroutines. These were problems that we'd frequently met, like calculating a sine or a cosine or a logarithm, and let the machine do it. Before you'd have to look up tables. Whereas now you just put in the number, type in 'sine' and out would come the answer, in much less than a second. And we found quicker ways of solving problems that had never been invented before. Which halved the time, halved the number of multiplications which were required.

> The first program was run on the Pilot ACE on 10 May 1950

HV: And what about the actual jobs which came in for the Pilot ACE, were they from academia or were they from industry?

TV: They were mostly from industry. Academia, the University world, were not particularly interested. But industry, well the Ordinance Survey was perhaps a surprising very early interested party, it stayed with us for a very long time. The whole of the aircraft industry, which in those days was spread over many different companies, they all got interested. I mean we had contact with them already, and we could then write a program which would satisfy all of them, because they were all doing the same kind of work. They had plenty of money to encourage us, and most of them got their own

the Automatic
g Machine

By Harriet Vickers

machines later on. Some got copies of the Pilot ACE called the DEUCE.

The nuclear industry which was again a new industry - it was only started after the war with the weapons people at Aldermaston, and also non-weapons people - they were always wanting very heavy calculations. So they were early customers.

we found quicker ways of solving problems that had never been invented before

The RAE at Farnborough, which was the National Aircraft Research Establishment, they had plenty of work for us. And when the Comet blew up in the air, I forget the precise details now, they wanted very many calculations done, trying to establish why, what had gone wrong. So they took a model Comet, filled it with water and tried to get the whole thing to expand, and took masses and masses of measurements. We worked long hours on doing that for them. That was just another example.

HV: So some big household names and important civil departments then.

TV: Oh, we were in touch with all the big departments.

HV: Were you particularly expensive?

TV: Well it didn't appear so because we were having to ration some of them, and we were criticised by our rivals once they got going five years later, saying our fees were too cheap. And that was really because they couldn't get the business. But that wasn't the reason they couldn't get the business, the reason was because our programs which were doing the same jobs were better, because we had the experience of people like Jim Wilkinson, and not Turing then but lots of other high-powered mathematicians.

HV: So don't blame the tools then!

TV: That's right.

HV: And what sort of reaction did you have from companies and industry, offering this service? Because this must have been such a radical change, before people had to sit and do these mundane, really routine kinds of calculations, and suddenly you can put it all through a computer.

TV: Well we didn't have to advertise what we were doing very much; they were able to see the possibilities, just as we had done. I think their new graduates and members of staff would see it even more quickly. And they were very quick to acquire their own machines.

HV: And did industry embrace it in general? Was it unanimously decided it was a positive thing or were there negative ideas about it as well?

TV: I wasn't particularly aware of any negative thing about it, if people didn't think it was very good they just didn't bother. But when machines were introduced into commercial applications like in banks, their bosses could see the possibilities because it would mean a reduction in the number of staff. Then there was a certain amount of disquiet about it, but it didn't last very long. Undoubtedly some staff would lose their jobs, but I think far more jobs were created as a result. So it wasn't like the days of the Toll Puddle martyrs in the 19th century!

In the middle is Jim Wilkinson, a fellow of the Royal Society and a bigwig mathematician. The identities of the other two gentlemen are unknown.

HV: So no one was up in arms banging on your door, saying people were going to be replaced by machines and it would lead to some awful revolution?

TV: No, no.

HV: Ok, so when you were using the Pilot ACE, and you were doing all these jobs for industry and for companies, did you ever look ahead to 60 years on, to 2010? Did you think there'd be a computer in most homes, that so many people would have access to them and be able to use them?

TV: No! Nor did anybody else. Much.

HV: Did you think about it at all?

TV: No. There was a suggestion in about 1950 that three computers would satisfy all the computing needs of the country. But that turned out to be absolute rubbish. You could see some things that were coming. Some work was done by a section of the laboratory on machine translation, translating Russian into English and English into Russian. It didn't catch on very much then but probably the machinery at that time wasn't quite up to what was needed. It must be used now far more I would think.

HV: Right ok, so just the, the advancements that have happened have been too incredible to foresee.

TV: Yes, that's right.

The Pilot ACE is now in the 'Making the Modern World' gallery in the Science Museum, where it retired to in 1955.

Catch the full interview on the I, Science website: bit.ly/brAwRG

Egg, Science

By Cian O'Luanaigh

About 340 million years ago, a small lizard-like tetrapod (four-legged animal) named *Casineria* laid a very special kind of egg. A new membrane, the 'amnion', inside this egg, protected the embryo within a liquid amniotic sac, giving the embryo its own 'private pond'. This evolutionary innovation would change the course of tetrapod evolution forever. For the first time, tetrapods could lay eggs on land.

It is not even the case that larger birds lay more nutritious eggs; larger eggs may contain more yolk than smaller eggs but not necessarily more yolk *per gram of embryo*

The amniotic egg is a fiendishly clever life-support system. The embryo's food supply (yolk sac) is a bag of lipids (fats) and proteins neatly separated from its waste disposal bag (the allantoic cavity) by membranes. The amnion prevents water loss but it allows gas exchange with the outside and acts as a protective cushion for the embryo. To top it all, a leathery outer shell protects the whole egg from bumps and grazes.

Before the amniotic egg, tetrapods needed to return to water to reproduce. Their eggs were surrounded by a jelly-like membrane which quickly dried out on land. The descendants of the original tetrapod still lead this double life, returning to water to breed; they are the modern amphibians (from the Greek *amphi* meaning 'two', and *bios*, 'life'). The amniotes, however, went from strength to strength. Amniotic eggs allowed the first reptiles to successfully survive on land and diverge into groups. One group retained their eggs inside their bodies, so there was no need for a protective shell; these gave rise to mammals. A second group hardened their shells with calcium and their body sizes increased, these included dinosaurs who dominated the planet until they suddenly disappeared 65 million years ago. But, not all dinosaurs went extinct. One group survived to this day and they still lay calcified eggs. We call them birds.

There are over 9,000 species of birds, which range from the tiny Bee Hummingbird (*Mellisuga helenae*) weighing about two grams to the ninety kilogram ostrich (*Struthio camelus*). Their egg sizes scale with their body sizes: the bee hummingbird's eggs weigh a fraction of a gram while the ostrich's weighs a kilogram. Yet egg size is not directly proportional to body size; larger birds lay relatively smaller eggs than expected for their size.

It is not even the case that larger birds lay more nutritious eggs; larger eggs may contain more yolk than smaller eggs but not necessarily more yolk per gram of embryo. The reason for this is twofold. Firstly, different species of birds have different development patterns. *Altricial* (meaning "requiring nourishment") developers are born naked, blind and helpless, entirely reliant on their parents for food. An example is the blue tit, whose incubation period is sixteen days. *Precocial* (meaning "early maturity") developers hatch ready for the outside world and can feed themselves within a few hours. The duckling spends twenty eight days inside the egg feeding on the large yolk sac. Sotherland and Rahn (1987) found that in waterfowl species the yolk content raises with increasing egg size but this is closely tied to the developmental pattern of the species. Eggs of altricial species are about 20% yolk, those of precocial are 50%. Secondly, female birds can alter the yolk content of their eggs depending on their body condition and the size of the clutch being laid. Changes in albumen (egg white) content largely reflect variation in the water content of eggs. Females can add extra testosterone to eggs laid late in the laying period to give newborns a fighting chance in the nest as they compete with older siblings. So yolk content and egg size do not necessarily correlate.

A notable exception is the kiwi (*Apteryx australis*). This fascinating bird lives in New Zealand where it has evolved to be mammal-like in a country without mammals. Kiwis are flightless (their Latin name means "without wings, from the south") and are about the size of a football. Like some mammals, they are nocturnal. Their feathers are bristly and hair-like. They have poor eyesight and, unusually for a bird, an excellent sense of smell with nostrils at the end of a long, probing beak. Kiwis are not fully precocial; the young stay in the nest for several days after hatching.

The most extraordinary feature of their biology is the egg.

Kiwis' eggs are enormous. Take an X-Ray of a pregnant kiwi bird and 25% of the picture is egg. Pair this with a massive 70% yolk content and it appears kiwis are going into reproductive overkill. Why the huge egg? The kiwi egg is an evolutionary hangover. Kiwis are descended from the extinct Moa, huge bipedal birds which stood over 3m tall and laid eggs 1m in circumference. In the absence of mammalian predators, the kiwis' ancestors suffered no evolutionary cost as their bodies got smaller, but they never lost the benefits of a large yolky egg. The kiwi's egg represents the greatest excesses of amniotic evolution. *Casineria* would be proud.

Hey, You, Get On My Cloud

By Jamie Condliffe

We're entering a new era in the way we use technology: it's time to say hello to the world of cloud computing. The basic idea is that software, services and documents are stored on a centralised network, somewhere on the internet. This allows users to access files and programs from any device connected to the internet, wherever they are in the world. So, it's possible to edit documents, manage your blog, or stream media on your desktop PC, notebook or smart phone, no matter where you are. Everything is synchronised, and you don't have to worry about your device having the right software: everything is processed and stored on the elusive cloud. Essentially, you can think of whatever computer you happen to be using as a window into your own virtual work-and-play space.

People are already using this kind of technology without even realising it. Take Spotify, a massive, centralised music library that millions of people use every day. Or Google Docs, a streamlined office suite that lets you edit files from a web browser. The list goes on: YouTube, Flickr, Google Maps, Wikipedia. All these offer amazing services, with everything stored remotely. It's easy to take these advances for granted but they are, without doubt, the future of the way we will use computers.

But, what is this cloud exactly? To claim it's a 'centralised network' is actually to miss the point. The cloud is a distributed network of thousands of computers and servers across the globe. Applications and documents are hard to pin-point geographically, but they're easy to find in the virtual world, where everybody has their own space – like your Google Mail inbox, or Flickr albums. It's this physical elusiveness, the ethereal quality of the data, from which the cloud gets its name.

However, there's currently a debate brewing over the future of the cloud. Some think that it should be a true democracy, that it should be open and shared; a bit like open source programming and Wikipedia. This would mean that users would be able to tailor the cloud to suit their own needs. They would be able to generate not just the content on the cloud, but how it works and fits together too. On a more ideological level, it would also prevent the bland homogeneity that would come with a cloud run by large corporations.
Skeptics, though, complain that an open source cloud raise huge issues for usability. One of the sticking points with open source projects is that they are often deeply incompatible with each other, and full of bugs. If the cloud is to provide a means of improving productivity, it at least needs to work properly. So, though there's a lot to be said for a digital world that isn't monopolised by the likes of Google and Microsoft, it may be the price we have to pay for a service that works properly.

Regardless of what direction the cloud takes in the future, there's no denying that it's here to stay. So, if you're not already, now's the time: c'mon, get on my cloud.


12 SOLIDUS