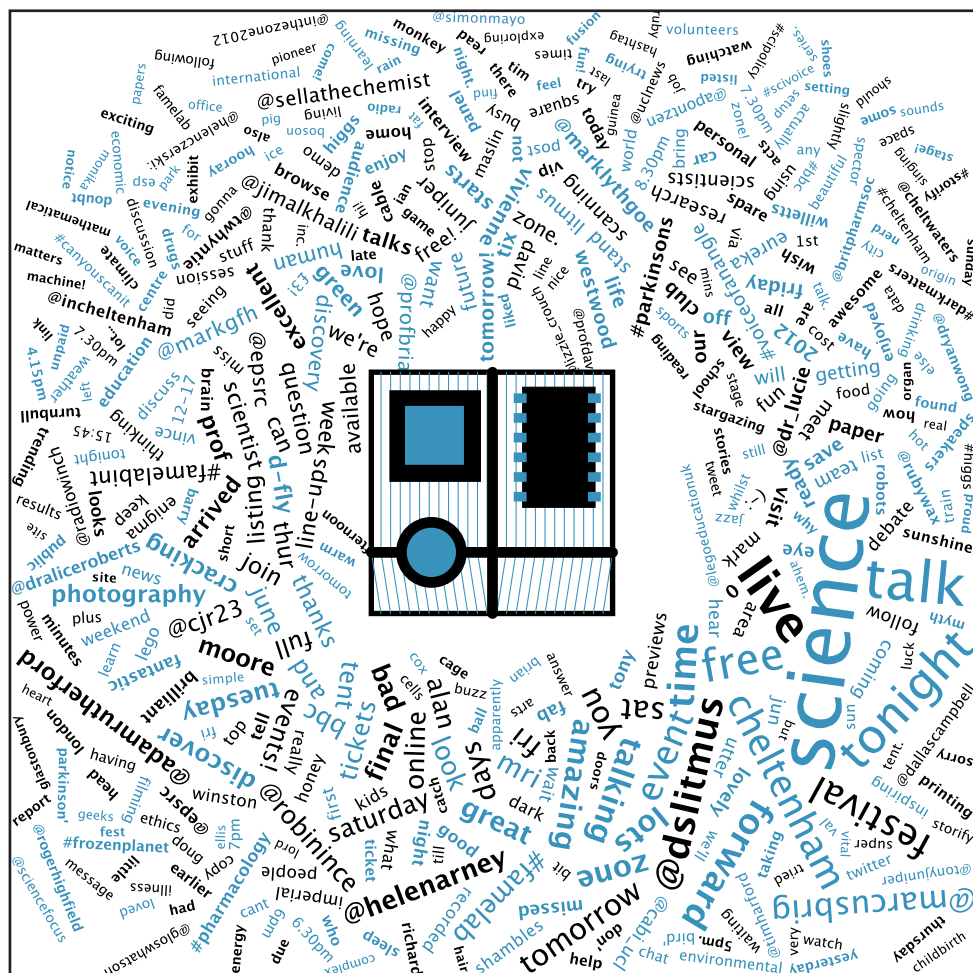


Sunday 17 June 2012

Festival events Venn diagram

Phillip Kent on design, science and education

Festival round up



Alex Bellos' book *Alex's Adventures in Numberland* took him all over the world. We spoke to him about his travels and the people he met.

Amongst the characters you met during your research, which one most stood out for you?

There is one character, but it's actually two people. They're brothers and they consider themselves one mathematician: David and Gregory Chudnovsky. Gregory, especially, is one of the greatest mathematicians in the world. They built what was at the time the world's most powerful supercomputer in their Manhattan apartment. One of the first jobs they did with it was to find more digits in pi than anyone had ever managed before. They were the first people to get to 2 billion using this homemade supercomputer, which in terms of parts probably cost them less than \$100,000 whereas normally a supercomputer that big would have costed tens of millions of dollars.

Did you think of the numbers in the book as characters?

What I'm doing is looking for stories. My background is in journalism so I'm always trying to [find] the story. The story of pi is amazing. It's been this thing that people have tried to understand, but the closer you get to it, the further away it gets. The different methods to find out about pi are simple to explain, but have changed. You can really tell the history of mathematics through pi. Or for instance, when I talk about the golden ratio, this number is linked to the fibonacci sequence, so that's about growth and nature, the idea of whether there's a prescribed beauty or not. You need to find the best story to suit the subject.

You've been to a lot of places with this book; did you find the attitude to maths in other countries very different to in the UK?

Totally. People in the UK think that if you like maths, you're kind of the 'nerd king'. Not the case in France. They're proud of their sciences in a way that we're not here. A million Japanese kids a year go to abacus schools for fun. It's not even part of the syllabus – they do that for fun. Maths is the universal language. The maths is the same everywhere but the approach is completely different.

Litmus Paper 2012

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DesignScience

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Nervous energy

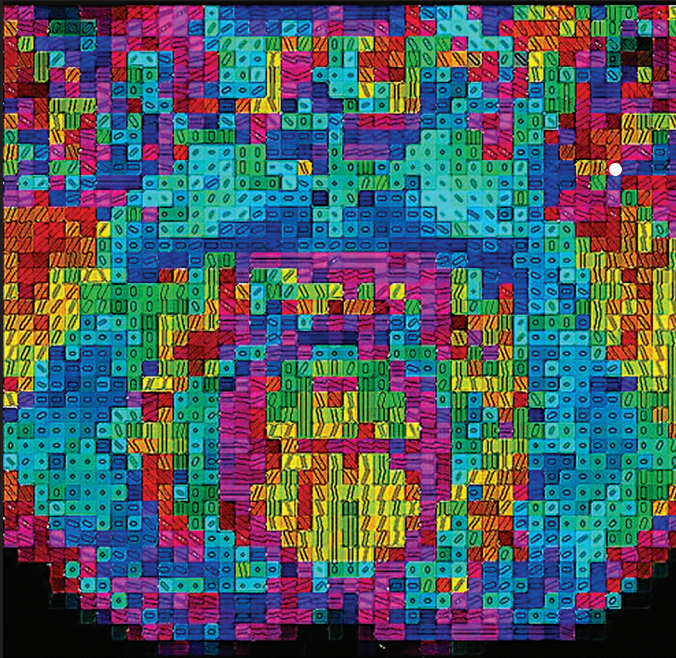
Magnetic resonance imaging (MRI) is a medical imaging technique that came into use in the early 1980s. MRI is used to visualise internal structures of the body in detail. The scanner itself is essentially a large, powerful magnet that uses radio waves to align the nuclei of atoms in the body. As the nuclei move back into place they send out radio waves of

their own which are detected by the scanner. A computer uses this information to construct 2D and 3D images of the scanned area of the body.

As our body consists mostly of water (which has two hydrogen atoms: H_2O) the nucleus of the hydrogen atom is usually used to create an MRI scan. Tissue that has the least water, such as bone,

turns out dark, while tissue that has many hydrogen atoms, such as fatty tissue, looks brighter.

Imaging techniques such as MRI are especially valuable in medicine as they allow us to see inside the body without damaging it. The ultimate aim is to make a visualisation, rather than taking a physical sample. But before this can be achieved, we must



be able to detect greater detail. Current clinical MRI methods are non-specific and low resolution but recent developments, as pictured here, have enabled researchers to reveal structural information 1000 times smaller than current technology (which is about one millimetre). The above image

shows microstructure MRI of nerve fibres descending from the spinal cord of a mouse embryo. In a nerve fibre, atoms can only move along the length of the fibre, so diffusion MRI allows scientists to gather directional information which helps elucidate how the brain is connected to the body.

Inside each coloured square you can see small, outlined shapes which represent the direction of clusters of nerve fibres. The colours are also linked to the direction of the nerve fibres, making the image easier to interpret.



It's not the end of the world

Theorising about the end of the world is a celebration of science, according to Alok Jha. In *Doomsday Handbook* on Saturday,

Jha, *The Guardian* science correspondent, explained to the audience that, despite the gloomy subject matter, detailing the possible

ways the world could end is not depressing. He argued that the reason we know about the different things that could lead to our demise is due to amazing advances in science and technology.

He explained that if we didn't know about possible doomsday scenarios then we wouldn't be able to do anything about them. If we know what might affect our future then we will be able to put plans in place to counteract them. 'Humans are nothing if not ingenious', Jha said.

The end of the world scenario which most interested Jha was all matter becoming one homogenous mass. This could happen due to particles called strangelets which, according to quantum theory, could lead to all matter rearranging itself.

Longlist for book prize announced

It was announced today that Stephen Pinker's book, *The Better Angels of Our Nature: The Decline of Violence in History and its Causes*, is one of the 12 books longlisted for the Royal

Society Winton Book Prize. The prize awards the best science book written for a non-technical audience. This year's judging panel included astrophysicist Dame Jocelyn Bell Burnell

and novelist Jasper Fforde, author of the *Thursday Next* novels. The overall winner, who will win prize money of £10,000, will be announced on 26 November.

Controlling dreams

Psychologist Richard Wiseman introduced the audience to a smartphone application he has developed which influences what people dream just before they wake at the event *Sweet Dreams*.

The ability to control our dreams is something all of us would love to have. Being able to consciously change your dreams whilst you are asleep – walking through a world you are building in

real time – is like something from the film *Inception*.

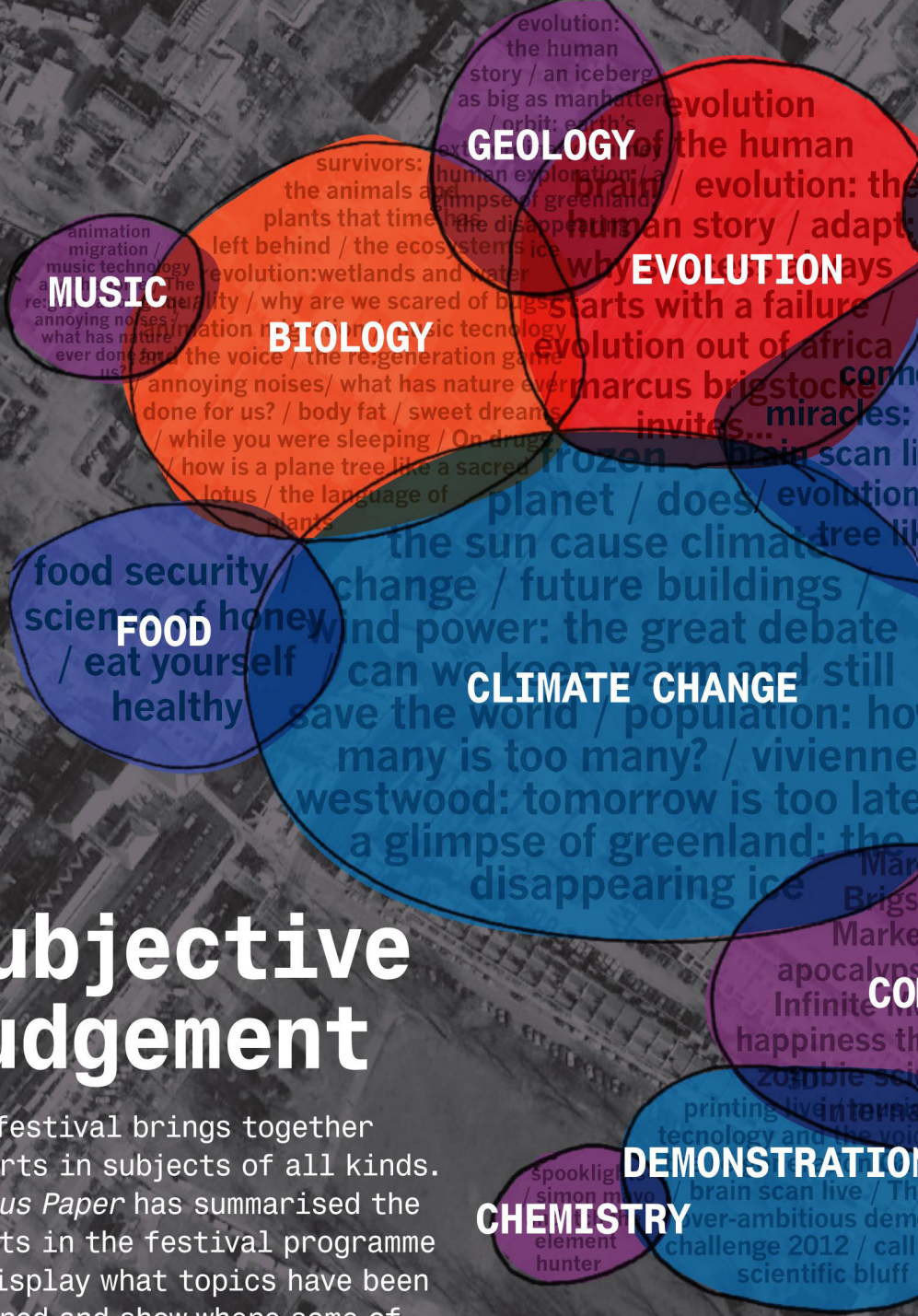
Wiseman's smartphone application, called 'Dreamon', works by monitoring the stages of the user's sleep in the early morning and playing a themed music sequence for about an hour before they wake up in order to influence the sleeper's dreams. On waking, the user reports their mood back to the app, confirming the soundscape

they listened to the night before and the mood they felt when they awoke.

Studies using this information have shown that a soundscape, such as the hustle and bustle of a city, can influence and manipulate dreams. Results, collected by participant feedback, have shown that the popular 'city themed' sound causes people to wake in a happier mood.

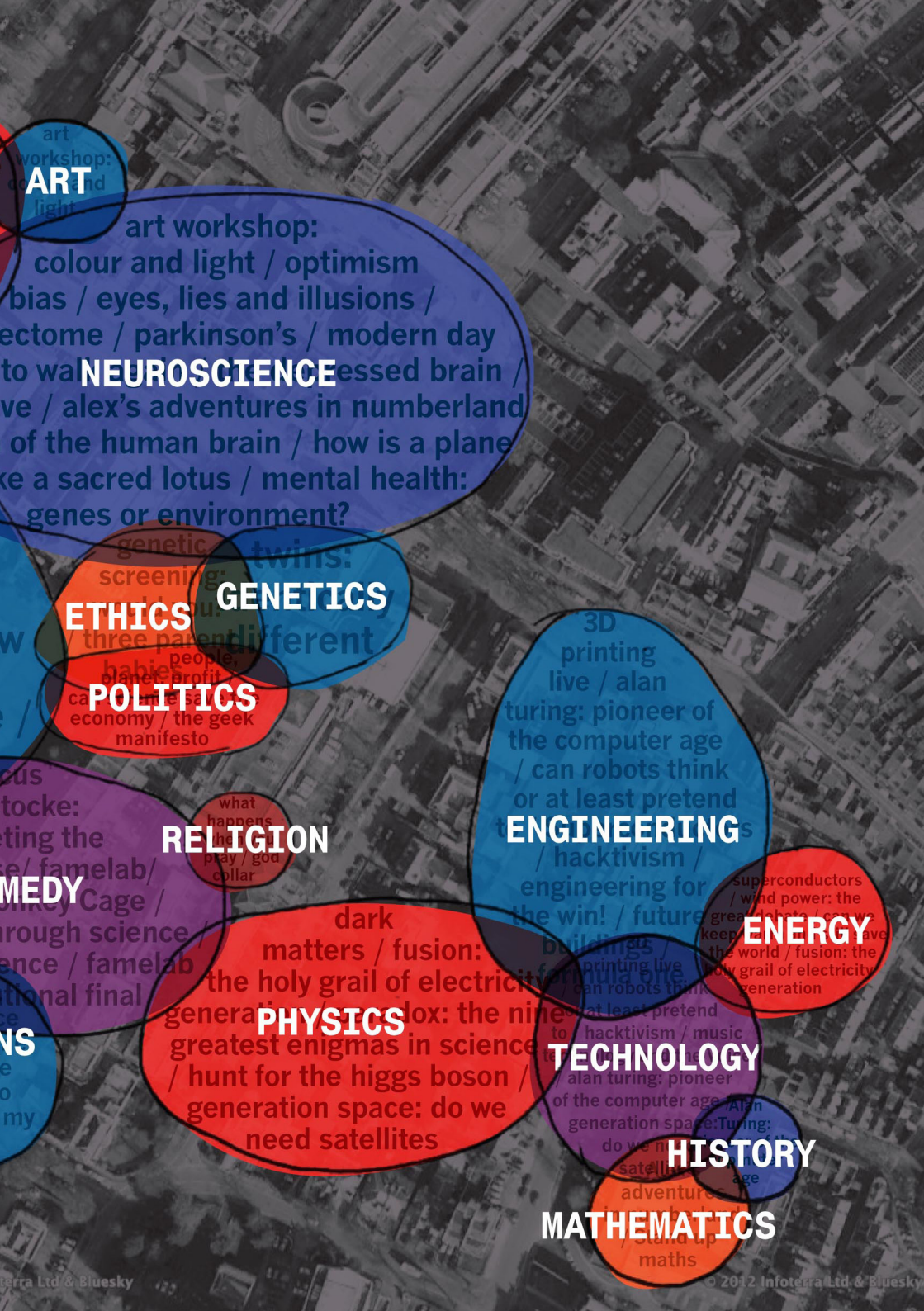


PAUL AICHELE, SLEEP



Subjective judgement

The festival brings together experts in subjects of all kinds. *Litmus Paper* has summarised the events in the festival programme to display what topics have been covered and show where some of the unusual crossovers lie.



ART

art workshop:

colour and light / optimism

bias / eyes, lies and illusions /

ectome / parkinson's / modern day

to walk / alex's adventures in numberland

of the human brain / how is a plane

ke a sacred lotus / mental health:

genes or environment?

NEUROSCIENCE

genetic

screening:

GENETICS

ETHICS

three parent

habits

POLITICS

economy / the geek

manifesto

RELIGION

what

happens

the

play / god

collar

MEDY

dark

matters / fusion:

the holy grail of electricity

PHYSICS

generation / alex: the nine

greatest enigmas in science

/ hunt for the higgs boson /

generation space: do we

need satellites

ENGINEERING

3D

printing

live / alan

turing: pioneer of

the computer age

/ can robots think

or at least pretend

to / hacktivism /

engineering for

the win! / future

buildings /

printing live

/ can robots think

or at least pretend

to / hacktivism / music

alan turing: pioneer

of the computer age: alan

generation space: Turing:

do we need

satellites

adventures

ENERGY

superconductors

/ wind power: the

great photo / can we

keep the world / fusion: the

holy grail of electricity

generation

TECHNOLOGY

HISTORY

MATHEMATICS

maths



WED
THU
FRI
SAT
SUN

The British Library review

LIBRARY
HSLINB

In this last issue of *Litmus Paper*, The British Library Science Team sum up their experience of The Times Cheltenham Science Festival

The Times Cheltenham Science festival lived up to its reputation. Inspiring and exciting, serious and frivolous, it reminded us that engaging the public with science is vital to its future and its place in our culture.

As an organisation that runs public events related to environmental science, we often wonder how we can better reach out to groups who aren't typical

environmentalists. PR guru Mark Borkowski suggested that we need to create new narratives about the threats our planet faces.

Enabling people to access and share scientific information is close to our hearts here at The British Library, so we were encouraged to hear this is something that politicians support. David Willetts (Science Minister) called us all to action

during *Science Question Time*, saying about open data, 'we need to make as much as possible, as open as possible, as quickly as possible'.

Enthusiastic scientists and audiences challenging one another (in a nice way) can be exciting. This is something we are hoping to carry forward in our own Science Week in March 2013. Hope to see you there!

Science not magic

Camila Ruz finds that demonstrations offer more than just crowd-pleasing explosions, and examines why showing might sometimes be better than telling.



Scientists at last year's *Over-Ambitious Demo Challenge* were busy lighting matches with steam in order to win the accolade of best science demonstration. In doing this they joined a tradition of live science that has been delighting crowds with phenomena since Michael Faraday first lit up the Royal Institution with his candle.

Audiences have learned to expect the unexpected when science is put on display. But there is tension between spectacle and explanation. 'I have seen educational shows where it is just whizz-bang and they haven't made an effort to explain what's going on', said Steve Mould, science presenter, comic and host of 2012's *Over-Ambitious Demo Challenge*. 'I think that when you demonstrate something surprising, people are genuinely hungry for the answer and it's a shame if you don't give them that.'

Giving away the answer is what distinguishes a science demonstration from a magic show. 'We're trying to take the incomprehensible world and make it something which can be understood,' says Dr Simon Watt, participant of this year's competition and presenter of Channel 4's *Inside Nature's Giants*. 'If we think of a demonstration as an experiment, which is the whole basis of science... you not only have to explain what your findings are, but you have to show that they are true.'

Treating demonstrations as experiments also means that things can go wrong. A failed demo can be an opportunity to work things out together. 'I use a mis-fire or failed demo as a discussion point to try to figure out what happened and explore the science going on,' said Greg Foot, science presenter for BBC3's *The Secrets of Everything* and the Science Junkie live show. Exploring the science can be made more interactive if the audience are asked to predict the event before it takes place.

Foot's favourite demonstration is also one of the simplest: the *Yellow Pages* demonstration plays on the power of friction between two phone books when their pages have been overlapped one by one. Once the pages of two books have been interleaved, two people cannot pull them apart; Foot and his team illustrate the full force of this by dangling themselves from the interleaved books. But even without the special effects, demonstrations using familiar objects in unexpected ways can be the most memorable.

'If you can demonstrate something incredible about the known world and leave it as an open-ended thing then you are still going to get a whole room full of people thinking about a delightful phenomenon and what the explanation could possibly be', concludes Steve Mould.

Network potential: design science, computation and education

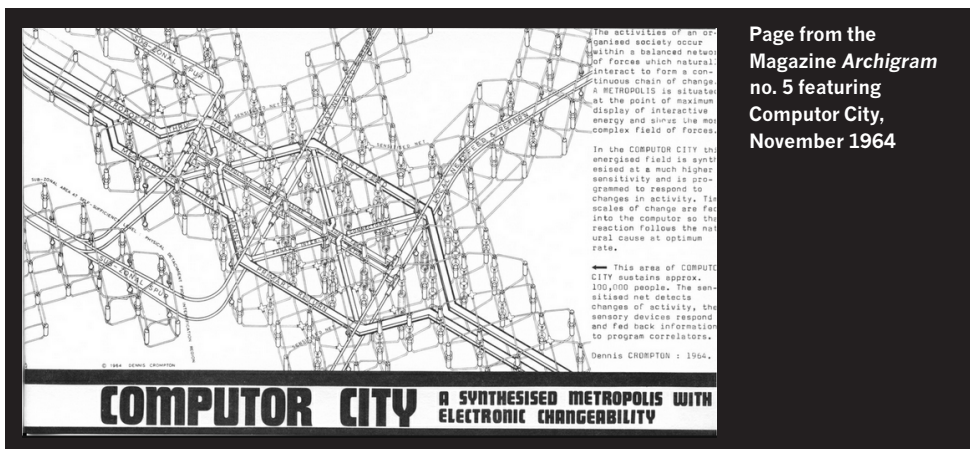
DesignScience Associate Phillip Kent explains the ‘computational thinking’ theme that has featured in *Litmus Paper*, and how computational thinking may change science communication and popular participation with science.

The plan for *Litmus Paper* developed by the DesignScience team proposed a theme of computation, presented through several contributed essays (Wagner, Rucker and Rushkoff), and the issue covers as computational products, to be shared and (perhaps) further developed through a process of ‘social coding’ (your contributions to that are still welcome, by the way, via the Litmus Paper website: www.design-science.org.uk/litmus-paper).

I like the diversity of the three essays: Phil Wagner (in Issue 1) reports on current work in the educational field, supported by major companies (Google, as well as

Microsoft, etc.) to change perceptions and practices of educators and re-consider the place of computational thinking. The Raspberry Pi project is a similar initiative launched a few months ago (based in Cambridge, UK: www.raspberrypi.org) which is going to have an increasingly big impact in the months to come, as its new super-cheap computer hardware aims to be a game-changer for popular computing.

Rudy Rucker (Issue 2) talks about the professional and recreational pleasures of computational thinking and computer programming, suggesting that computational thinking offers a radically



different means of engaging with ‘the universe’ – and a fundamental shift in one’s entire world view. This is a far cry, it seems to me, from the contemporary obsessions with social media – or the consumption of commercial video games – which dominate what we might call popular computing today. (I grew up with computers through the 1980s, with Sinclair, Commodore, and BBC Micro computers, and I can remember experiencing a powerful sense of computational thinking as Rucker describes it, though my home in a north of England town was a huge distance culturally from Rucker’s ‘spaced-out’ California.)

Douglas Rushkoff (Issue 4) writes with huge impact about the political-cultural context for computational thinking. The political imperative for action is now – to counter the commercial technological forces that will further disempower individuals. Although, interestingly, those companies which express the commercial forces (Google, Microsoft) are at the same time promoting computational thinking.

So, what does all this mean for science, and the communication of science, at the Cheltenham Science Festival? The Festival has evolved into a major phenomenon, which twenty-odd years ago we would hardly imagine existing. In many ways we may say that science communication and public engagement with science has progressed enormously in recent years, and there is much to celebrate. I would frame it in terms of ‘ownership’ and ‘participation’. I believe we would like more people to feel ownership of science in this (British-European) society, which is at heart the product of science and technology developments going back hundreds of years. Arguably the popular sense of ownership has become much stronger in recent years – for example, we see strong

public expression of identification with the science celebrities of television and radio. The weak spot however is participation. We have seen a certain amount of ‘citizen science’, however I would question the form of participation that this involves – yes, many people become additional pairs or eyes or hands in scientific experiments, but the participation does not extend into analysing experimental results or developing new experiments – the essence of the practice of science.

The Festival has evolved into a major phenomenon, which twenty-odd years ago we would hardly imagine existing

Participation in science is a major element of the work that the DesignScience group intends to develop over the next few years. We take a particular interest in the place of computing and computational thinking, because one of the greatest barriers to popular participation in science is lack of mathematical knowledge. It is fair to say (although it is a simplification) that the language of science is mathematics, so to speak and think science involves mathematics most of the time. Computers extend and re-structure the ways in which it is possible to engage with the mathematical expression (largely algebra and calculus) of scientific ideas. Science and mathematics educational researchers have been exploring this for many decades, but the results have not been well-known or widely accessible. We currently have the technological infrastructure of widespread personal access to computers, and electronic networks for exchange of information and social interaction. It is a question of devising educational resources and practices to change public participation with science and mathematics.

Today's cover by Phillip Kent

Today's theme is 'information outflow'. In the centre is an abstracted version of the Festival site, transformed to a 'microchip' (compare an aerial/satellite view of Imperial Square). A swirl of Twitter activity emerges from the Festival, as ideas and experiences are shared: the wordle is generated by processing the twitter 'tweets' containing

the hashtag #cheltscifest. The words used in the tweets are counted up and displayed with a font size representing the word's frequency. I used the open source statistical package R to perform the text frequency analysis, with the results passed into Processing (it is possible, though more complex, to do this process in Processing). The process of analysis and construction is a simple example of a phenomenon that is being called 'big data': attempting to extract meaningful

information from the massive data flows through social media websites. This is also a small illustration of Douglas Rushkoff's argument (see Issue 4): if you do not program to manipulate the data yourself, you can only 'be programmed' as pieces of data to be manipulated and (possibly) exploited by others. As usual, the interactive version of this cover and relevant information is at www.design-science.org.uk/litmus-paper
phillip.kent@gmail.com

Today's free activities

DISCOVER ZONE

Town Hall, 10am – 5pm

For all ages. Open every day, gives kids the perfect opportunity to get hands-on with interactive technology and experiments.

cheltenhamfestivals.com/discoverzone



FAMILY FUN DAY

Imperial Gardens, 11am – 4pm

The weekend of the Festival is packed with exciting free activities for all ages at our family fun day. Make your own pinhole camera, create a cure for the worlds nastiest diseases, make bouncy balls, make your own jewellery and more!

EDF ENERGY ZONE

Imperial Gardens, 11am – 6pm

Come to the EDF Energy Zone to pick up the Energy Trail quiz forms with a chance to win tickets to the Olympics. Stop a while to visit the fascinating interactive exhibits exploring the world of energy.



BBC SCIENCE ZONE

Imperial Gardens, All day

For all ages. The opportunity to meet the production teams and presenters responsible for some of your favourite BBC science programmes, explore the content and get hands-on with science.

Visit cheltenhamfestivals.com/bbc-science-zone

SCIENCE STORY ZONE

Queen's Hotel, 11am – 4pm

For under 7s, with six interactive zones, each with their own inspiring story. The perfect place for young children to explore science by looking, touching and carrying out simple experiments.

LEGO® EDUCATION ZONE

Imperial Gardens, 11am – 5pm

Get involved with an exciting building challenge where you can help create the Green City of the Future. Build the Change is designed for children and parents as an opportunity to envision, design and share the change you want to see for your city. There will also be a competition to showcase your creations with the opportunity to win LEGO® Education resources for your local school.

A DUPLO Zone is also available inside the marquee for younger children. Sessions last 1hr



GE PAVILION

Imperial Gardens, 11am – 6pm

The GE team are offering lots of things to do and see for all ages including a Caterham Formula 1 racing car, the hugely popular flight demonstrator, a model of the first jet engine and much more!



GE imagination at work

AREA 42

Imperial Gardens, 12pm – 6pm

For over 16s, Area 42 is the Discover Zone just for adults. See and get hands-on with some of the best cutting edge research and technology science and engineering have to offer.

cheltenhamfestivals.com/area42