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**The Working Brain: what physics can tell us about
autism, shopping and learning algebra.
IOP 21 November 2012.**



Above: (Left) Dr Mark Telling (Branch Chair) and (right) Prof. Stephen Swithenby.

The brain is a complex and interesting organ. By studying the brain, we can obtain insights into the nature of cognition and human behaviour.

There is a widespread concern in areas such education, particularly in regards to the teaching and learning of mathematics and behavioural interaction challenges, such as autism. Professor Swithenby has been carrying out brain imaging studies in collaboration with other academic centres. Neuroscience is significantly relevant in describing and elucidating the mechanisms of brain structure and function. The brain has an enormous plastic capacity and carries on learning for life. With better understanding of the neural processes we can dispel some ingrained myths such as: Right/left brain dichotomy, Gardner's multiple intelligences, the existence of an exclusive and fixed critical learning phase in childhood for example.

Several models of cognition have been postulated. Carnegie Learning are focusing their attention on the Adaptive Control of Thought Rational (ACT-R) model of cognition of both declarative and perceptual knowledge, with emphasis on moving from the declarative to the procedural.

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To Join the Retired Members Section (REMS) Contact John Belling

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A good paradigm, grounded on scientific discovery, will be an invaluable asset to teachers (i.e. 'maths phobia'), parents, researchers and policy-makers.

The brain has 100,000.000.000 cells, with up to 50,000 connections per cell. Half of the brain is involved in processing and is constantly re-modelling itself by the continuous action of the synaptic connections. It can be studied with the aid of functional diagnostic methods such as:

- 1- fMRI (functional magnetic resonance imaging) The MRI signal is affected by the blood oxygen. By repeating an MRI measurement, the oxygen levels can be compared 9the subject is given a task).
- 2- PET (positron emission tomography)= The emitted positrons meet the electrons, are annihilated and produce two coincident gammas. By repeating the measurement, the radio tracer distributions can be compared at both times. Both fMRI and PET measure blood flow.
- 3- MEG (magnetoencephalography)= Detecting and mapping the brain's magnetic fields produced by its electrical currents. MEG has a high time resolution.

Autism (or autistic spectrum disorders, ASD) was defined by Kanner and Asperger in the 1940's as a childhood disorder of social interaction. The concept has been defined and refined since then, thus including impairments in social, communicative and imaginative development. MEG aims to find the neurophysiological basis of autism. Recent studies reveal a hypo-responsivity in face processing which manifests from childhood, hinting at abnormalities of the face-recognition cerebral pathways and consequently, 'less tuned' social interaction and awareness.

In mathematics education, algebra appears to be more 'phobia-prone' than arithmetic. fMRI studies suggest the existence of declarative knowledge for the rules of algebra (lateral inferior prefrontal cortex gets activated when studying the rules). The perception and recognition of algebraic form is carried out at the fusiform cortex (activated with the practice of algebraic reading), and finally the anterior prefrontal cortex gets activated when using the required transformations for reasoning the result. These results suggest that the differences in algebraic processing rely on a strong perceptual component and that practice makes better! In these studies, MEG can be used longitudinally and can separate out the steps in reasoning. In conclusion, the brain never stops learning and repeated practice, rehearsal, rote learning combined with novelty are essential in learning.

Dr N M Calvo.

Exploring the Diversity of Exoplanets



Above: (left to right), Dr. Cyril Isenberg, University of Kent, Dr Suzanne Aigrain, University of Oxford, and Mr Phillip Young, South East Kent Astronomical Society (SEKAS).

On 20 November in Rutherford Lecture Theatre 1 of the University of Kent, Canterbury, Dr Suzanne Aigrain from Oxford University gave a wonderful lecture on 'Exoplanets'.

Less than twenty years ago, the Solar System was the only planetary system we knew about. Since then, astronomers have discovered many hundreds of exoplanets - planets that orbit other stars than the Sun.

We now know that exoplanets are common, perhaps even outnumbering the stars in our Galaxy. Some of them are so utterly unlike the Solar System planets that they challenge both our imagination, and our theories of how planets form and evolve.

Dr Suzanne Aigrain gave a crystal clear account of the successful search, in the past decade, for exoplanets and their characterization. It is conjectured that some form of life must be discovered eventually.

This was a joint meeting with SEKAS.

Dr C Isenberg

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The branch newsfeed and calendar are at <http://london.iop.org>

An attempt to break the world record for the 'biggest simultaneous physics experiment in multiple venues'.



On 13 November, London and South East branch committee members, Alex McDowell, David Parkes, Lee Crouch & Mark Telling were invited to South Hampstead High School (SHHS), London, to witness, and help steward, an attempt to break the world record for the 'biggest simultaneous physics experiment in multiple venues'.

This event was orchestrated as part of the Girls' Day School Trust's (GDST) 140th anniversary celebrations to commemorate 'women in science'.

SHHS was just one of over 25 schools and academies within the GDST network simultaneously performing measurements to determine the Earth gravity; namely by performing 'pendulum' and 'dropping a ball' experiments.



Approximately 170 Year 6 and Year 7 pupils at SHHS took part in a makeshift gymnasium-based physics laboratory. The results from SHHS, along with all the other schools, have been passed onto Guinness World Records for verification with an announcement from Guinness expected in the New Year.

Dr M Telling

Branch Certificates presented at Ellen Wilkinson School.

The London Region Big Bang was held in Westminster Kingsway College off Grays Inn Road on 11 July 2012 with projects and exhibitors through the foyer, library and on many floors.

Professor Peter Kalmus and Bob Boutland had been elevated to be moderators rather than judges at this event; we had plenty to look at.

One stand in particular caught our attention; the students were knowledgeable regarding their chosen topic, engaged with the public and other students well and stood up to questioning. Their answers and explanations were good.



It was for these reasons that a branch physics prize was awarded to the students from Ellen Wilkinson School.

Unfortunately the Ellen Wilkinson School Pupils had to leave before the award ceremony but this was rectified on 12 November 2012, at an assembly at the school, when Bob Boutland visited the school at Queens Drive, Acton and presented the students who took part in the Big Bang event with their Branch IOP Certificates.

The presentation award at the school was reported in the Ealing Gazette (Friday 16 November 2012). The report mentions Peter Kalmus, a renowned particle physicist, who was awarded the Rutherford Medal in 1988 <http://www.ealinggazette.co.uk>

The students had chosen their own topics to present at the London Region Big Bang and their enthusiasm was clear.

Kent Christmas Lecture for Schools: Polar explorations in light.



Above: (Left) Dr Cyril Isenberg and Professor David Pye (right)

Polar Explorations – In Light was the talk by Professor David Pye, Queen Mary, University of London on 26th November the Gulbenkian Theatre of the University of Kent

Just because we cannot see whether light is polarised or not, we often think of it as a rather obscure phenomenon, yet most natural light is partially polarised.

Its properties are widely important in physics, geology and natural history, and they have many technical applications. All four ways in which light can become polarised will be demonstrated and their various practical applications will be explored.

The results are not only important, but are often extremely beautiful. They touch upon such diverse topics as how the Vikings navigated, how to make the most amazing kaleidoscope, how to take a photograph in a millionth of a second, how a flying water bug checks that it is really water before diving in, and the sunset at the Taj Mahal... and then there is the Cheshire Cat...

Professor Pye produced numerous demonstrations to illustrate examples of polarized light in all aspects of our everyday life. These can be observed with a one or two Polaroid strips.

(A book derived from his lecture was published by the Institute of Physics Publishing in 2001 under the title 'Polarised Light in Science and Nature'.)

Dr C Isenberg

REMS Thames Walk 2: Saturday 24 November 2012



The Thames Path is a National Trail, opened in 1996, following the length of the River Thames from its source near Kemble in Gloucestershire to the Thames Barrier. It is about 184 miles long.

This second walk, about 8 miles long was from Greenwich to Waterloo passing Tower Bridge, London Bridge, the Globe Theatre and the South Bank complex of concert halls, theatres, cinemas and practically every restaurant chain that you have heard of.

The first two thirds of the walk were over what used to be dockyards and wharfs. Surrey Docks occupied a large part of the area. Most of the area has been filled in and planted with blocks of flats with more sprouting up all the time.



The planners of the Thames Path did the best that they could to keep the path beside the river.

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At Deptford Strand, Henry VIII established a great naval dockyard, which amongst other things contained rum storehouses. Later we passed through Surrey Docks Farm with its painted gates, models of animals and a homely little café. There are supposed to be live animals too.

Lunch was at the Old Salt Quay pub, where in good weather you can sit outside watching the river and its traffic go by. In Rotherhithe, we passed the Brunel Museum, which used to be the engine house for pumping water out of his tunnel under the Thames. The Thames Tunnel was the first to be built under a navigable river and was opened as a foot tunnel in 1843. It is now used by underground trains. Nearby is the old pub, The Mayflower, named after the famous ship which carried the Pilgrim Fathers to America in 1620.



The last third of the walk was almost all beside the river and passes the shopping and eating areas around Tower Bridge and London Bridge. After passing under London Bridge, we walked through an old quarter which contrasts with the modern flats and offices. We passed a replica of Francis Drake's galleon Golden Hinde. After that we walked along Clink Street where the former Clink Prison is now a museum.

Reinalt Vaughan-Williams and Mike Quinton

REMS visit the Goldsmiths Centre: 29 November 2012.



Since 1300 it has been responsible for hallmarking gold and silver articles and promoting the work of its freemen. To further its work in supporting gold and silver smithing and offering training, it has opened the new Goldsmiths' Centre in Clerkenwell. <http://www.goldsmiths-centre.org>



Peter Taylor, the director, kindly offered to tell us about the Centre and showed us some of the workshops. We saw the classical metal forming techniques for gold, silver, platinum and the high tech area of CAD design and metal forming.



Peter Taylor, (above), the director and our host, was an excellent guide.

George Freeman and Mike Quinton

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AT HOME – AN ENVIRONMENTAL MISCELLANY THURSDAY 10 January 2013

This meeting has been organised by George Freeman

PROGRAMME

Chairman Mike Quinton

10:20 Registration and coffee

10:50 Welcome and notices

11:00 **Anita McConnell**

(Affiliated Research Scholar, University of Cambridge, am638@cam.ac.uk)

The barometer and its early use in forecasting on land and at sea.

11:40 **Jeremy Batch** (jeremy.batch@bwml.co.uk)

The Story of Navigation: 2000 BC to 2020 AD.

13:00 **Lunch**

14:15 **David Richmond-Coggan**

(Volunteer Branch Secretary and Adult Presenter, RNLI, david@rnli-leatherhead.org.uk)

The RNLI and its Boats

14:45 **Keri Nicoll** (Department of Meteorology, University of Reading, k.a.nicoll@reading.ac.uk)

Radiosondes; their history and importance

15:45 **David Gowing** (Professor of Botany, Open University, d.i.gowing@open.ac.uk)

Vegetation patterns in meadows are explained by patterns in hydrology.

16:45 **Tea**

Institute of Physics, 76 Portland Place, W1B 1NT.

Nearest underground stations are Oxford Circus and Regents Park.

This meeting is open to visitors.

Please contact John Belling, john.a.belling.secrems@gmail.com 07986 379935,
42 Cunningham Park, Harrow, Middx, HA1 4QJ, **if you wish to attend.**

Costs are £31 with lunch or £10 without lunch.