



# The Royal Society of New South Wales

## Bulletin and Proceedings 338

ABN 76 470 896 415

ISSN 1039-1843

August 2010

### Future Events 2010

Lectures in Sydney are held in Lecture Room 1, Darlington Centre, University of Sydney at 7 pm on the first Wednesday of the month with drinks available from 6 pm.

**Wednesday 1 September 2010 at 7 pm**

**Dr Ken McCracken**

**Long-term changes in solar activity - including the current "Grand Minimum"**

(see details at right)

**Wednesday 6 October 2010 at 7 pm**

**Dr Ziggy Switkowski**

**Is the climate right for nuclear power?**

### Southern Highlands Branch

Meetings are held on the third Thursday of each month in the Drama Theatre at Frensham School, Mittagong (enter off Waverley Parade), at 6.30pm.

**next talk**

**Thursday 16 September 2010, at 6.30pm**

**Professor Heinrich Hora**

Nuclear Energy without Dangerous Radiation

(see details page 2)

**Friday 26 November 2010, at 5.30pm**

**Liversidge Lecture**

**Professor John White, ANU**

Merewether Theatre,  
University of Sydney

Details in future Bulletins

Bulletin Editor, Bruce Welch

### Lecture 1 September 2010, Darlington Centre at 7pm

**Dr Ken McCracken, Jellore Technologies and the University of Maryland**

**Long-term changes in solar activity – including the current "Grand Minimum"**

The sunspot record since Galileo's time, and the cosmogenic nuclides  $^{10}\text{Be}$  (in ice cores) and  $^{14}\text{C}$  (in tree rings) show that the degree of activity of the Sun has varied greatly over time. The solar activity, manifested by the occurrence of sunspots, solar flares, and coronal mass ejections may be quite high, as it has been since 1946; and was during Roman times, or very small as during the Maunder Minimum (1645-1715); the Dalton Minimum (1810-20) or the Gleissberg Minimum of 1900-10. In the first part of the lecture, the speaker will discuss his recent studies with Swiss colleagues of the last 10,000 years of  $^{10}\text{Be}$  data from the Arctic and Antarctic that shows that the Sun has exhibited a number of persistent periodicities in solar activity, the most important being of duration 2300yr, 210yr, ~85yr, and the well known 11/22 year solar cycle. He will also outline the last 30 years of satellite data that show that the solar irradiance varies by ~0.1% over the 11 year solar cycle.

Against that background, he will then describe the substantial reduction in solar activity that commenced in 2006. Since then, the sunspot behaviour has been similar to that during the Dalton minimum (1810-20). The interplanetary magnetic fields have been lower than at any time during the space age, and the cosmic radiation intensities are well above those at any time during the past 60 years. The solar irradiance has decreased well below that observed in the previous 30 years. The evidence indicates that the magnetic properties of the Sun are now very different from those at any time in the "Space Age". Based on the 10,000 year  $^{10}\text{Be}$  record, he will speculate that the Sun will remain relatively inactive (and cool) for the next 20 years, and it will then resume a steadily increasing state of activity until it reaches a peak of the Hallstatt (2300 year) cycle ~200 years in the future.

Ken McCracken has had a long and varied life as a scientist, technologist, and contrarian. Starting his research career in Tasmania and New Guinea in the 1950s, he was then deeply involved in the early days of the US space program for seven years while at the Massachusetts Institute of Technology and the University of Texas. He designed and built scientific instruments that were flown on seven spacecraft that went to the orbits of Mars and Venus in the 1960s to provide the information needed to protect the US astronauts from being killed, or loosing their virility en route to the Moon. Following a professorship at the University of Adelaide, CSIRO appointed him to inaugurate a new research laboratory to improve geophysical exploration for minerals in the harsh Australian environment. Moving to the Southern Highlands in 1989, he operated a consultancy providing scientific advice to the mining industry.



### Patrons of The Royal Society of NSW

**Her Excellency Ms Quentin Bryce AC**

**Governor-General of the Commonwealth of Australia**

**Her Excellency Professor Marie Bashir AC CVO Governor of NSW**

**Lecture delivered for the Society's 1183rd Ordinary General Meeting held on 4 August 2010**

## **The Dynamic Brain: Modelling Sleep, Wake, and Activity in the Working Brain**

**Prof Peter Robinson, School of Physics, University of Sydney, Brain Dynamics Center, Sydney Medical School – Western, University of Sydney, Center for Integrated Research and Understanding of Sleep**

Modelling the human brain is difficult on a fundamental level because the system is highly interrelated with multiple interactions on many different scales inside the brain, and because there are also complex two-way interactions between the brain and the outside world. It is difficult on a practical level because of the need to incorporate many different kinds of observations and to deal with a wide range of phenomena across physics, chemistry, neurophysiology, medicine and psychology (to name but a few areas). In the past this has lead to a plethora of "ad hoc" models that each addressed only one phenomenon, or one type of observation. This has now changed.

Prof Peter Robinson provided a very clear and stimulating description to the August OGM of Neural Field Theory. The brain has 100,000,000,000 neurones, far too many to model on an individual basis. So Neural Field Theory uses a continuum model at scales >0.1 mm, adds anatomical connections, incorporates different neural types, and uses physical models of neuronal excitation and signal propagation. The

result is a series of partial differential equations for fields that can give great insight into brain functioning.

Most of the model's parameters are either known from experiments or can be estimated directly. The model then gives very good fits to normal brain wave patterns. Adjusting some of the parameters can give remarkably accurate fits to brain wave patterns during seizures, and work is ongoing to investigate the resulting physiological models. There are also implications for understanding some aspects of Parkinson's disease.

Another important aspect of Prof Robinson's research is sleep physiology, particularly the question of how the brain moves between arousal states. Standard physiology and dynamics constrains all but a few of the relevant parameters for the Neural Field Theory model, and the rest can be determined via a few experiments. The resulting model is in excellent agreement with a wide range of observations. It gives robust explanations for important aspects of arousal thresholds that were previously hard to understand. There are

implications for understanding changes in sleeping patterns as people age, understanding the complexities of sleep deprivation, insight into the problems caused by shift work, and a deeper understanding of the sleep patterns of other mammalian species. (Primates are unusual in having long periods of sleep – most mammals only sleep in bursts and whales and dolphins sleep unihemispherically with one side of the brain always awake.)

The fact that such a (relatively) simple model works for such a wide range of phenomena and species gives confidence that real progress is being made in understanding the dynamic brain.

Jim Franklin,  
Councillor, Activities Coordinator

## **Southern Highlands Branch Lecture**

**Thursday 16 September 2010, at 6.30pm**

**Professor Heinrich Hora**

### **Nuclear Energy without Dangerous Radiation**

Coal contains 2 parts per million uranium, but you can ignore its radioactive radiation hazard. Nuclear fusion of hydrogen with boron generates even less radiation but this was considered far too difficult to work in a power station. In the search for laser ignition of this reaction, a new possibility may be opened with the latest exotic lasers based on knowledge initiated in Australia with worldwide cooperation.

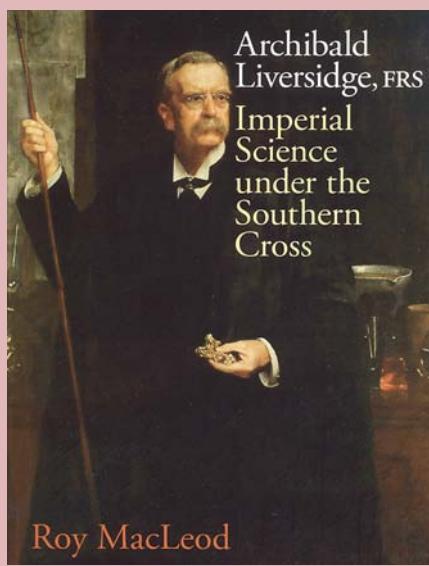
## **Liversidge Book - Special member's Discount**

The Council has decided to offer a 10% discount to Members on this superb book. It is a joint publishing effort between the Society and Sydney University Press

This book is a detailed narrative of the progress and beginnings of scientific inquiry in Australia.

For anyone interested in Archibald Liversidge, his contribution to crystallography, mineral chemistry, chemical geology, strategic minerals policy and a wider field of colonial science.

Now \$54 collected or \$65 posted (within Australia)



## **New Members**

Three new members were announced at the July meeting of the Society:

Nat Burgio - Full Member  
Rudolf Dominguez - Full Member  
William Kneprath - Full Member

We welcome them into the Society.

## From the President



I am writing this in the middle of Science Week and it is gratifying that we have such a thing at all. It is gratifying that this event continues to become more and more well-known and is able to do great things to keep science at the forefront of people's minds. I would encourage all members to get involved and participate in as many events as possible. I hope the Society will be able to become more involved in the future.

This is the International Year of Biodiversity and there are many events being held throughout the country to celebrate it in Science Week, 135 in all and 23 in NSW. It so happens that one of our former office assistants, Val Gregory, is doing a marvellous job helping to co-ordinate these events at the Australian Museum, in co-operation with Teresa Belcher from the Western Australian Museum. Congratulations Val.

You can keep up to date with biodiversity events across Australia by visiting [www.biodiversity2010.org.au](http://www.biodiversity2010.org.au). To find out about more National Science Week events, visit [www.scienceweek.gov.au](http://www.scienceweek.gov.au).

Congratulations also to all Eureka Prize winners announced this week. They showed the depth and breadth of scientific work being carried out in Australia today. They also showed that science can be successfully communicated through intelligent journalism. One of the winners is known to us through his recent lecture given before the Society – congratulations to Professor Phillip Hogg, Director of the Lowy Cancer Research Centre at the University of NSW, who won the Medical Research Translation Award for his work on better cancer therapeutics.

John Hardie

## Southern Highlands Branch

### Report of August Meeting

#### Tutankhamun: The Dead Do Tell Tales.

Dr Michael Birrell

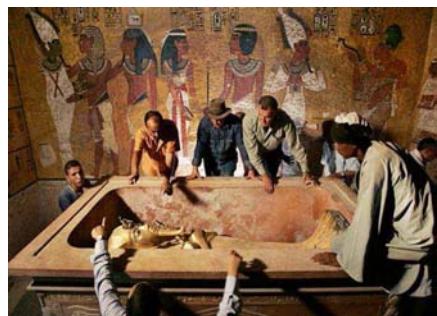
The Southern Highlands Branch meeting of 19 August 2010 was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong. A 60-strong audience started arriving at 6pm on a crisp winter's evening.

Michael Birrell gave a fascinating presentation on the life and times of Tutankhamun, who ruled Egypt during the 18th Dynasty (around 1330-20 BC), coming to the throne as a child and famously dying young at the age of about 19. It was Howard Carter who discovered Tutankhamun's tomb in 1922, an event which received worldwide coverage. It awakened a renewed level of public interest in the boy-king, and in particular, in the nature and cause of his early death which has often been attributed to murder.

The king's death more than 3000 years ago has remained the subject of dispute among historians up to the present day. Theories that he was assassinated stemmed from the fact that he was the last ruler of his dynasty. It was not until February 2010 that compelling evidence based on DNA studies became available. Michael Birrell's presentation was largely based on these studies, on X-ray data and on CT scan results. The conclusions to be drawn from this data give compelling insights into this period of early Egypt.

When British archaeologist Howard Carter and his team examined Tutankhamun's mummified remains in the early 1920s, they found that the jewelry and adornments on the body had been stuck fast by the hardened embalming fluids used. The arms and legs were detached, the torso was cut in half and the head was severed. Hot knives enabled the head to be removed from the solid gold death mask. Intriguingly, Tutankhamun's tomb also contained two tiny fetuses, the identification of which has only now been made possible by the recent DNA testing.

Analysis of all available data now seems to point to the fact that Tutankhamun was not assassinated. Although scientists discovered a small, loose sliver of bone within the upper cranial cavity, it appears



likely its presence was due, not to a blow to the head as many have surmised, but rather to the mummification process itself, when sticks were used to macerate the brain before its removal through the nose. The finding of a fractured leg is now considered very significant as a contributing cause of death. It is thought not to have resulted from the mummification process, but rather from a fall from some height, such as a fall from a chariot. DNA tests have revealed that the king was also infected with *Plasmodium falciparum*, a form of malaria, and that he suffered from numerous congenital conditions. It seems likely that the combination of the fall from a chariot and the onset of malaria brought about the death of the king.

As for the identification of the fetuses found in the tomb, it is clear that they were the offspring of Tutankhamun. The finding that these fetuses spontaneously aborted due to genetic factors seems quite consistent with the data.

This lecture was clearly appreciated by the audience, who put a wide array of questions to Dr Birrell. The vote of thanks was given by Anne Wood.

Anne Wood

## **Meet your new Councillors**

### **Brendon Hyde**



**Brendon Hyde BE(Syd), MEngSc(NSW), GradDipLLR(Syd), MICE(Lon), FIEPak, FIEAust, CPEng**

With qualifications in engineering and law from Sydney University, Brendon has over 40 years civil engineering experience - designing hundreds of bridges as well as many heavy industrial structures. After early work with DMR NSW and several Sydney consulting firms he has been engaged as a technical adviser by government road, railway and dam authorities and by many consulting engineering firms both in Australia and overseas - from Asia to Africa - where he has worked on some major international bridge projects.

Both an Australian and an international Lincoln award were conferred in 1992 for his design of the Leura railway underbridge. The WH Warren Medal was awarded in 2008 for his civil engineering eco design paper.

An active member of the engineering profession he has authored numerous technical papers and guidelines, lectured at universities as well as serving on the

committee of the Civil and Structural Engineering Panel of the Sydney Division of Engineers Australia - being a past secretary and chairman. He is a past secretary of the AUSTROADS Structures Technology Reference Group and is now on the CECAR5 committee.

A veteran backpack traveller he is a past chairperson of the Sydney Region Outdoor Club of Hostels International, Australia. As a six times NSW representative and university Blue in athletics he is a keen sportsman and still competes regularly in distance athletics, swimming, triathlon, kayak and cross country skiing events - recently gaining a Worldloppet Master gold medal. He also serves at Sydney University Sport on the Blues Association committee.

### **Central West Branch**

#### **August Meeting**

#### **Dr Alex Ritchie**

#### **A scientific treasure trove**

A report on Dr Ritchie's talk will appear in the next Bulletin.



### **Contact your office bearers**

John Hardie President	02 9363 9360	Prof Heinrich Hora Vice President	02 4627 7769
Clive Wilmot Vice President	02 4886 4199	Bruce Welch Hon. Secretary (General)	02 9569 9928
Prof Jak Kelly Hon. Secretary (Editorial)	02 9419 6877	Marian Haire Hon Treasurer	02 8467 3575
Alan Buttenshaw	02 9569 0236	Jim Franklin	02 9514 2195
Julie Haeusler	0410 320 776	Dr Don Hector	02 9484 4378
Prof. D Brynn Hibbert	0411 286 480	Brendon Hyde	02 9498 3520
Dr Michael Lake	02 9514 2238	Dr Frederick Osman	0418 444 477
A/Prof Bill Sewell	02 9295 8434	Prof. Bruce A Warren	02 9665 7537
Clive Wilmot - Southern Highlands Rep.	02 4886 4199	Prof Kevin Parton - Central West Rep.	02 6365 7500

**The Bulletin and Proceedings is issued monthly by the Royal Society of New South Wales  
Address: 121 Darlington Rd, Building H47, UNIVERSITY OF SYDNEY, NSW 2006, AUSTRALIA**

**Phone: 61 2 9036 5282 • Fax: 61 2 9036 5309**

**Sonia Chan, Administrative Assistant**

**Email: [royalsoc@usyd.edu.au](mailto:royalsoc@usyd.edu.au) • Web page: <http://nsw.royalsoc.org.au>**

## **Australian Institute of Physics NSW Branch**

### **7th General Meeting 2010**

Monday 21 September 2010

#### **5:30pm**

Dr Felix Lawrence, University of Sydney.  
"Photonic Crystals: Light's Playground"

#### **7:00pm**

Br David Coutts, Macquarie University.  
"Exploiting the colour variable in scientific imaging"

Location of talks: Slade Lecture Theatre,  
School of Physics, University  
of Sydney. Refreshments will  
be available before each talk.  
Entrance to all events is free.



Dinner to follow at Buon Gusto Restaurant,  
Abercrombie St.

Please contact Dr Fred Osman on 0418 444 477 to book.

### **RACI News**

Weekly E-News (including forthcoming events) of The Royal Australian Chemical Institute Inc. NSW Branch are obtainable on their web site at <http://www.chem.unsw.edu.au/raci/News.html>

