



The Royal Society of New South Wales Bulletin and Proceedings 319

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September 2008

Future Events 2008

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 October

Dr Naomi McClure-Griffiths
Exploring the Milky Way
The Past, Present and Future

Wednesday 5 November

Professor Matthew England
Climate and Environmental Dynamics Laboratory
School of Mathematics, University of NSW

Global Climate Change

Tuesday 23 September

Australian Institute of Physics NSW Lecture
Dr Viv Robinson *ETP Semra Pty Ltd*
Commercialising Research
From Scientist to Entrepreneur and Back Again
6pm, Slade Lecture Theatre, School of Physics,
University of Sydney

Wednesday 3 December 2008

Liversidge Lecture
Professor Cameron Kept
School of Chemistry, University of Sydney

Molecular Materials

From Clean Energy Storage to Shrinking Crystals
– and Society Christmas Party, see details next issue

Thursday 16 October • 6.15 pm

Southern Highlands Branch
Frensham, Mittagong

Thursday 16 October • 6.30 for 7pm

Australian Museum

Richard Saunders
International author
Past President of Australian Skeptics

Adventures into the Claims of the Paranormal

Book online:
<http://www.amonline.net.au/tams/events.cfm#Night%20Talks>

Dr Naomi McClure-Griffiths

Lecture: Wednesday 1 October 2008

Exploring the Milky Way: The Past, Present and Future

How galaxies come to be and how they evolve are two of the main questions driving modern astrophysics. Our own galaxy, the Milky Way, provides the closest laboratory to study the structure and evolution of galaxies. Radio telescopes play a unique role in this field by studying the distribution of the gas in galaxies and their enigmatic magnetic fields. Atomic hydrogen, as the dominant component of the Milky Way's interstellar gas, is a particularly useful tracer of the structure and evolution of the Galaxy. Since the first detection of the atomic hydrogen spectral line in 1951, it has been used extensively to map the structure of the Galaxy. And yet, some very basic questions about the Milky Way remain unanswered: Exactly how big is the Galaxy? Where is the Sun in relation to the Galactic Centre? If we could look at the Milky Way from above what would it look like and how many spiral arms would it have? How does the Milky Way evolve and how do we interact with our neighbours?

I will take us on a walk around the Milky Way revealing what we do know about the structure of the Galaxy and how gas in the Galaxy leads to its evolution. I will focus on our current work on the interstellar gas and magnetic field in the Milky Way and what it is telling us about the complex interstellar ecosystem of the Milky Way. I will also discuss the world's next generation radio telescope, the Square Kilometre Array (SKA), which will be one hundred times more powerful than any existing facility and which we hope to host in Australia. I will conclude by discussing how the SKA will revolutionise our understanding of our home galaxy.

Dr Naomi McClure-Griffiths is a CEO Science Leader at the CSIRO Australia Telescope National Facility (ATNF), where she leads a research group with the aim of better understanding our own galaxy, the Milky Way. McClure-Griffiths has led two major surveys of the Milky Way including the Galactic All Sky-Survey, an on-going international project to produce an atlas of the hydrogen gas in the Milky Way. McClure-Griffiths holds an Honorary appointment at the University of Sydney and supervises PhD students in Australia, the U.S. and Japan. In 2006 she was the recipient of the Prime Minister's Malcolm McIntosh Prize for Physical Scientist of the Year for her discovery of a new spiral arm in the outer Milky Way.



Dr Naomi McClure-Griffiths

Darwin Celebrations 2009

There will be much celebrating next year for the 200th anniversary of the birth of Charles Darwin (February) and the 150th anniversary of the publication of his revolutionary book, *The Origin of the Species* (November). Check the website www.evolution09.com.au for the Victorian spectaculars. We have decided to stage our event in November at Science House. Your input and help would be very welcome. Please contact the office.

To set the scene see p4 for Instalment 1 of a three-part article *From Lamarck to the Agouti: The evolution of epigenetics* by Emeritus Scientia Professor, Eugenie Lumbers FAA and A/Professor Tamas Zakar.

Patron Her Excellency, Professor Marie Bashir AC CVO Governor of NSW

From the President

Following on from our very well attended September meeting, I'm pleased to report that 2008 promises to end as frantically as it began, as far as the Society is concerned. Not only do we have our advertised lectures for October and November, but we also have some additional events lined up to excite our scientific palates.

I'm pleased to announce that this year we are able to bring back the Liversidge Lecture, which has been absent from our diaries for some years now. Our distinguished lecturer this year will be Professor Cameron Kepert from the University of Sydney. This event will be held on 3 December in place of our advertised student lectures, and will be followed by our Christmas Party.

Negotiations are also well in hand for a distinguished researcher to deliver the Pollock Memorial Lecture later in the year. This lecture is held in conjunction with the School of Physics at the University of Sydney, where Pollock was a professor from 1899 -1922.

Speaking of Pollock, it was encouraging that on the first day of History Week, Saturday 6 September, we had around 35 hardy souls emerge from the wind and rain to hear Professor Jak Kelly and Dr Joe Khachan from that same department talk about one of Pollock's discoveries, the 'Pinch Effect', in the auditorium of Science House. Several people took the opportunity to have a quick look around Science House during afternoon tea.

John Hardie

Congratulations Peter Tyler

The Library Council of NSW has awarded Dr Peter Tyler the inaugural **Merewether Scholarship** in the State Library for *An investigation of the development of a scientific consciousness in New South Wales between 1820 and 1900, based on the archives of The Royal Society of NSW and other documents held in the Mitchell Library.*

The Scholarship is for a period of 12 months and will culminate with a public lecture delivered at the State Library. He will be taking up the Scholarship at the beginning of October following his return from overseas.

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Roles of telomeres and telomerase in human health and disease

A summary of the September lecture by Dr Elizabeth H. Blackburn

A packed audience was privileged to hear a broad ranging and highly entertaining talk on telomeres and telomerase by the co-discoverer of telomerase, Dr Elizabeth Blackburn, FRS, from the University of California, San Francisco.

Telomeres are the repetitive DNA sequences at the ends of every chromosome that form a protective 'cap' which stabilizes and protects the chromosomes' ends. During replication, the telomeres shorten and this cumulative erosion eventually causes cells to stop dividing altogether. This means that ordinary cells can only divide a fixed number of times ('Hayflick limit') before they senesce and die. In 1984 Dr Blackburn co-discovered telomerase, a specialized ribonucleoprotein reverse transcriptase that can replenish telomeres. This is used in a highly regulated way in stem cells and germ cells to permit endless reproduction.

Cancer cells are rogue cells derived from ordinary tissues that have somehow managed to evade the Hayflick limit and become immortal. Dr Blackburn explained that 90% of cancers do this by producing telomerase (the remainder do so by ALT, a poorly understood alternative method that probably involves multiple recombination events at the telomere). Thus telomerase is a prime target for controlling many cancers. Her experiments have shown that if telomerase production is decreased in melanoma cancer cells, they rapidly become much less invasive and much less prone to metastases. The cancer continues to grow, but only slowly, and with much reduced malignancy. Down regulation of the cell cycle, particularly glucose metabolism, appears to be a key factor.

The method used to achieve these results was an elegant use of a special small interfering RNA, siRNA. Dr Blackburn explained that telomerase consists of a highly unusual combination of a protein (Telomerase Reverse Transcriptase – TERT) enfolding a special small RNA (TERC). Both are highly conserved across species and tiny changes in either stop telomerase functioning. The siRNA binds to TERC and so inhibits the telomerase. Dr Blackburn then described how telomerase has a surprisingly wide role in cell and human health and aging. 'It's an upper-level manager of cell programs' she explained, 'not a humble bricklayer'.

Dr Blackburn and her co-workers have recently linked telomere length to overall health. They found that people with shortened telomeres in their blood cells had higher mortality, a 3.2 elevation in heart disease, an 8.5 fold increase in infectious diseases and poorer survival from all causes.

A recent landmark study with her colleague, Elissa Epel, has shown that chronic stress is associated with decreased telomere length, which is in turn associated with elevated risk of cardiovascular disease. The predictive value is low for individuals, but good for cohorts. Clearly the investigation of telomeres and telomerase is of great and increasing importance.

Jim Franklin

Project report: History of the Royal Society of NSW

I have been reading a great deal of secondary material relating to nineteenth century scientific bodies in order to gain a greater understanding of the intellectual environment in which Royal Society of NSW formed. I have also begun compiling detailed biographies of the early protagonists in the Royal Society and its antecedents.

With Robyn Stutchbury's return to Australia, we will commence the oral history component of the research. The State Library of NSW have agreed to provide assistance with training interviewers from the beginning of October.

I attended the Australian Historical Association biennial conference in Melbourne last month and took the opportunity to visit the Royal Society of Victoria. I hope to find material touching on the relationships between the two Royal Societies. I acquired a short history of the Society which they have published.

When in London I will be inspecting the archives of the Royal Society there.

Peter Tyler

Southern Highlands Branch report

Meeting held on 21 August 2008 at Frensham, Mittagong

Dr George Collins, Chief of Research at ANSTO, discussed the various sources of energy generation including coal fired power plants, solar, wind, geothermal, hydroelectric and nuclear. He outlined the use by major countries of these types of energy production. He noted that energy production in France is 70% nuclear, while Canada produces more from hydroelectric, New Zealand derives energy from geothermal while Denmark uses mainly wind.

Australia derives nearly all of its energy from coal which is a contributor to atmospheric carbon dioxide production and the increase is implicated in global warming. Black coal in NSW produces less CO₂ than brown coal from Victoria.

He noted that the economics of running a nuclear power plant was cheaper than coal, not including capital costs and the possible costs of nuclear disposal which has not been properly assessed as there are still unknowns in relation to long term storage.

It was also pointed out that deaths from the coal industry are far higher (in the thousands) while immediate deaths from direct nuclear accidents were only about 30. The only unknown is the long term incidence of increased cancers.

Dr Collins was introduced by Ted Smith and thanked by Dr. Fred Hertz. Attendance was a total of 74.

Hubert Regtop, Vice Chair of the Southern Highlands Branch

One Hundred Years Ago ...

The date of Wednesday 2nd September 1908 was a busy evening of physics and geology at the meeting of the Society. Three papers were read, many letters tabled and items exhibited.

'The Discharge of Electricity from Glowing Carbon' by J A Pollock, Professor of Physics in the University of Sydney, and A B B Ranclaud, BSc. In these experiments Prof Pollock investigates the flow of electricity in the form of a luminous arc from a hot carbon rod to a cool carbon rod across an air gap of up to 3 millimetres in length. Prof Pollock himself describes this phenomenon; *'At low voltages the current is of the order of a milliampère and is not accompanied by any luminosity. As the potential difference increases, a critical value, depending on the temperature and on the distance between the carbons, is reached at which an arc forms, and the current jumps instantly from milliampère to several ampères...'*

'The Relighting of the Carbon Arc' by J A Pollock, DSc, E M Wellisch, MA, and A B B Ranclaud, BSc, followed on from the previous talk. *'When the arc between fixed carbons, in a hand-fed lamp, burns itself out, it may be restarted if too great an interval of time is not allowed to elapse, by lessening the distance between the carbon terminals but without bringing them into contact. Again, if the circuit is broken and reclosed after a short time, the arc may re-establish itself without the carbons being moved.'*

It is interesting to consider that arc lamps were the primary source of high intensity light at this time and had important applications such as projector lamps and light houses. Yet today this technology, like the carbon arcs themselves, has been extinguished by more advanced technology. Today we can hold in our hands laser pointers with intensities far exceeding the dreams of Prof Pollock. What technology will replace ours?

The final paper was *'Evidence of Recent Submergence of Coast at Narrabeen'* by T W Edgeworth David, BA, FRS, Professor of Geology, University of Sydney, and Gerard H. Halligan, FGS, Hydrographic Officer, Public Works Department. Edgeworth David says in this paper, *"It has long ago been pointed out by the late Rev. W.B. Clarke, the late Government Geologist, Mr. C.S. Wilkinson, Mr. E.C. Andrews, and one of the authors, that the numerous deep inlets along the coast, such as those at Lake Macquarie, Tuggerah Lakes, Broken Bay, Port Jackson, Botany Bay etc., were distinct evidence of recent coastal submergence."* This paper is very interesting and mentions numerous sites around Sydney where ancient tree trunks lie submerged.

Continued next column

Farewell to the Governor-General



Society President John Hardie wishing His Excellency well at a reception in his honour

One Hundred Years Ago... (cont)

The *'Abstract of Proceedings'* for this meeting recorded that 32 members and two visitors were present. Dr Marden and Mr L. Hargrave were appointed scrutineers, and Mr H. Deane presided at the Ballot Box. The President reminded members that a *Conversazione* would be held on Tuesday evening in the Great Hall of the University and that exhibits should be sent to the Hon. Secretaries as soon as possible, so as to appear in the catalogue.

Letters were received from Prof. Liversidge, London and Sir William Turner, Edinburgh, acknowledging their election as Honorary Members of the Society. The text of their letters was included in the proceedings of the meeting (See RSNSW Journal, Vol XLII, 1908, Abstract of Proceedings, page xxvi). A Letter was also received from the Linnean Society of NSW inviting the RSNSW to attend their next meeting and *'to give special consideration to what is being done ... to protect native animals and plants from extermination.'* The Hon. Secretary (Mr. J.H. Maiden) was asked to attend the meeting and to inform the Linnean Society of the steps already being taken by the RSNSW in this matter. There was also a letter, which had been inadvertently laid aside from a previous meeting, from the Department of Public Health. This seems to be a request that further specimens of blood-sucking insects sent to Cambridge be *'divided between and simultaneously dispatched to the Director, Natural History Museum, and Professor of Biology already mentioned.'* Reading between the lines indicates that some politics was occurring. Finally W J Clunies Ross, BSc, FGS, exhibited specimens of crystals of various salts formed when the salts are dissolved in sodium silicate.

Dr Michael Lake, September 2008

From Lamarck to the Agouti: The evolution of epigenetics

Eugenie Lumbers FAA is Emeritus Scientia Professor, UNSW • Tamas Zakar is an A/Professor, U of Newcastle

Instalment 1: In the beginning...

Epigenetic inheritance was one of the early theories of evolution that although proposed by Jean-Baptiste Lamarck (1744-1829), was first described by Erasmus Darwin, Charles Darwin's grandfather (1731-1802). Erasmus Darwin's theory of evolution is most beautifully espoused in these lines from his poem *The Botanic Garden*¹.

*Till o'er the wreck, emerging from the storm,
Immortal Nature lifts her changeful form,
Mounts from her funeral pyre on wings of flame,
And soars and shines, another and the same.*

Epigenetic inheritance is best described as the inheritance of acquired characteristics. Lamarck's theory of evolution said that evolutionary change was the result of use or disuse of organs. Over generations, an organ that was used grew bigger or changed to suit its use better while an organ that was not used, such as the human appendix, atrophied. The most quoted example of epigenetic inheritance or Lamarckism cited the long neck of the giraffe. Lamarckism postulates that the necks of the giraffe grew longer over successive generations because giraffes reached up into the trees to feed.

By the 20th century epigenetic inheritance became discredited in western science following publication of *Darwin's Theory of Natural Selection*, the acceptance of Mendelian genetics and the demonstration by Muller that genes could mutate.

This was not the case in Soviet Russia where it was adapted, modified and promoted by Trofim Denisovich Lysenko, a rather shoddy scientist who supported Michurianism during the Lenin/Stalin era. Michurin was an advocate for Lamarckism. Lysenko violently opposed the theory of natural selection. He was so successful in getting his ideas accepted by Stalin, that proponents of the genetic basis of inheritance were sent to gulags. For example, Nikolai Vavilov, an eminent geneticist who studied with William Bateson and who strongly criticised Lysenko's non-Mendelian concepts was arrested and died of malnutrition.

Another tragedy in the battle between Lamarckism and Darwinism was that of Paul Kammerer, an Austrian biologist who tried to demonstrate inheritance of acquired characteristics by studying the effects of the environment on salamanders and a species of toad, the midwife toad. His claims of demonstrating Lamarckian evolution were most famously associated with the development of enlarged footpads and spurs in the male toad when forced to mate in a watery environment. After he was accused of falsifying the enlarged footpads by injecting Indian ink, Kammerer committed suicide. There is a mystery surrounding this case of scientific fraud as Kammerer had previously taken his specimens to the UK where the elite of the pro-Darwinian biologists of the age examined them. They accepted the biological evidence he brought with him, even though they did not support Lamarckism or epigenetic inheritance. Kammerer had resigned from the institute where his specimens were stored and was about to take up a position in Soviet Russia, when the discovery of falsified footpads in the specimens was made. It has been claimed that the toad footpads were tampered with in order to discredit him; a tragedy described in a very readable biography by Koestler².

Continued next column

In recent years, however, epigenetics has become an exciting and growing field of research. Epigenetics is the heritable modification of cell phenotype occurring independent of changes in the nucleic acid sequences that make up DNA. It is now a major area of research in plant and animal biology and is of particular importance in the emerging field of the study of the developmental origins of adult disease.

How can this be?

Instalment 2, The Epigenetic mechanism will explain all. See B&P 320.

¹ Erasmus Darwin, *The Botanic Garden, Part I, The Economy of Vegetation. 1791, London, J. Johnson*
² Arthur Koestler *The Case of the Midwife Toad. 1971, Random House*

Briefly... Robyn Stutchbury

Science for Science House is progressing slowly but remarkably well. It seems those in government are accepting of our initiative, but there can be little more done until we have a business plan lodged. This is currently being undertaken and will be covered by a more detailed report next Bulletin.

The Blue Mountains Historical Society invited me to give a presentation on our Collection and the Community Heritage Grants on Saturday 6 September at Wentworth Falls. It was very gratifying to have such a large and interested audience on so cold and wet a day. Peter Tyler and Marian Haire both contributed to the talk and questions that followed.



Robyn Stutchbury addressing the Blue Mountains Historical Society

Contact your office bearers

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