The Royal Society of New South Wales
Report of Activities 2010

ABN 76 470 896 415

The Royal Society of New South Wales is one of the oldest learned societies in the southern hemisphere.

Its main function is to promote science in all its aspects, and to link the disciplines of science to each other and to other elements of human endeavour.

Membership of The Royal Society of New South Wales is open to anyone interested in the pursuit of these ideals. The special category of Student Member encourages science scholarship, especially among the young.

THE SOCIETY'S HISTORY

The Royal Society of New South Wales was established as the Philosophical Society of Australasia on 27 June 1821.

It was the first scientific society in the Colony of New South Wales, and was formed 'with a view to inquiring into the various branches of physical science of this vast continent [Australia] and its adjacent regions'.

In 1850, after a period of quiescence, the Australian Philosophical Society was re-established with the Governor of NSW as President. The name was changed to the Philosophical Society of NSW in 1855.

On 12 December 1866, Royal Assent [by Queen Victoria] was given to the title of The Royal Society of New South Wales and this name has been retained throughout the succeeding years.

The Society was incorporated by Act of the New South Wales Parliament in 1881.

Throughout its history, the Society has done much to promote science in all its aspects through meetings, symposia, publications, awards, research library services, summer schools, studentships, and international scientific exchange.

FAMOUS MEMBERS

Charles Darwin was elected a member of the Royal Society of New Wales in 1879. His letter of acceptance to the Society is one of the significant items in our collection of Australia's scientific heritage.

Lawrence Hargrave, Australia's pioneering flight researcher, was a member of the Royal Society of New South Wales and published all his papers in the Society's Journal.

LIBRARY COLLECTION

The Society has an extensive collection of historical and more recent publications available for research. Over 500 journals are received from throughout the world each year under our journal exchange program. These are available through the Dixson Library at the University of New England, Armidale NSW.

AWARDS

The Society recognises excellence in Australian science by awarding medals, prizes and special lectures, including:

The Clarke Medal

Awarded since 1878 for distinguished work in the natural sciences, recipients have included Professor Thomas Huxley in 1880, Baron Ferdinand von Müller in 1883, Professor Sir Edgeworth David in 1917 and Sir Douglas Mawson in 1936.

The Edgeworth David Medal

This medal has been awarded since 1948 for distinguished contributions to the advancement of Australian science by a scientist under the age of thirty-five. Past recipients include Lord May in 1968, Martin Green in 1981 and Tim Flannery in 1990.

The James Cook Medal

The James Cook Medal is awarded for outstanding contributions to science and human welfare. Recipients have included Sir Ian Clunies Ross in 1956, Albert Schweizer in 1959 and Sir Marcus Oliphant in 1974.

The Walter Burfitt Prize

Awarded since 1929, the Walter Burfitt Prize honours exceptional research demonstrated through publication in the previous six years. In 1956 it was awarded to Sir John Eccles.

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

JOURNAL

The Society has published the Journal and Proceedings of the Royal Society of New South Wales without interruption since 1877. It is fully peer reviewed and has been the proud vehicle for the publication of ground-breaking work such as that of Lawrence Hargrave on flight. It has been the journal of choice for many leading scientists over the years, especially in revealing the complexities of the geology of NSW and the variety and usefulness of the natural oils of Australia.

THE BULLETIN

The Society produces a monthly Bulletin for Members. Included are notices of forth- coming meetings, biographies of speakers, proceedings of the Society and Branch news.

BRANCHES

The Society has established Branches in some regional areas of NSW to enable members in those areas the opportunity to participate fully in the activities of the Society. There are currently Branches in the Southern Highlands and Central West of NSW.

ANNUAL DINNER

The Society's Annual Dinner, at which the Society's Awards are presented, is held in March each year in Sydney.

FELLOWS

The Society honours those who have distinguished themselves at the highest level in any area of scientific endeavour with the title 'Fellow'.

MEETINGS

The Society holds regular public meetings to which leading researchers are invited to reveal the latest developments in their field of science. These talks are varied, topical and extremely informative.

In Sydney, meetings are held on the first Wednesday of the month from April to December. Meetings usually commence at 7.00 pm and are free of charge. Visitors are always welcome to attend. Branch meetings and other colloquia are organised from time to time throughout the year and are notified in the Bulletin.

CONTACT US

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Annual Report of Council for the year ended 31 March 2011

The Council of the Society for 2010/11 comprised:

President	John Hardie
Vice Presidents:	Prof Heinrich Hora
	Clive Wilmot
Hon. Secretary (General)	Bruce Welch
Hon. Secretary (Editorial):	Prof Jak Kelly (resigned October 2010)
	Dr Don Hector (co-opted October 2010)
Hon Treasurer	Marian Haire
Librarian	vacant
Councillors:	Alan Buttenshaw
	Jim Franklin
	Julie Haeusler
	Prof. D Brynn Hibbert
	Brendon Hyde
	Prof Jak Kelly
	Dr Michael Lake
	Dr Frederick Osman
	A/Prof Bill Sewell
	Prof. Bruce A Warren
Southern Highlands Rep	Clive Wilmot
Central West Rep.	Prof Kevin Parton

The Council met eleven times during the reporting period at the Society's Rooms, and in addition, several meetings of Council sub-committees were held. Sub-committees for Awards, Activities, Publications and Publicity were active during the term of the Council.

ACCOMMODATION

The Society continues to occupy premises at 121 Darlington Rd, Darlington Campus, University of Sydney. The Society would like to express its gratitude to the University of Sydney for its continuing support of the Society's accommodation needs.

LIBRARY

The Society continues to operate a journal exchange programme with some 600 overseas organisations. The exchanged journals are housed in the Dixson Library at the University of New England, which maintains and provides full access to this material. The Society wishes to thank the University for its support of the Society's collection. Further library holdings of the Society continue to be housed in secure warehouse accommodation, and the Society wishes to thank Mr Clive Wilmot for his efforts here.

LECTURES

The Society held a full program of monthly lectures in Sydney, usually at the Darlington Centre, University of Sydney. Attendance figures have shown a slight increase compared to the previous year.

In addition the Society participated in joint lectures. These were the 2010 Einstein Lecture with the NSW Branch of the AIP; the Four Societys Lecture with the Sydney Division of Engineers Australia, the Australian Institute of Energy and the Australian Nuclear Association; and finally a joint lecture with the NSW Branch of the AIP.

FELLOWS

On Monday 29 March 2010 Her Excellency Ms Quentin Bryce AC, Governor-General of the Commonwealth of Australia and Chief Patron of the Society, presented the Society's Inaugural Fellows with their certificates. These were:

Professor Michael Archer AM FAA FRSN
Professor Gavin Brown AO FAA CorrFRSE FRSN
Professor Robert Clark FAA FRSN
Professor David Craig AO FRS FAA FRSN
Professor Jak Kelly DSc FInstP (London) FAIP FRSN
Professor Richard Stanton AO FAA FRSN
Professor Bruce Warren DSc FAIM FRCPA FRCPath FRSN

At the Liversidge Research Lecture for 2010 held on 26 November, the President announced that the Society had created five new Fellows:

Robert, Professor Lord May of Oxford, OM AC Kt FRS FAA FRSN
Professor Elizabeth Blackburn AC FRS FRSN
Professor Kurt Lambeck AO FRS FAA FRSN
Professor Michelle Simmons FAA FRSN
Emeritus Scientia Professor Eugenie Lumbers FAA FRSN

AWARDS

Awards for 2010 were presented at the Annual Dinner by the Governor of NSW (and our patron) Marie Bashir.

Clarke Medal (Geology)	Professor Kenton Campbell
Edgeworth David Medal	Associate Professor Angela Moles
Walter Burfitt Prize	Professor Richard Shine

Society's Studentship Awards for 2009 were won by Lidia Matesic, Dennis Black and Kerensa McElroy.

The Society congratulates its Award winners.

JOURNAL

Volume 143 of our Journal was published in 2010.

Council wishes to thank the referees for their time in refereeing our papers, our Hon. Secretary (editorial), Professor Jak Kelly, and Dr Mike Lake who prepared and typeset the master pages for printing and who maintains our web site at htpp://nsw.royalsoc.org.au.

BULLETIN AND PROCEEDINGS

The Bulletin and Proceedings of the Society was published monthly during the year, except for December and January. We are indebted to the authors of short articles and for information submitted to the Bulletin and to members who assisted in its preparation and distribution, particularly Mr Bruce Welch, and to our Office Assistants Ms Sonia Chan and Brittany Cooper for their support.

LIVERSIDGE BOOK

During the year the book Archibald Liversidge, FRS: Imperial Science under the Southern Cross was published by the Society in conjunction with Sydney University Press and launched by the Governor of NSW (and our patron) Marie Bashir.

SOUTHERN HIGHLANDS BRANCH

The Southern Highland Branch held ten meetings during the reporting period with an average attendance of 70 members and visitors. The Branch has sent out 60 monthly Newsletters to members and about 150 notices of meetings each month to other interested people. At the request of the Branch the printing and distribution of the Lecture Flyers was conducted by the central office.

The Southern Highlands Branch Committee for 2010/11 was:

Chairman:	Mr Clive Wilmot
Vice-Chairman:	Mr Hubert Regtop
Hon. Secretary:	Ms Anne Wood
Hon. Treasurer:	Mr Mike Jonas

The Branch thanks Frensham School, Mittagong, for their generous provision of meeting venues, Fitzroy Inn, Mittagong, for their wonderful after-meeting dinners and hospitality, the many fine guest speakers who visited the Branch, and the Council of the Society for its ongoing support.

CENTRAL WEST BRANCH

During the year the Central West Branch held a number of meetings.

Reports of Speakers

Annual General Meeting and 1179th Ordinary General Meeting of the Society

Wednesday 7 April 2010 Conference Room 1, Darlington Centre, University of Sydney

Anniversary Address for 2010

Science and Scientists in the Modern World

Professor Jill Trewhella, Deputy Vice Chancellor (Research), University of Sydney

Professor Trewhella will pose some pertinent questions which she will consider during the course of her presentation: What is society asking of scientists today? How can science contribute to the betterment of society?

She will try to suggest what the modern scientist must do differently in the future compared to their 20th century counterpart. She will also explore how we prepare the next generation of scientists, given the importance of science in our everyday lives, so that they can take on the challenges and enjoy the adventure.

Professor Trewhella is the newly appointed Deputy Vice Chancellor for Research at the University of Sydney. She is a biophysicist who uses physical methods to study bio-molecular structures as a basis for understanding their function.

Professor Trewhella returned to Australia from the US in 2005 to take up a 2004 Australian Federation Fellowship in the School of Molecular and Microbial Biosciences at the University of Sydney. She also holds auxiliary appointments in the Department of Chemistry, University of Utah, and the Bragg Institute at ANSTO.

She received a Bachelor of Science (1975) degree with first class honours in Physics and Applied Mathematics and a Master of Science (1978) in Physics from the University of New South Wales. Her PhD (1981) is in Chemistry from the University of Sydney. She went to the United States in 1980 to complete post doctoral studies at Yale University in the Department of Biophysics and Biochemistry.

In 1984 Trewhella went to Los Alamos National Laboratory (America's top nuclear research facility) to begin a structural molecular biology program centred around the spallation neutron source there. She held various science leadership and management positions before being named Laboratory Fellow (1995) in recognition of sustained outstanding contributions to science and technology. She was named Fellow of the American Association for the Advancement of Science in 2000.

Lecture delivered for the Society's 1180th Ordinary General Meeting held on 5 May 2010

The Weird World of Nanoscale Gold

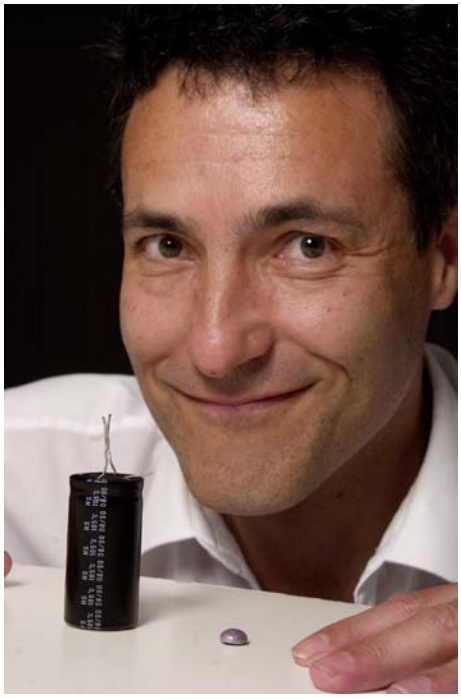
Michael Cortie, Director : Institute for Nanoscale Technology, University of Technology Sydney

Not all gold is the inert, soft yellow metal that we all know and love to own. In fact, as Professor Cortie explained to a very interested audience at the May OGM, if you take a piece of bulk gold and divide it into smaller and smaller particles, gold's material properties change dramatically. Gold particles with a diameter of a few hundred nanometres are black (and very useful for absorbing solar radiation). Shrink them down to a few 10's of nanometres and they become a beautiful deep red (ideal for making stained glass). Decrease the size to 2 nanometres and the gold particles become brown and sticky with a melting point of only 300º C (compared to 1063º C for bulk gold). The chemical reactivity also changes radically with particle size. Bulk gold is extremely inert (which is why we use it for wedding rings and electrical contacts). However, 5 nanometre sized gold nanoparticles are extremely reactive. So reactive in fact, that they are the best-known catalyst for producing carbon monoxide.

The unique properties of gold nanoparticles make them a very useful new material. By controlling the size, shape and surface coatings of the nanoparticles it is possible to tailor a wide range of chemical, optical and biological properties that have great technological potential.

One application that Professor Cortie's group are working on is optically selective coatings. By carefully controlling the particle size and shape it is possible to create a coating that transmits most of the visible part of sunlight but blocks solar heat. This can greatly reduce the cost of heating a building. The gold is used in such small amounts that it does not add much extra cost to the windows.

Another application is killing pathogens and cancer cells inside the body. We usually think of the human body as completely opaque. However, it is actually relatively transparent at a wavelength of about 700 nm. So if gold nanoparticles are introduced into the body that absorb at this wavelength, one can selectively kill tissues by focusing 700 nm laser light onto diseased areas deep inside the body. The light is absorbed by the nanoparticles and turned into heat that quickly and completely destroys the targeted tissue. The precise focus of the laser minimizes harm to healthy tissues compared to the brute-force, blunderbuss approaches of radiation therapy or chemotherapy. Another advantage of gold nanoparticles is that they are non-toxic and not retained by the body. Indeed, gold nanoparticles have been a staple of Traditional Chinese Medicine for over two thousand years. Professor Cortie has also had considerable success in coating the gold nanoparticles with antibodies to enhance the fraction that reach the target zone. So far the results are limited to invitro tests. But it may not be long before gold nanoparticles are coming to a hospital near you.



Mike Cortie shows two capacitors. The big one is made by conventional technology and the small one has the same capacitance but is made using mesoprous gold (a sponge made of gold nanoparticles)

Jim Franklin,

Councillor, Activities Coordinator

Mike Cortie is the Director of the Institute for Nanoscale Technology at the University of Technology, Sydney (UTS), in Australia.

Mike Cortie was born and educated in South Africa. He has a BSc(Eng) degree in Physical Metallurgy, a Masters degree earned from research on the corrosion of zirconium and a PhD degree, which was focused on metal fatigue and awarded in 1987. After a stint at South Africa's Atomic Energy Corporation and at Pylon Engineering, a gear-cutting works, Mike joined Mintek, a minerals and metals research organisation. Mike headed the Physical Metallurgy Division of Mintek between 1997 and 2002. The Division consults widely to South African and international industry and now generates the major portion of its funds from foreign contract research. He relocated to Australia and joined UTS in July 2002.

Mike's current research interest is nanotechnology, and in particular the applications of precious metals in nanotechnology. Previous research activities included research on ferritic and nickel-substituted stainless steels, on intermetallic compounds with the C1 (CF12) and B2/L21 crystal structures, on X-ray diffraction and crystallographic texture of bcc and fcc alloys, on cellular automata and the simulation of metal solidification, cracking and solid state transformations, on explosive interactions between molten metal and water, on displacive transformations in Pt-containing alloys and compounds, on the phase relationships in the Al-Au-Cu ternary system, and on the crystal structures of the martensite phase formed by displacive phase transformation in the b Au-Al-Cu shape memory alloy. He has also been active outside of the materials arena, and has made contributions to the mathematical modelling and graphics rendering of mollusc shells, and the science education of children.

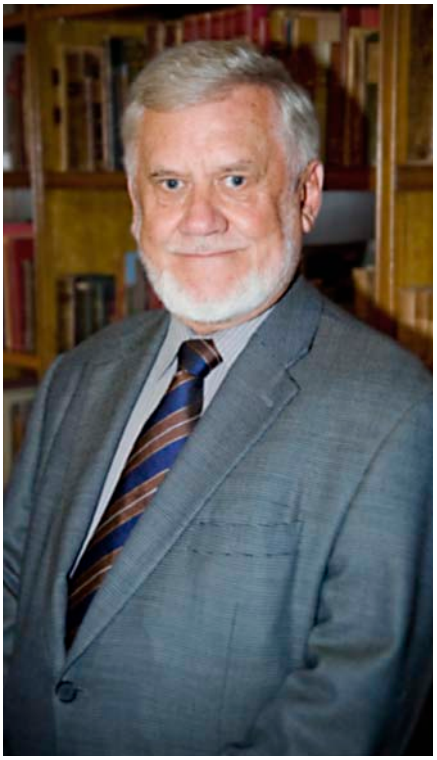
Lecture delivered for the Society's 1181st Ordinary General Meeting held on 2 June 2010

Science for gentlemen: the Royal Society of NSW in the 19th century

Dr Peter J Tyler, Historian, Royal Society of NSW

The middle of the 19th century was a time of great change in NSW. Responsible government was introduced in 1856 and full manhood suffrage followed two years later. Queensland separated from NSW a year after that. And just 10 years after the introduction of responsible government, Queen Victoria granted Royal Assent to the title of The Royal Society of New South Wales. However, as Dr Peter Tyler, the Society's Historian, explained in his lecture at the 1181st ordinary general meeting on 2 June 2010, The Royal Society of NSW traces its origins back to 1821 when The Philosophical Society of Australasia was formed. There were several early attempts to form such societies with mixed success but this should not understate the commitment of a group of progressives who wanted to see the natural history, agriculture, and culture of the nascent colony flourish.

The Philosophical Society of Australasia was established under patronage of the Governor, Sir Thomas Brisbane and he also became its first President. The founding members included Major Goulburn (the Colonial Secretary) and Edward Wollstonecraft a wealthy merchant and landowner at North Sydney. The purpose was to study the physical sciences and the mineralogy of NSW (which then, of course, included what is now Queensland and Victoria). The early society only lasted a year or so but there were other attempts to stimulate more intellectual activities in the colony in the first part of the 19th century. The first subscription library was started by Wollstonecraft in 1826 and between



1820 and 1850 other societies began, such as the Agricultural Society (which lapsed for some years and then was re-established in the 1850s), The Australian Society for the Encouragement of Arts, Science, Commerce, and Agriculture (more commonly referred to as the Australian Philosophical Society) but, like the early Philosophical Society, these early groups generally did not thrive.

But by the 1860s, with Sydney having been formally declared a city (in 1842), NSW having been granted responsible government, and the buoyant economic growth of the period created an environment where interest in science, art, and literature blossomed. The University of Sydney was founded in 1854 and the time was right for a successful society to be established.

Just six years after the granting of Queen Victoria's Royal Assent there were 122 members of the Society across a range of occupations – pastoralists, businessman, scientists, artists, lawyers, and the clergy – and by the 1890s there were nearly 500 members. In the latter half of the 19th century a number of eminent scientists (Prof John Smith (physics and medicine), Prof Archibald Liversidge (geology and chemistry), Sir Thomas Anderson Stuart (physiology) were but a few). The Society's transactions were published in a prestigious, peer-reviewed journal (which continues today) and attracted publications from such eminent scientists and engineers as Lawrence Hargrave.

The first 80 years of the society were colourful, strongly influenced by the personalities of the time when NSW was finding its feet as a society. Dr Tyler's work was made possible through his appointment as the inaugural Merewether Scholar of the State Library of NSW.

Donald Hector

Dr Peter J. Tyler is the Historian for the Royal Society of New South Wales. In 2008-9 he was the inaugural Merewether Research Scholar at the Mitchell Library. A graduate of the University of New England, Peter has held management positions in the public, private, and not-for-profit sectors. He has been President of the NSW Branch of the Australian and New Zealand Society of the History of Medicine, and of the Professional Historians Association (NSW).

Lecture delivered for the Society's 1182nd Ordinary General Meeting held on 7 July 2010

Pluto and the Über-nerds

Dr Fred Watson, Australian Astronomical Observatory

At the end of the 19th Century, anomalies in the orbits of Uranus and Neptune led some astronomers to believe that there was an unknown "planet X" in the outer reaches of the solar system that was tugging these gas giants. Mathematicians calculated the probable position of this new planet and astronomers searched for decades without success. After more than a year's arduous searching, Clyde Tombaugh announced in 1930 that he had found planet X in its expected position. The prediction and discovery of the new planet Pluto was hailed as a great triumph for astronomy and physics.

Initial measurements suggested that Pluto was bigger than the earth and more than large enough to cause the observed orbital anomalies for Uranus and Neptune. However, as Dr Fred Watson explained to a very interested audience of 40 at the July OGM, all was not what it seemed. First, as technology advanced, new and better measurements of Pluto showed that it was smaller than expected. Every time the technology improved, Pluto shrank until now we know it is only 18% of the radius of the Earth with a puny 0.21% of Earth's mass. So did other strange objects cause the deviations? No. It turned out that the orbital anomalies were just measurement errors.

So astronomers were left with a tiny planet with a wispy atmosphere of nitrogen and a large moon, Charon, fully half the sized of Pluto. In fact Charon is so big that some argued that the Pluto-Charon system was really a binary planet.

Fred Watson says he has spent so many years working in large telescope domes that he has started to look like one. He is Astronomer in Charge of the Anglo-Australian Observatory at Coonabarabran, where his main scientific interest is gathering information on very large numbers of stars and galaxies. He is also an adjunct professor at the Queensland University of Technology, the University of Southern Queensland, and James Cook University.

Dr Watson is the author of "Stargazer - the life and times of the telescope", and is a regular broadcaster on ABC radio. His new book "Why is Uranus upside down?" is based on listener questions, and was published in October 2007 and won the 2008 Queensland Premier's Literary Prize for Science Writing. In 2003, Fred received the David Allen Prize for communicating astronomy to the public, and in 2006 was the winner of the Australian Government Eureka Prize for Promoting Understanding of Science. Fred has an asteroid named after him (5691 Fredwatson), but says that if it hits the Earth it won't be his fault...

In the 1990s astronomers started discovering large icy objects beyond the orbit of Neptune. Systematic searches kept discovering bigger and bigger ice balls that looked more and more like Pluto. In 2005 the trans-Neptunian object 136199 Eris was discovered which turned out to be 27% more massive than Pluto. No one wanted to call Eris a planet, so what was the justification for calling the puny Pluto one?

In 2006 the International Astronomical Union declared that Pluto was not a planet, it was just a dwarf planet. This demotion caused a public outcry and protests that the über-nerds were taking over. So in 2008 the IAU decided that the term "plutoid" would henceforth be used to describe Pluto and other similar objects that orbit beyond Neptune and have enough mass to be of near-spherical shape. Pluto may no longer be a full planet, but its name lives on.

Jim Franklin,

Councillor, Activities Coordinator

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

The brain's activity varies around the clock in response to stimuli, light inputs, and the build-up and clearance of sleep-promoting chemicals — somnogens. Signatures of brain activity have been observed for over a century and are widely used to probe brain function and disorders. These are recorded via the electroencephalogram (EEG) by electrodes on the scalp, or through functional magnetic resonance imaging (fMRI), which measures a combination of blood volume and deoxygenation. This talk will present a quantitative physiologically based model of the working brain that responds correctly to the day-night cycle, somnogens, caffeine and pharmaceuticals. The model generates activity in the cortex that is consistent with brain imaging measurements. Successful applications to numerous experiments are described, including EEGs, seizures, sleep deprivation and shift work. Aside from its scientific uses, this working brain model is currently finding clinical and industrial applications to brain function measurement and to prediction and monitoring of alertness.

Professor Peter Robinson received his PhD in theoretical physics from the University of Sydney in 1987, then held a postdoc at the University of Colorado at Boulder until 1990. He then returned to Australia, joining the permanent staff of the School of Physics at the University of Sydney in 1994, and obtaining a chair in 2000. He is currently an Australian Research Council Federation Fellow working on topics including sleep, brain dynamics, space physics, plasma theory, and wave dynamics.

Lecture delivered for the Society's 1184th Ordinary General Meeting held on 1 September 2010

The Sun in Time

Ken McCracken, University of Maryland and Jellore Technologies

Over the past few years the sun has been behaving in a very unusual fashion. Dr Ken McCracken explained to a very interested audience at the September OGM that when the sunspot minimum approached in September 2006, a new solar cycle was widely expected to start in early 2007. NASA and others predicted it would be "the biggest ever". However, no one told the sun. Sunspots completely disappeared in late 2006, and very few sunspots were seen until December 2009. In fact, the new sunspot cycle is a weak shadow of any in living memory.

This is of considerable importance because work by Dr McCracken and his co-workers shows a very strong historical link between solar activity and global climate. Some kind of link has been suspected for over a century, but its statistical significance has always been marginal until now. The key advance is looking at the abundance of ^{10}Be in ice cores. This isotope is produced solely by high-energy galactic cosmic rays hitting the upper levels of the earth's atmosphere. When the sun's magnetic field is high (and the sunspot number is also high), these interstellar particles are deflected away from the solar system and so little ^{10}Be is produced on earth. Conversely, when the solar magnetic field (and sunspot number) is low, many galactic cosmic rays reach earth and so there is a relatively high abundance of ^{10}Be in the atmosphere. Snow falling in the polar regions records the beryllium abundance with a resolution of about a year. Dr McCracken and his co-workers have laboriously measured ice cores dating back over 20,000 years and have been able to construct high-resolution magnetic activity curves for the entire period. Their data has very good agreement with the 400 years of visual data and excellent agreement with the instrumental record (post 1935). There is also good agreement with the ^{14}C data (this isotope is produced by a different process and so serves as a confirmation of the ^{10}Be measurements, albeit at relatively low resolution because of the long residence time of CO_2 in the atmosphere).

There are several key conclusions. It is very clear that solar activity has varied strongly throughout the Holocene. Fourier spectra indicate strong, well-defined periodicities in solar activity of 2300, 970, 208, 87, 22 years and other weaker periods. In the past 10,000 yr there have been 22 "Grand Minima" similar to those that accompanied the 1650-1725 "Maunder Minimum" in sunspot activity and the "Little Ice Age" that so strongly shaped 17th Century European history.

There are also strong correlations between solar activity and the movements of European ice fields and glaciers over the past 10,000 years. Indeed, the change from the last glacial period to the Holocene appears to have coincided with maxima in the Halstatt cycle in solar activity.

Dr McCracken said that the mechanism for the link between solar magnetic activity and terrestrial climate is unclear. It may be due to changes in the solar irradiance, but he ventures no opinion. "This is the data" he said, "it is for others to explain it."

Dr McCracken indicated that the "space era" is definitely not representative of the sun's past behaviour. Instead, history suggests that the sun has entered a grand minimum similar to the 18th Century "Dalton minimum" and that this may last 2 solar cycles (>20 years). What this will do to global climate is unclear. It seems that we live in interesting times.

Jim Franklin,

Councillor, Activities Coordinator

The sunspot record since Galileo's time, and the cosmogenic nuclides 10Be (in ice cores) and 14C (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 10Be 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.

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.

Lecture delivered for the Society's 1185th Ordinary General Meeting held on 6 October 2010

Is the climate right for nuclear power

Dr Ziggy Switkowski, Chair ANSTO

Many of the stalwarts of the Society were pleasantly surprised to see a larger than usual audience for this much anticipated talk. Young people, whom we had not seen before, were gathered, not, as it transpired, to hear Dr Switkowski, but to regale the meeting with chants against the nuclear industry. The tragedy was not that these folk were passionate about something they felt keenly involved in, but that they did not stay to listen and debate. Perhaps they felt, as youth often does, that those a few generations in advance of them would not wish to engage in the kind of debate with which they would feel comfortable. Was it ever thus?

Dr Switkowski was the least discomforted of anyone in the room. As a high profile protagonist of nuclear power he has probably entertained worse. With mastery of his subject, fact followed statistic, followed question, followed conclusion. Why is Australia the only country in the G20 not to have nuclear power or plans for nuclear power? How can we plan for 2 % per annum energy growth leading to a doubling of energy needs by 2050, while meeting obligations to reduce atmospheric carbon? Why has the energy White Paper explicitly left out the nuclear option? Why are we earning $5 billion a year from uranium, when Saudi Arabia makes $6 billion a day from oil?

Nuclear power has about the same carbon footprint as solar and wind (10% of that of brown coal), and is a well-established technology. Off-the-shelf reactors can be bought for $5 billion and built in less than a decade. Twelve clusters of reactors could satisfy all of Australia's present and projected energy needs. With present reserves of less than a century, breeder technology and the use of lower grade uranium isotopes and thorium will need to be developed to ensure a suitably sustainable future. Cost might drive future expansion. Although nuclear cannot compete with coal now, a carbon price in the range of $15 to $40 per tonne per year would level the playing field.

Dr Switkowski was careful to acknowledge some of the arguments against the development of nuclear power. 1) long-term toxic waste; 2) nowhere to build the reactors; 3) capital cost; 4) potential for disaster; 5) weapons proliferation and terrorism; and 6) water requirements and environmental damage. His responses covered the expected bases: explaining the life cycle of a fuel rod and how and where the final waste can be buried; if Australia can't find a site then nowhere can; and state and world regulation of nuclear material.

Questions took up Dr Switkowski's assertions that renewable forms were not capable of playing a major role in meeting a country's energy needs. One of the remaining young people offered Spain as a country with 53% of its energy being satisfied by wind. Inspection of Wikipedia reveals that 53% was reached on November 8th 2009, (it must have been mighty windy) but over the year 2009 only 14.3% was from wind, so Dr Switkowski's observation that he would be surprised if more than half of the country's energy were satisfied by wind seems vindicated. Further reading rubs it in, as nuclear capacity in Spain is more than that of wind. The psychology of the nation's response to the nuclear question was also explored. If the case is so overwhelming why are we not building nuclear reactors fit to bust? Dr Switkowski's reply was that at the moment the benefits were not enough to balance the political downside, which is a truism if there ever was one.

Dr Switkowski remains optimistic, expecting the tide of opinion to turn in a couple of years, when other solutions to climate change and energy security will be seen not to be sufficient.

The vote of thanks by Professor Hora was made over more complaints from the back of the room. At least these people had stayed to listen.

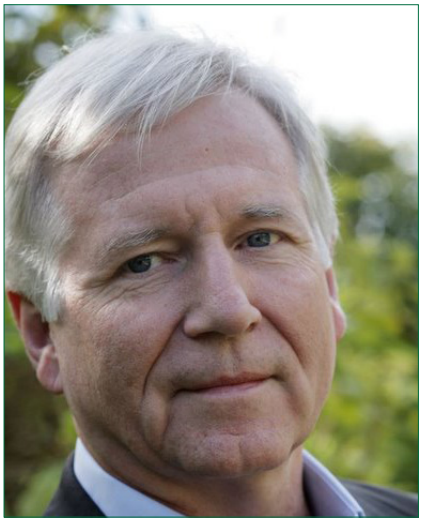
Brynn Hibbert

Lecture delivered for the Society's 1186th Ordinary General Meeting held on 3 November 2010

Powering the US Grid from Solar and Wind

Dr David Mills, Chief Scientific Officer and founder of Ausra, Inc.

This month's lecture was in sharp contrast to the October lecture that explored the practicalities of supplying large amounts of base-load power demand using nuclear energy. Nuclear power generation is an established technology but highly controversial due to its perceived risks and potentially its high cost. Solar and wind energy generation are emerging technologies with great promise but currently are expensive and are yet to be used to meet so-called base-load demand.



Dr David Mills has a background in developing novel solar energy technologies, including two-and-a half years in Silicon Valley in the US establishing a company commercialising "concentrating solar thermal" technology. (This technology uses mirrors or lenses to concentrate the sun's rays in order to heat a heat transfer medium or to generate steam which in turn can be used to generate electricity.) In this lecture, Dr Mills described work recently completed to determine whether the 2006 energy demand on the US electricity grid could, theoretically, have been provided through commercially available solar and wind technologies.

There are enormous amounts of both solar and wind energy available (the potential of global wind energy is 72 TW whereas human demand is about 15 TW; solar power is even more abundant – 120,000 TW is available – about 8,000 times human demand). The challenge is developing and commercialising technologies that are cost-effective in comparison with the well-established coal, gas, and petroleum sources. The obvious advantages of both solar and wind energy are that they produce no greenhouse gas emissions or pollution. Wind energy generation has grown substantially in recent years but with about 160 GW installed, this meets only about 2% of global demand. Solar thermal generation has been under development for the last 30 years but is expensive and is only recently becoming competitive. Spain and the US are the leaders in this technology and 14,000 MW are expected to be installed in the next five years with capital costs of around $400 million per project.

With appropriate design, solar and wind technologies can be complementary: solar generation is not directly available at night, whereas wind is often at its maximum at night; storage of wind-generated energy is difficult (although there are some interesting battery technologies under development), whereas solar can store energy in heat-sinks such as molten salts and this can be used to generate energy at night or when there is heavy cloud.

The study by Dr Mills and his colleagues produced some unexpected results. Their detailed analysis of US demand (done by evaluating hourly demand data taken from the US grid over the 2006 year) concluded that currently commercially available wind and solar technologies could have produced 90% of the US electricity grid load with 25% redundancy (redundancy is the ability to bring additional generation resources online to replace generation equipment which is not functioning) and no energy storage. Further, they found that these technologies could have produced 100% of electricity demand at 35% redundancy, with 12 hours storage.

One of the key challenges is to think about the electricity system differently. The current paradigm of thinking about base-load demand with peaks that sit on top of this has come about because of the inflexible technologies currently used to generate electricity. For example, it is difficult and expensive to start and shut down coal-fired power stations in response to demand changes, so the concept of having some base-load that is met by power stations running 24 hours a day, seven days a week makes sense. But when a variety of technologies that are much more flexible are available (for example concentrating solar thermal (with storage); battery technologies; hydroelectric; and photovoltaic (with storage) enable us to establish a new way of looking at electricity demand in terms of its load capability rather than its capacity to meet base-load plus peaks.

The October and November lectures provided interesting contrasts with one another. It is clear that there are a number of entirely feasible options for countries like Australia to reduce greenhouse gas emissions. The problem is not so much a technological one, rather it is finding the political resolve to come to terms with the social concerns and economic issues and invest in a sustainable future.

Donald Hector

Dr Mills is the former Head of the Solar Energy Group at the University of Sydney and past President of the International Solar Energy Society. He is the co-founder and former Chairman of the SHP and Ausra companies.

The 2010 Liversidge Lecture
Belief in Science
Professor John White, Australian National University

Friday 26 November 2010, at 5.30pm
Merewether Theatre, University of Sydney

Academy of Science, Leighton Medal of the Royal Australian Chemical Institute, Distinguished Friend of Oxford University.

The achievements of science in the last 400 years have been of great benefit to humanity and are appreciated widely. Less well understood is how personal attributes of awareness, excitement, frustration and recognition of beauty are central to successful science. These very human qualities and the role they play in making discoveries interest me. Science requires absolute honesty and care about conclusions to be believable. Science is not autonomous and the sometimes necessarily tentative opinions are often incomprehensible and even unacceptable to the public - we must do better in explaining! The current climate change debate is an example - the believability of developing scientific opinions has been questioned and mocked by positive assertions from cynics. I am not sure what to call this humane part of science but I insist on its importance from personal experience and to disabuse the public of the common scientist stereotype.

These thoughts were provoked by a letter to the Royal Society of Chemistry house journal in 2007 on "the scientific method" - evoking another part of "the method":

"As a very old scientist (University College London, 1934-1939) I am concerned about the decay of the scientific method. I read so often "scientists believe that …"Yet it was the abandonment of belief in favour of the results of experiments that has been the key to science's success.'….

"We must grant that in highly connected non-linear systems, the design of controlled experiments on Poperian principles is very difficult. "We must find ways to do it. Otherwise science will simply become another "religion" dependent on faith."

In the Liversidge Lecture I will examine how scientists' optimism, "suspended disbelief" and a reliance on empiricism are as much part of the "scientific method" as clear logic. I will describe also some of my recent work on the structure and function of industrially valuable explosive emulsions - understood by the novel neutron scattering methods of "contrast variation" pioneered in my research.

John White CMG FAA FRS is currently Professor of Physical and Theoretical Chemistry at the Research School of Chemistry at the Australian National University.

Graduating from Sydney University he went to Oxford University on an 1851 scholarship in 1959. He became a Research Fellow of Lincoln College before finishing his DPhil and an official Fellow of St John's College Oxford in 1963. He is one of the discoverers of isotopic contrast variation in neutron scattering - which is currently used worldwide for understanding the structure of "soft matter". Returning to Australia in 1985 he established a new scientific program and immediately became involved in processes to establish in Australia synchrotron radiation and neutron scattering facilities comparable to or better than those available internationally. At various times he has been Chairman of the National Committee of Crystallography of the Australian Academy of Science, Science Policy Secretary of the Australian Academy of Science, (where key papers on human cloning, higher education and stem cell research were written), President of the Royal Australian Chemical Institute, President of the Australian Institute of Nuclear Science and Engineering and Chairman of such committees as International Advisory Committee of the J-PARC project in Japan and the Bragg Institute International Advisory Committee (ANSTO). He is currently Chairman of the Asia-Oceania Neutron scattering Association (AONSA). On the policy side he currently chairs an Academy of Science committee on the effects of low level ionising radiation and is Chairman of the Oxford- Australia Scholarship Committee.

Professor White has received a number of awards which include: the Marlow Medal and the Tilden Lectureship - of the Royal Society of Chemistry, Argonne Fellow of the University of Chicago, T.G.H Jones Memorial Lecture, University of Queensland, H.G Smith Medal, Royal Australian Chemical Society, Craig Medal of the Australian

Royal Society of NSW Scholarship Awards 2010
6.30pm, 1 December 2010
Rodgers Room, St Paul's College, University of Sydney

Our last meeting of 2010 provides the opportunity for members to hear research presentations from the winners of the Society's scholarships. The winners were selected from a range of high quality submissions from research students in several different Universities in NSW and the ACT. Come and hear about work being done by top research students! Outlines of three winning submissions are presented below. In addition, the winner of the Australian Institute of Physics (AIP) Royal Society Scholarship will give a presentation. This winner will be decided at the AIP event on Tuesday 23 November 2010.

Lidia Matesic is a PhD student in the School of Chemistry in the University of Wollongong. Her project is on "Targeted Delivery of Chemotherapeutic Agents Using Novel Isatin-based Compounds."

Targeted drug delivery increases the availability of a drug at the target site while reducing its availability at other sites. A novel strategy which shows promise for the targeted delivery of cytotoxins into tumour cells exploits the urokinase plasminogen activation (uPA) system. Once the uPA system has been used to deliver the cytotoxin into the cell, the cytotoxin must be released in an acidic intracellular environment. Lidia is working on isatin, a natural substance isolated from the *Isatis* genus of plants, which has anti-cancer activity. The chemical structure of isatin has been modified to improve potency against human cancer cell lines. Lidia is investigating the properties of a range of imine-based acid-labile linkers, to join isatin to the PAI2 component of the uPA system. These linkers are designed to allow effective release of isatin within the target cell.

Dennis Black is a PhD student in the Faculty of Engineering at the University of Wollongong. His thesis is entitled "Factors affecting the drainage of gas from coal and methods to improve drainage effectiveness".

The objectives of Dennis's research are to investigate and isolate specific geological properties and operationally controlled factors that impact on coal seam gas production. The research will lead to recommendations to improve the efficiency and effectiveness of gas drainage, particularly in known difficult drainage zones. The success of this project will have significant impact on the health and safety of mine personnel, economics and environmental performance of underground coal mining in Australia and beyond, through increasing the effectiveness of coal seam gas extraction. This will contribute to improving the utilization of coal resources. Increased gas extraction from *in situ* coal seams also serve to reduce the gas content ahead of mining. This will inevitably reduce the risk to mine and personnel safety, as well as reducing the mine's fugitive emissions.

Kerensa McElroy is a PhD student in the School of Biotechnology and Biomolecular Sciences at the University of New South Wales. Her project is "Evolutionary dynamics of the human pathogens *P. aeruginosa* and Hepatitis C Virus".

Kerensa's research focuses on using mathematical and bioinformatics tools to understand the evolution of human pathogens. She has developed mathematical models to explain the structure of pathogen populations by analyzing the vast quantities of DNA sequences obtained by pyrosequencing technology. Her bioinformatic research is complemented by wet-lab approaches. She is studying two important human pathogens, the bacterium *Pseudomonas aeruginosa* and the Hepatitis C Virus (HCV). She has shown that four out of 10 HCV patients are likely to have been initially infected with only a few (1-3) as opposed to many (>3) founding viruses. She has discovered that a pathogenic *P. aeruginosa* strain has an elevated death rate compared to a harmless, environmental strain. She aims to develop techniques in her PhD that are applicable to as broad a range of pathogens as possible.

William Sewell

Southern Highlands Branch

Report of March Meeting

Tridentine America:
Decline, Corruption, Moral Ambiguity, Folly, Stupidity and the Refusal to Reform

Dr Michael McKinley, Political Science and International Relations, School of Political Sciences, ANU

The Southern Highlands Branch meeting of 18 March was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong, immediately following the AGM. The lecture attracted an audience of 64, including RSNSW President, John Hardie.

The speaker, Dr Michael McKinley presented a thought-provoking and wide-ranging lecture, which clearly interested the audience. In contrast with previous lecturers, he used no computer assistance in his presentation, instead prompting himself from time to time with a stack of pages comprising an early print of his soon-to-be-released book. The data he presented to the audience included many surprising statistics, information that obviously supported the title of his lecture.

The statistics showed that one child in fifty in the USA is homeless, that 7.3 million USA citizens are either in gaol, or are somewhere in the incarceration process, and that 600,000 seniors are soon to have their homes taken from them because of financial difficulties. As for the health care system in USA, 44,000 people die each year because of lack of the simplest medicine; 50 million people have no healthcare, leading to the now common practice of 'granny-dumping'; in addition, the greatest cause of bankruptcy is due to medical bills. McKinley stated that in his view, President Barack Obama had inherited a situation where economic reform is impossible.

It is McKinley's view that the United States is in a time of peril, and he is supported by many analysts, commentators and scholars who claim that nothing short of radical reform is required. He posed the question of whether the United States - the sole remaining superpower and traditional leader of the West since 1945 - is capable of reforming itself and leading the corresponding project. He argued that although the sources of peril are to be found in many categories, there are four interrelated areas within the US that need special consideration: economics, strategic guidance, politics and higher education. His belief is that failing reform in these key areas, the USA will slip further into decline. He likened the current times in the USA to the 60 year period leading up to the Protestant Reformation and the Council of Trent.

At the conclusion of the lecture, the audience responded with many questions. RSNSW President John Hardie complimented the Southern Highlands Branch of the Royal Society for hosting such a diverse range of speakers.

Anne Wood

Southern Highlands Branch

Report of April Meeting

Weirdness in the Quantum World:
When light and matter behave as both particles and waves.

Professor Kenneth Baldwin, Deputy Director: Research School of Physical Sciences and Engineering and the Australian Research Council Centre of Excellence for Quantum Atom-Optics, ANU

The Southern Highlands Branch meeting of 15 April was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong. The lecture attracted a 48-strong audience.

Professor Baldwin is a laser physicist based at the Australian National University. He is a Past-President of the Australian Optical Society, and is the first Australian to be elected to the Board of Directors of the Optical Society of America. He is also Past-President of the Australian Scientific and Technological Societies (FASTS). In 2004 he won the Australian Government Eureka Prize for Promoting Understanding of Science for his role in initiating and championing "Science meets Parliament". He has 81 refereed publications, 183 conference papers and has given 17 invited/postdeadline conference talks.

Professor Baldwin introduced his audience to the dual behaviours of light as both particles and waves using practical demonstrations. He showed the wave behaviour of light using double-slit diffraction patterns from a laser beam, and the particle behaviour of the same beam with a photometer. He then used these basic experiments, along with numerous accompanying video presentations, as a platform to describe the type of research that he and his teams are conducting in order to develop new laser technologies.

According to the laws of quantum mechanics that govern conditions in the microcosmos, what we normally term a particle can sometimes behave like a wave. This is well known and is used in the electron microscope, for example. As early as 1924, de Broglie postulated the existence of matter waves and expressed their wavelength in terms of an inverse relationship with the momentum of the particles. The more slowly the particle moves, the less its momentum and the longer the de Broglie wavelength. According to the kinetic theory of gases, low particle velocities correspond to low temperatures. If a sufficiently dense gas of cold atoms can be produced, the matter wavelengths of the particles will be of the same order of magnitude as the distance between them. It is at that point that the different waves of matter can 'sense' one another and co-ordinate their state, and this is Bose-Einstein condensation. It is sometimes said that a "superatom" arises since the whole complex is described by one single wave function exactly as in a single atom.

Professor Baldwin described many aspects of his research interests. He talked of his research into atom optics, where lasers can be used to create nanostructures for better microchips, and showed how lasers can be used to cool atoms to the lowest temperatures in the universe, at which point they behave more like waves than particles. A large part of the presentation dealt with the physics of the wavelengths generated, many examples being chosen to demonstrate the relationship between the achieved wavelength and the momentum of the particle involved. One practical application of this wave behaviour is the generation of sensitive detectors of, for example, changes in the earth's gravitational field to enhance mineral exploration.

It was clear from Professor Baldwin's presentation that his field of quantum atom-optics is advancing at an unprecedented pace, one only has to consider the recent spate of Nobel prize winners in that field.

At the conclusion of this extraordinary lecture, Professor Baldwin answered as many audience questions as time allowed.

Anne Wood

Southern Highlands Branch

Report of April Meeting

Polar biotas of southern Australia of the Early Cretaceous age

Professor Patricia Vickers-Rich, Personal Chair, Palaeontology, Monash University, Melbourne and Dr Tom Rich, Senior Curator, Museum Victoria

The Southern Highlands Branch meeting of 20 May 2010 was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong. An audience of 50 welcomed the husband and wife palaeontologists who arrived from Melbourne to deliver the lecture.

In May 2009, Thomas Rich delivered a fascinating lecture to the Southern Highlands Branch. It was entitled Mammals from the Age of the Dinosaurs: An Australian Perspective. During that address, he referred to the work that was being undertaken by his wife, Patricia Vickers-Rich. The pair have collaborated on numerous projects, and co-authored at least 10 books, three of which have won major science publishing awards. The committee subsequently decided to issue an invitation to both scientists to deliver the Southern Highlands Branch May 2010 lecture. The shared address was very well received by the audience, whose only complaint was that the lecture time of one hour was far too short!

Patricia Vickers-Rich's research centres on understanding the changes in the biota of Earth during the late Proterozoic, at a time when complex animals first appeared and the major animal phyla were differentiating. Her studies look for correlations between such biotic change, ocean chemistry, climate and plate tectonic effects on continental relationships and ocean basin geography. She commented during her lecture that, quite independently of the current world interest in climate change, she had in fact been conducting highly relevant studies into historical climate change as her teams investigated their correlation data.

Much of Patricia Vicker-Rich's research is being done overseas. Her field areas include south-west Africa (particularly Namibia in a joint program with the Namibian Geological Survey), the Eastern European Platform including the White Sea and Siberia (in conjunction with the Palaeontological Institute of the Russian Academy of Sciences), north-west Argentina, and the Flinders Range of South Australia (with the South Australian Museum). She also works with Tom Rich (Museum Victoria) on the polar biotas of southern Australia of the Early Cretaceous age. Recently she has edited a Geological Society special publication, the book entitled *The Rise and Fall of the Ediacaran Biota*.

Thomas Rich's presentation concerned a time when Australia was joined to Antarctica, which was located close to where we find it today. Thus, south-eastern Australia was well within the Antarctic Circle of the day. Thomas Rich's research is conducted over an area of approximately four square kilometres of the Victorian coast, where he continues to locate and identify polar dinosaurs between 106 million and 120 million years old . The fact that these creatures had to survive in a frigid climate adds significantly to the evidence that some dinosaurs at least were warm blooded.

As more is learned about the Victorian polar dinosaurs, it is becoming clearer that, unlike the present fauna of Australia, the dinosaurs were not as uniquely Australian. That is, dinosaurs in Australia are members of a group of dinosaurs known from elsewhere. There is no equivalent of the uniquely Australian koala among them.

One particular dinosaur that will be forever remembered by members of the audience is Timimus, a small coelurosaurian theropod known only from two fossilized upper leg bones. Tom and Patricia named this particular discovery after their son Tim, and also in honour of Tim Flannery. The pair have recently collaborated with David Attenborough for a documentary sure to intrigue a world audience.

Anne Wood

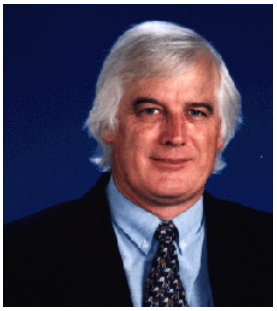
Southern Highlands Branch

Report of May Meeting

Global Warming – The Missing Science: Why I am sceptical of human-induced climate change

Dr Ian Plimer, Professor of Geology, University of Adelaide. Emeritus Professor of Earth Sciences, University of Melbourne,Victoria

The Southern Highlands Branch meeting of 17 June 2010 was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong. On a crisp Highlands evening, an audience of 86 people assembled to hear Plimer's lecture. Many arrived early with copies of his seventh book, the bestselling Heaven and Earth – Global Warming: The Missing Science, taking advantage of the opportunity to have their copies signed by the author. Ian Plimer happily obliged.



Ian Plimer began his lecture by presenting data on the cyclical nature of climate change throughout both the modern industrial age and the pre-industrial period, going back to 600 million years ago. Such a wide time period under consideration allowed comparison between times when man's contribution to global carbon dioxide concentrations was negligible, to more recent times when numerous scientists around the world are attributing observable changes in climate to measurable changes in man's carbon dioxide emissions. Plimer emphasised that climate has always changed and always will, and went on to comprehensively refute the widely held belief that man's contribution to carbon dioxide in the atmosphere is the cause of climate change.

Professor Plimer cited evidence from ice core work at the South Pole to demonstrate that there is no relationship between global temperature and carbon dioxide concentrations. Warmings in the industrial age have occurred in 1860-1880, 1910-1940, and 1975-1998. However, carbon dioxide rise correlates only with the most recent warming. Industrial age coolings have occurred in 1880-1910, 1940-1975 and 1998-present. In all of these, carbon dioxide levels increased. In five of the six great ice ages, atmospheric carbon dioxide was up to 1000 times higher than today's levels.

Plimer showed from his data that the warming effect of carbon dioxide on the atmosphere is 1.5 degrees for the first 20 parts per million, but after that, the concentration can be doubled and quadrupled with no further effect. History shows that in times when the carbon dioxide levels were 100 times the current levels, there was no global warming. Instead, there was glaciation.

The conclusions to be drawn from the presented data are that current changes in climate, sea level and ice are within natural variability. Climate has always been driven by the sun, the earth's orbit and plate tectonics. Throughout it all, humans have thrived in warm times and struggled in cool times. During a previous warm period, the warmth was such that on Greenland, barley and wheat were grown, and the land supported cattle and sheep. The hypothesis that humans can actually change climate is unsupported by evidence from geology, archeology, history and astronomy.

Carbon dioxide is absolutely vital for living on earth. Ian Plimer calls it "plant food", and adds that to demonise it shows a lack of school child science. He likens the present conflicting views on climate change to the situation in recent times when the prevailing belief was that stomach ulcers were the result of an acid stomach and stress. It took the efforts of two Western Australian scientists to prove from scientific evidence that bacteria were the cause. They ingested the bacteria, gave themselves ulcers and proved that the scientific community had been quite wrong. Ian Plimer believes that in time he too will be proven correct in his views on the disconnect between carbon dioxide concentration and climate change. He says that science must work on evidence, not consensus.

At the end of this thought-provoking and very popular lecture, Ian addressed numerous questions from the audience.

Anne Wood

Southern Highlands Branch Lecture

Dr Michael Birrell

Thursday 19 August 2010, at 6.30pm

Dr Michael Birrell is a PhD graduate from Macquarie University in the field of Egyptology with a special interest in ancient cults and government.

He has worked as an archaeologist in Egypt and Israel for the past 20 years. He teaches classes at the WEA and Sydney University Summer School and is a tutor at Macquarie University. He also runs historical study tours to the ancient world with his company, BC Archaeology.

Central West Branch

next talk

Friday 20 August 2010, at 6pm

Dr Alex Ritchie

Australian palaeontologist, Dr Alex Ritchie, will be the next guest speaker in the public lecture series being run by the Central West Branch of the Royal Society of NSW.

Dr Ritchie's talk will be held on Friday August 20 in the West Room of the Orange Regional Gallery beginning at 6pm. The cost, which includes light refreshments, is $3 for Royal Society members and $5 for non-members. For bookings, contact Mark Filmer (mfilmer@csu.edu.au) or Kerry Madden (kmadden@csu.edu.au).

Southern Highlands Branch

Report of August Meeting

Tutankhamun: The Dead Do Tell Tales.

Dr Michael Birrell

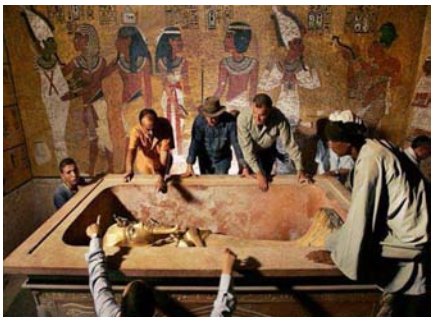
The Southern Highlands Branch meeting of 19 August 2010 was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong. A 60-strong audience started arriving at 6pm on a crisp winter's evening.

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.

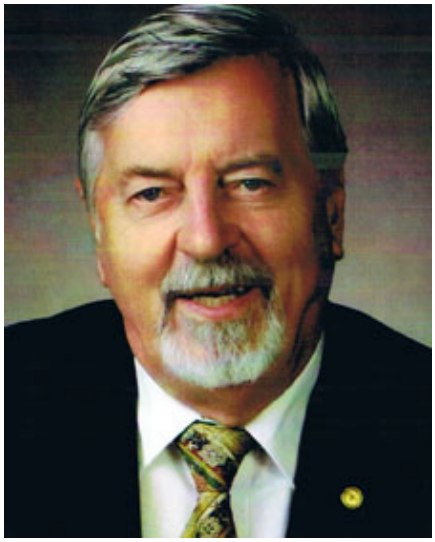
Anne Wood

Southern Highlands Branch

Report of September Meeting

Nuclear Energy Without Dangerous Radiation

Professor Heinrich Hora



The Southern Highlands Branch meeting of 16 September 2010 was held at 6.30pm in the Drama Theatre, Frensham School, Mittagong. An audience of 55 began arriving early on a cold, windy night to hear the latest research on a new process of radiation-free nuclear fusion, which could in future lead to the development of clean and sustainable electricity production.

Professor Hora began his lecture by explaining the benefits of nuclear fusion, in particular its potential to provide vast quantities of electricity cleanly and sustainably. However, to date, the complications with nuclear energy are the serious and well-recognised adverse environmental and health issues due to side effect radiation. If fusion could be conducted so that the energy produced was free of radiation, then a whole new world of possibilities would be opened for generations to come.

Conventionally, deuterium and tritium are used as fuel in the fusion process. Laser irradiation is used to spherically compress the fuel which then ignites, producing helium atoms, energy, and neutrons which cause radiation. Hora described how fusion is also possible with a fuel of hydrogen and boron-11, a method which does not release neutrons. However, the disadvantage of this process is that the fuel requires much greater amounts of energy to

initiate, and for this reason, the process has remained unpopular.

A breakthrough has now been made by Hora's team who have demonstrated that new laser technology capable of producing short but high energy pulses could be used to ignite the hydrogen-boron11 fuel using side-on ignition. In this process, the fuel would not need to be compressed, with the result that the energy required would be less than previously thought. Hora said, "It was a surprise when we used hydrogen-boron instead of deuterium-tritium. It was not 100 000 times more difficult, it was only 10 times."

Professor Hora said that the hydrogen-boron11 process would produce less radiation than that emitted from current power stations that burn coal, which itself contains trace amounts of uranium. He added that hydrogen and boron are both plentiful and readily accessible, and that the waste product from their ignition would be clean helium gas.

Hora quoted Steve Haan, an expert in nuclear fusion at Lawrence Livermore National Laboratory in California, who stated recently that Hora's method has the potential to be the best route to fusion energy seen so far. However, both Haan and Hora are well aware that there is much work to be done before this technology is at hand. Hora concluded his lecture with the statement that the practical achievement of the new process will be heavily dependent on ongoing advances in laser optics, target physics and power conversion technology.

At the conclusion of the lecture, the audience showed their appreciation by asking Heinrich Hora as many questions as time allowed.

Anne Wood

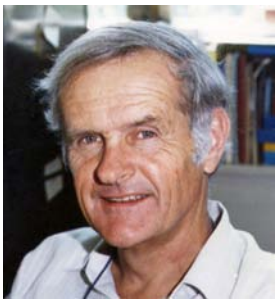
Southern Highlands Branch Lecture Report

held onThursday 21 October 2010, at 6.30pm

Dr David Branagan School of Geosciences, The University of Sydney

Geology & Geophysics of Antarctica: The Early Australian Story

David Branagan has had an extraordinary career as a consultant geologist in coal and metal mining, and particularly in engineering projects. He has been President of the International Commission for the History of the Geological Sciences, President of the Royal Society of New South Wales and is an Honorary Life Member of the Geological Society of Australia. He was awarded an honorary D.Sc. by the University of Sydney in 2008.



Branagan has written numerous textbooks and technical papers, but in recent years has concentrated on the history of geology. One of his biographical works is *TW Edgeworth David: A Life* published by the National Library of Australia. This book was one of four works short-listed for the first Prime Minister's History Award in 2007, and was largely the subject of Branagan's lecture to the Southern Highlands Branch October meeting. Others who played a role in stimulating interest in Antarctica, and who were discussed in the presentation included Franklin, Neumayer, von Mueller, Bull, Borchgrevink, Bernacchi, Gregory and David.

There were two major themes in this lecture. The first described the search for the elusive South Magnetic Pole while the second dealt with the growth of knowledge of the geology of Antarctica. A minor but linked theme was the relationship existing between Australia, Scandinavia and Japan during the period from about 1840 to 1914.

Considerable Australian interest in Antarctica exploration and science dates from the 1880s, with the formation of an Exploration Committee set up in Melbourne. One extraordinary outcome of the study of the rocks of Antarctic was that it allowed the conclusion that the land was indeed continental, and therefore at an earlier stage had been part of Gondwana. This was a pivotal realisation that influenced numerous fields of study in the years that followed.

The key figure in this presentation was Sir Tannatt William Edgeworth David (1858-1934), geologist, born in Wales. In 1891 he became Professor of Geology at Sydney University, and within ten years of taking the position had achieved world wide acclaim. In 1907 Ernest Shackleton invited David to journey south with his expedition and return in the ***Nimrod*** at the end of the summer. The university granted leave and in December 1907, David, with two former students, Sir Douglas Mawson and Leo Cotton joined Shackleton in New Zealand.

Even before his Antarctic landfall, David had decided to stay with the expedition. It meant taking unauthorized leave but he could not resist the unique opportunity to research the geology of such a remote and inhospitable part of the planet. He celebrated his fiftieth birthday within sight of the active volcano Mount Erebus (3795 m) and in March he stood on its summit, leader of the first successful climbing party.

Shackleton was so impressed that next spring he put him in charge of an attempt to reach the South Magnetic Pole. The journey of four months during which David, with Mawson and a young Scots doctor Forbes Mackay, dragged laden sledges from sea-level up more than 2200 m to their goal on the ice plateau and back, covering in all some 1250 km, has passed into the annals of polar exploration as an epic of courage and endurance.

In the general rejoicing at David's return to Sydney late in March 1909, it was hardly surprising that his unscheduled absence from Sydney University was easily forgiven.

The audience was clearly intrigued with this presentation of Antarctic exploration and asked as many questions as time allowed.

Anne Wood

Southern Highlands Branch

Report of February Meeting
Tomorrow's treatment for Cancer?

Dr Anita Hoskins, Garvan Institute

Dr Anita Hoskins was greeted by an audience of 51 when she arrived accompanied by the acting CEO of the Garvan Institute, Gabriella Lang, to address the February meeting of the Southern Highlands branch at 6.30pm on February 17th in the Drama Theatre, Frensham School, Mittagong.

Dr Hoskins' lecture focused on the latest developments in translational cancer research, particularly in the areas of breast and prostate cancer research. Translational research has transformed the way scientists research cancer today, driving new clinical therapies to reduce cancer incidence, morbidity and mortality. Research publications from the Garvan speak for the quality and quantity of medical research being conducted in the area of cancer and many other fields. Since 2005, research publications have numbered 995. In 2010 alone, scientists produced 195 publications.

The lecture described in detail the development and progression of cancer at the cellular level with particular emphasis on the Garvan's quest to find "Cancer's Achilles heel". Dr Hoskins discussed how targeted therapies are helping to deliver personalised medicine for all cancer patients, particularly in breast and prostate cancer sufferers. It was clear that as a result of these targeted therapies, the treatments of tomorrow will differ greatly from those in use now and in the past.

Sobering cancer statistics show that 1:2 men and 1:3 women will develop cancer during their lifetime, and that over 100 000 new cases were diagnosed in Australia in 2005. The number of new cases is projected to grow by over 3000 people per year. The rising incidence of cancer is largely due to increasing life expectancy in both males and females. In 2010, 1.5 million people worldwide were told that they had developed breast cancer.

Researchers into the ultimate goal of "personalised medicine" for cancer treatment through targeted therapies are currently facing problems on several fronts. These include the development of drug resistance, and the fact that these treatments do not work for all cancers or cancer subtypes. Examples of targeted therapies in use today include Trastuzumab (Herceptin) – breast cancer, Erbutix (Ceyuximab) – colorectal cancer, Imatinib (Gleevec) – chronic myeloid leukemia, Gefitinib (Iressa) – non-small cell lung cancer, and PLX4032 – melanoma. Dr Hoskins said research must be aimed at identifying new targeted therapies and ways of identifying patients who will respond to those treatments. Incorporating a patient's molecular information, such as protein biomarkers in the blood or genes in tumours would be one way of guiding treatment decisions in such a personalised medicine approach.

Dr Hoskins concluded her lecture with comments on the significant progress that has been made in recent years in the treatment of breast and prostate cancer. Both now have 5-year survival rate exceeding 90%. She emphasised that we are in an age of discovery, and that the only way we will achieve personalised medicine will be through translational cancer research.

The audience showed their appreciation of the lecture through their wide-ranging questions, and their comments on the excellent presentation by Dr Hoskins.

Anne Wood

Report of Marc h Meeting
When the staff of life becomes a rod for your back: tackling the rising problem of coeliac disease

Dr Jason Tye-Din, MBBS, FRACP, PhD

Once considered a medical curiosity afflicting young infants, coeliac disease is now understood to be a strikingly prevalent disorder in adults, affecting at least 1 in 100 Australians, with most remaining undiagnosed. The identification in the 1950s that gluten from wheat, rye and barley causes the disease led to the treatment we still use today – a lifelong gluten free diet. However the disease is often not diagnosed, the role of the gluten free diet is not fully understood, and general misconceptions abound.

Dr Tye-Din talked of the emerging epidemic of coeliac disease, and described how research has progressed from a primitive understanding of gluten to a comprehensive molecular characterization that is now opening up avenues for novel diagnostics and therapies that could one day mean an end to the gluten free diet. His presentation coincided with Coeliac Awareness Week, so it was hardly surprising that many in the 47-strong audience were sufferers of the disease.

Coeliac Disease (CD) is a systemic inflammatory illness caused by gluten. While small bowel villous atrophy is characteristic, multiple organ systems are targeted. CD is now more than twice as common as type 1 diabetes, and more frequently diagnosed in adults without overt malnutrition. Despite improvements in disease awareness and serologic testing, CD remains frequently overlooked. Untreated CD is associated with increased morbidity and mortality – a major concern given that 80% of the more than 210 000 Australians with CD remain undiagnosed.

With a fourfold increase in prevalence in the past 50 years, the burden of CD continues to grow, with a substantial rise in diagnosed cases projected over the next decade. The cause for this rate of prevalence is unknown. Typically CD begins in early childhood, but may not manifest until adulthood and even old age. Dr Tye-Din noted that in Victoria, new members joining the Coeliac Society are generally females of median age 40 years. He suggested that a disproportionately higher rate of coeliac serology testing in females is likely to explain the sex differences in the rate of diagnosed CD rather than substantial differences in biological risk.

Dr Tye-Din stressed the clinical need for a less restrictive and more effective therapy for CD. Insight into the molecular mechanisms underpinning CD pathogenesis provides several opportunities for novel therapeutic development. An understanding of the gluten peptides driving CD pathogenesis has formed the basis of an immunotherapy ('coeliac vaccine') designed to induce tolerance of gluten. This has recently completed a phase I trial in Australia.

New approaches also under development include oral protease supplements ('glutenases') that digest toxic gluten peptides, blockers of small intestine permeability (zonulin antagonists) to reduce the absorption of peptides, and inhibitors of the enzyme transglutaminase. Several of these new investigations have already been subjected to early-phase human clinical trials.

Although much research work lies ahead, these proposed therapies offer a ray of hope for CD sufferers. Dr Tye-Din feels that the challenge of ensuring satisfactory gluten detoxification means that most therapeutics are likely to supplement the gluten free diet and provide a safeguard against inadvertent gluten exposure, but not replace the gluten free diet completely. The possibility always exists however that, in the future, long-acting agents that qualitatively modify the immune response to gluten may entirely replace the gluten free diet.

At the conclusion of this excellent lecture, all agreed that Dr Jason Tye-Din and the Royal Society had presented an outstanding event for Coeliac Awareness Week. Jason was warmly applauded.

Anne Wood

First meeting of the Central Western Branch of RSNSW

The first meeting of the Central Western Branch of the Royal Society of New South Wales was a great success. They had a room at the Orange Regional Gallery that held 60 but crowded in 70 and turned many people away.

Kevin Parton chaired the meeting, starting with some remarks about the Royal Society of NSW and the local branch. I spoke briefly about our history and invited people to join. I then presented membership certificates to the new members, followed by the evening's lecture.

The speaker was Prof Ray Norris on "Galaxy Evolution". It was an interesting lecture, pitched at just the right level and illustrated with great astronomical slides. The questions afterwards had to be truncated and were mostly intelligent and relevant. One was, "How does gravity work?" A question to which we would all like to know the answer. Light refreshments and wine were served in an adjacent room after the lecture at which animated discussion continued.

I put out on a table our Cook and Banks plaque, copies of two of our recent bulletins, the Liversidge book and its order form, our Royal Society of NSW leaflets (all of which went) and membership application forms, many of which were taken.

After the light refreshments the speaker was taken to dinner at a nearby restaurant with nine of us.

Kevin Parton will be doing a full report on the meeting and talk for the next Bulletin.

I think the time is right to continue efforts to revive our Armidale branch. I suspect that the response would be similar to that in Orange.

Jak Kelly

Central West Branch

Report of Lecture held on Friday 20 August 2010

Dr Alex Ritchie

An unexcavated fish fossil site near Canowindra in the state's Central West could be a scientific treasure trove, according to renowned palaeontologist Dr Alex Ritchie, the Australia Museum's palaeontologist from 1968–1995, who delivered the second public lecture held by the newly formed Central West Branch of the Society.

The site is located about 18 kilometres west of Canowindra and was the subject of a major dig, led by Dr Ritchie in 1993, which unearthed 70 tonnes of rock containing about 4000 fish fossils. These fossils, which scientists estimate are 360 million years old, are now housed in the Age of Fishes Museum in Canowindra. Most were remarkably well preserved. They included specimens up to 1.6 metres long—air-breathing, lobe-finned sarcopterygians, which scientists believe include the ancestors of the first vertebrates to step onto dry land. Dr Ritchie told the meeting that the site would most likely contain species of fish that were new to science.

Dr Ritchie said it appeared the Devonian fossils unearthed in 1993 were trapped in a dried-out billabong where the fishes became more and more concentrated as the water evaporated. However, the original dig only touched the edge of the billabong and there are almost certainly many thousands more fossils waiting to be unearthed. Indeed, Canowindra could prove to be one of the world's great fish fossil sites.

Dr Ritchie has lobbied for many years for the expansion of the Age of Fishes Museum through the development of a complementary facility on the fossil site. The proposed development could include a range of interactive exhibits and an area allowing visitors to walk above part of the fossil site, as well as a working excavation area—this would be ideal for a group of postgraduate students to work on, he said. Such a facility could be a major tourist drawcard for the Central West. However, it would also require major government or corporate funding, which was proving difficult to obtain.

Mark Filmer

Dr Ritchie displays a cast of fish fossils found near Canowindra.

Dr Ritchie (left) chats with Professor David Kemp of Charles Sturt University following the lecture

Annual Dinner 2011

The Society held its Annual Dinner for 2011 at St Paul's College, University of Sydney on Friday 18 February 2011. Our guest-of-honour was the Governor of NSW, Her Excellency Professor Marie Bashir AC CVO, one of our two Patrons and a long-standing supporter of the Society. We were also pleased to have three Deans of Science from universities in Sydney present. In her Occasional Address Her Excellency made reference to the antecedents of the Society and the work of one of her predecessors, Governor Lachlan Macquarie, in creating a climate in which Societies such as ours might germinate. We appreciate her support and that of the unbroken line of her predecessors.

The Governor, Marie Bashir, presents Fellowship to Professor Michelle Simmons

The Governor, Marie Bashir, presents Fellowship to Emeritus Scientia Professor Eugenie Lumbers

The Governor, Marie Bashir, congratulates Dr Ken Campbell on his award of the Clarke Medal

The Governor, Marie Bashir, presents Assoc. Prof. Angela Moles with the Edgeworth David Medal

The Governor, Marie Bashir, presents Prof. Rick Shine with the Walter Burfitt Prize

The Governor, Marie Bashir, presents Dr Julian King with the joint AIP/Royal Society of NSW Studentship Award

The Governor, Marie Bashir, with Society President John Hardie after he presented her with a token of the Society's appreciation. .

Vice President, Heinrich Hora, gives the vote of thanks.

Liversidge Book Launch

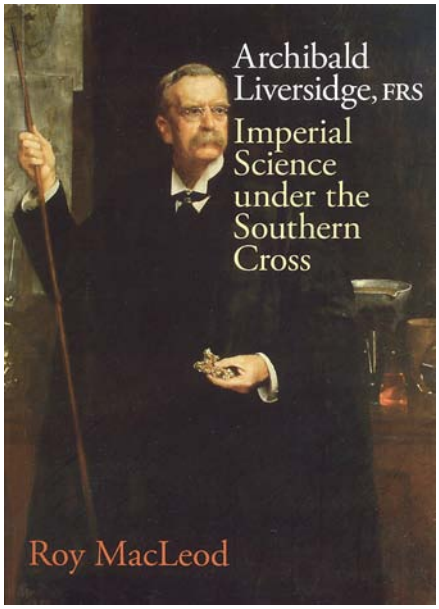
Speech delivered at the launch of *Archibald Liversidge: Imperial Science under the Southern Cross* by Roy MacLeod

John Hardie, President

Your Excellency, distinguished guests, ladies and gentlemen.

It gives me great pleasure to welcome you here today for what I see as a very important and historic occasion. We are here to witness the unveiling of nearly half a lifetime's work on one of the most influential figures in this university.

In my view, Australian science would have been held back by upwards of a generation had it not been for Professor Archibald Liversidge, first professor of chemistry and mineralogy at this university, first Dean of Science and thrice President of the Royal Society of NSW. I am welcoming you here today because Liversidge meant so much to the Royal Society of NSW and it to him.



The Royal Society of NSW is arguably Australia's oldest scientific society. It was formed in 1821 as the Philosophical Society of Australasia with Governor Brisbane as President. After a period of quiescence it was revived in 1850 by some of the original members, among others, and those seeking to establish a university in Sydney. It could be said that the Society and the University were thus spawned by the same parents.

It is fitting that even to this day this relationship persists as we have both the Society and the University working together as joint publishers of this book. It is also fitting that the book be launched by the Chancellor of the University, who is also the Patron of the Royal Society of NSW.

Marie Bashir, Chancellor of the University of Sydney, Patron of the Royal Society of NSW.

Because of these connections it was with great relish that the Society took up the cudgels to enable Professor MacLeod to take the final steps to have his work see the light of day. We were also fortunate in having a revived Sydney University Press eager to partner with us, and to see the value in getting this period of great importance to the development of science in this country more widely known. My own connections with technical education are also fortuitous as Liversidge was instrumental in establishing technical education in NSW.

Over 20 years ago Professor MacLeod lighted upon Archibald Liversidge as a pivotal figure in the formation of a scientific culture in this country. Liversidge was a product of the particularly British school of scientific thought of the mid-nineteenth century and by happy coincidence managed to bring this rigour to these shores. This book is a product of exceptional research and scholarship expended over a 25 year period, and it shows.

I would encourage those whose academic interests include the history and philosophy of science to take a leaf out of Roy's book – there is much more to be learnt about where our solid scientific foundations have come from and the key characters in the shaping of this world. We have excellent biographies of Edgeworth David and Mawson, but where are the biographies of HC Russell, Threlfall and their contemporaries? This book shows that there have been and still are enormous gaps in our understanding of the development of Australian science. Professor MacLeod has led the way and I would encourage others to follow. We would like to think of this as the first in a long line of scientific biographies published by the Society and Sydney University Press.

Thanks must go to all who have supported this project. We would not have achieved this without their help. In particular, I would like to single out the author on whose shoulders most of the burden of this project has fallen – and I would like to say a most emphatic 'well done'.

So on behalf of the Royal Society of NSW I thank you for being present at this important occasion and welcome you to the launch.

John Hardie, Marie Bashir, Roy MacLeod and Professor Iqbal Ramzan, Dean of Pharmacy at Sydney University

Roy MacLeod with the portrait of Archibald Liversidge in the Great Hall

Inaugural Fellows honoured at Admiralty House

On Monday 29 March Her Excellency Ms Quentin Bryce AC, Governor-General of the Commonwealth of Australia and Chief Patron of the Society, presented the Society's Inaugural Fellows with their certificates. This splendid occasion, held in the delightful surrounds of Admiralty House in Sydney in front of an invited audience of over 50 distinguished guests of the Society, honoured the achievements of these seven great scientists:

Professor Michael Archer AM FAA
Professor Gavin Brown AO FAA CorrFRSE
Professor Robert Clark FAA
Professor David Craig AO FRS FAA
Professor Jak Kelly DSc FInstP (London) FAIP
Professor Richard Stanton AO FAA
Professor Bruce Warren DSc FAIM FRCPA FRCPath

The Governor-General began by noting her deep respect for the achievements of these individuals and noting the importance of awards such as these to honour them.

The President, John Hardie, then offered a Vote of Thanks to Her Excellency. Here is a brief extract:

The Royal Society of NSW has contemplated the notion of awarding Fellowships for a considerable length of time. We watched as other learned societies and professional associations created the designation but we continued to ponder. Then along came the Australian Academy of Science, and still we pondered. The Society and its aims have moved on since then and the time has come to exercise our own judgement and in our own right. It has only been in the last few years that we have seen fit to properly consider the fact that we, as the oldest scientific society in Australia, were not giving due recognition in a public and ongoing way to those who had excelled. This has now changed.

The main aims of the Royal Society of NSW have in recent years moved towards science advocacy. We are relying on our Fellows to help in this regard by making science a field of endeavour more recognisable for what it actually is, and by helping practising scientists not to lose sight of the fact that they are part of a much broader discipline where each can learn from the other. Our Fellows will also help us realise that we can learn from other fields of endeavour – the arts, philosophy, music, history and so on.

He then read out the individual citations as each Fellow was presented with their certificate. Professor Craig's was accepted on his behalf by Professor Stanton. In conclusion, Her Excellency called for a standing ovation by those assembled, which was undertaken with great enthusiasm and vigour. Guests were then able to mingle with the new Fellows and our Patron.

A full account of this important event with photographs and the full citations will appear in our next Bulletin.

Congratulations to our new Fellows!

Mary O'Kane and Gavin Brown

John Hardie reads citation for Mike Archer

Ted Smith, Clive Wilmot and Mike Archer

Marian Haire, Bill Sewell, Patrick McGorry and Michael Bryce

Richard Stanton with his daughter Marion and Peter Yates

Address by Her Excellency Ms Quentin Bryce AC, Governor-General of the Commonwealth of Australia on the occasion of the inaugural Fellow awards by the Royal Society of New South Wales, Admiralty House, Sydney

29 March 2010

President, Royal Society of New South Wales, Mr John Hardie, Australian of the Year 2010, Professor Patrick McGorry, Inaugural Fellows, other distinguished scientists and scholars, ladies and gentlemen, I'm delighted that you could join us in this historic Australian house for an important occasion in the life of the Society, and of each of your Inaugural Fellows.

I am very proud to be your patron.

The Society has a long, rich and eminent history in this State: your keen and intense contribution to scientific enquiry and exposition since the early 1820s; your prescience in fostering scientific thought, not as an exclusive field, but as one, that naturally and sensibly sits alongside, and engages with, philosophy and the liberal arts.

Those early forays, and the public prominence and recognition that followed, helped to influence a culture and method of reasoning in this country that are now cross-disciplinary, lateral and creative, intellectually unencumbered, and thus, far-reaching in their possibilities, and also, rigorous and demanding in the high standards you consistently require of your members and your audiences.

Friends, I have to confess that I am absolutely fascinated and exhilarated by science – and always have been – though never brave enough to enter its scholarship.

I'm in awe of the discipline and exacting care with which you undertake its exploration and analysis, the ardour and deft control with which you write and talk about it.

I'm amazed, time and again, by the coalescence of conventional and unprecedented thinking; the simplicity and complexity of it; and its unfathomable opportunities.

As Einstein said, "I love the sense of mystery and beauty that underlies its endeavour."[1]

Last week I presented this year's Stellar Scholarships to twelve young women in public schools in New South Wales, mostly – I noted, from small country towns who have excelled in their secondary science studies.

Our Inaugural Fellows with Her Excellency: l to r Professors Bruce Warren, Robert Clark, Gavin Brown, Jak Kelly, Michael Archer, Richard Stanton (absent: David Craig)

The scholars do a week of work experience at the Sydney Observatory, receive a marvellous telescope and considerable funds over the coming two years, to spend wisely on developing their scientific interests.

I talked to them about cherishing these opportunities, as they represent new pathways, particularly for women, in science.

I mentioned our new Nobel Laureate, Professor Elizabeth Blackburn, whom I was privileged to invest recently with the Companion of the Order of Australia.

I recalled my girlhood memories of the first young woman from my little country town who went to The University of Queensland to study science in the 1940s – how we marvelled at the very idea.

In 1960, when I started there myself, there was one woman professor on the campus; Dr Dorothy Hill, a geologist. How we all admired her from afar.

And how we still admire you, women and men, at the forefront of your disciplines, at a time when the world is afflicted like never before.

Former Chief Scientist in Britain, and former President of the British Science Association, Sir David King, said this [2] in his 2008 address towards the end of his term: "We are faced with a series of enormous challenges in this century. They are quite different from anything our civilisation has had to face up to before, and, interestingly, they arise because of what science, engineering, medicine and agriculture have delivered in the 19th and 20th centuries. Notably, we have a lifespan of around 75 to 80 years, almost double that at the start of the last century; and, as a result, we're adding another billion people to the planet every twelve years, so by mid-century we'll be around the nine billion mark."

Sir David says we need to put these facts into all of the thinking we apply to governing and sustaining modern society, not just science.

As the Society has long appreciated and acted on, he talked about how vital it is for every field to be exposed to the 21st century challenges, philosophy, politics, economics, physics, engineering and the environmental sciences.

We need to keep reassessing our priorities – where we direct our research and teaching and funding – so that the urgent calls of the planet are responded to, growing and securing food for the nine billion of us, malaria, HIV/AIDS, better technologies to harness solar energy and there are many more of course.

I am reassured and inspired by the work the Society continues to support and encourage.

It is critical to how we live now, and how we aspire to live ten, twenty, thirty, forty years hence.

Inaugural Fellows, the awards you are to receive this evening are due recognition of your extraordinary contribution to the matters that are at the centre of our existence and wellbeing.

Friends, I salute you.

[1] Denis Brian, Einstein: a life, John Wiley & Sons, New York, 1996, p 234

[2] Refer interview by Robyn Williams, Science Show, Radio National, 20.9.08

Inaugural Fellows Reception

As announced in the previous Bulletin, the Society was honoured by its Chief Patron, Her Excellency Ms Quentin Bryce AC, Governor-General of the Commonwealth of Australia, with a reception at Admiralty House Kirribilli at which the seven Inaugural Fellows of the Society were presented with their awards before an invited audience of about 60. Among the guests was the Australian of the Year, Professor Patrick McGorry, the NSW Chief Scientist and Scientific Engineer, Professor Mary O'Kane, the Deans of Science of Sydney, NSW, Macquarie and Charles Sturt universities, and the Chair of the Royal Institution of Australia, Mr Peter Yates. We have included Her Excellency's speech at the investiture in this issue of the Bulletin (see next page).

Inaugural Fellows (seated) are given a standing ovation by all present

The President reads a Fellow's citation under the watchful gaze of the Governor-General

Bob Clark, Irene Kelly (obscured), Bruce Ramage, Peter Tyler, Quentin Bryce, John Hardie, and Marian Haire

Royal Society of NSW Fellows for 2010

At the Liversidge Research Lecture for 2010 held on 26 November, the President announced that the Society had created five new Fellows. This honour is awarded for distinguished contributions to science. The formal presentation ceremony will occur on 18 February at the Society's Annual Dinner in Sydney. The Society's new Fellows will continue their work to promote the importance of scientific endeavour in Australia. They are now entitled to use the postnominal FRSN.

Robert, Professor Lord May of Oxford, OM AC Kt FRS FAA FRSN

Robert, Lord May of Oxford, holds a Professorship jointly at Oxford University and Imperial College, London and is a Fellow of Merton College, Oxford. He was until recently President of The Royal Society of London (2000-2005), and before that Chief Scientific Adviser to the UK Government and Head of the UK Office of Science and Technology (1995-2000). He is also, amongst others things, a member of the UK Government's Climate Change Committee, a Non-Executive Director of the UK Defence Science & Technology Laboratories and until recently Chaired the Trustees of the Natural History Museum.

His career includes a Personal Chair in Theoretical Physics at Sydney University aged 33, Class of 1877 Professor of Zoology and Chairman of the Research Board at Princeton, and in 1988 a move to Britain and Oxford as Royal Society Research Professor.

He was awarded a Knighthood in 1996, and appointed a Companion of the Order of Australia in 1998, both for "Services to Science". In 2001 he was one of the first 15 Life Peers created by the "House of Lords Appointments Commission". In 2002, The Queen appointed him to the Order of Merit (the fifth Australian in its 100-year history).

His many honours include: the Royal Swedish Academy's Crafoord Prize (bioscience and ecology's equivalent of a Nobel Prize); the Swiss-Italian Balzan Prize; and the Japanese Blue Planet Prize. He is a Foreign Member of the US National Academy of Sciences, an Overseas Fellow of the Australian Academy of Sciences, and an Honorary Fellow of the Royal Academy of Engineering and several other Academies and Learned Societies in the UK, USA and Australia. In 2007 he received the Royal Society's Copley Medal, its oldest (1731) and most prestigious award, given annually for "outstanding achievements in research in any branch of science".

Professor Elizabeth Blackburn AC FRS FRSN

Dr. Elizabeth H. Blackburn, Morris Herztein Professor of Biology and Physiology in the Department of Biochemistry and Biophysics at the University of California, San Francisco, is a leader in the area of telomere and telomerase research.

She discovered the molecular nature of telomeres – the ends of eukaryotic chromosomes that serve as protective caps essential for preserving genetic information – and the ribonucleoprotein enzyme telomerase. Blackburn and her research team are working with various cells including human cells, with the goal of understanding telomerase and telomere biology.

Blackburn earned her B.Sc. (1970) and M.Sc. (1972) degrees from the University of Melbourne, and her Ph.D. (1975) from the University of Cambridge in England. She did her postdoctoral work in molecular and cellular biology from 1975 to 1977 at Yale.

In 1978, Blackburn joined the faculty at the University of California at Berkeley in the Department of Molecular Biology. In 1990, she joined the Department of Microbiology and Immunology at UC San Francisco, where she served as Department Chair from 1993 to 1999. Blackburn is currently a faculty member in the Department of Biochemistry and Biophysics at UCSF. She is also a Non-Resident Fellow of the Salk Institute.

Throughout her career, Blackburn has been honoured by her peers as the recipient of many prestigious awards. She was elected President of the American Society for Cell Biology for the year 1998. Blackburn is an elected Fellow of the American Academy of Arts and Sciences (1991), the Royal Society of London (1992), the American Academy of Microbiology (1993), and the American Association for the Advancement of Science (2000).

She was elected Foreign Associate of the National Academy of Sciences in 1993, and was elected as a Member of the Institute of Medicine in 2000. She was awarded the Albert Lasker Medical Research Award in Basic Medical Research (2006). In 2007 she was named one of TIME Magazine's 100 Most influential People and she is the 2008 North American Laureate for L'Oreal-UNESCO For Women in Science.

In 2009, Dr. Blackburn was awarded the Nobel Prize in Physiology or Medicine.

Professor Kurt Lambeck AO FRS FAA FRSN

Professor Kurt Lambeck has been at the Australian National University since 1977, including ten years as Director of the Research School of Earth Sciences. He is the immediate past President of the Australian Academy of Science and a member of the Antarctic Ecosystem and Environment CRC. Before returning to Australia he was Professor at the University of Paris. He has also worked at the Smithsonian and Harvard Observatories in Cambridge, USA. He has studied at the University of New South Wales, the Technical University of Delft, Netherlands, the National Technical University of Athens and Oxford University from which he obtained DPhil and DSc degrees. He has held visiting appointments in Belgium, Britain, Canada, France, Netherlands, Norway and Sweden.

He was elected to the Australian Academy of Science in 1984 and to the Royal Society in 1994. He is a foreign member of the Royal Netherlands Academy of Arts and Sciences (1993), Norwegian Academy of Science and Letters (1994), Academia Europaea (1999),the Académie des Sciences, Institut de France (2005), and the US National Academy of Sciences (2009). He has received a number of international prizes and awards including the Tage Erlander Prize from the Swedish Research Council (2001), the Prix George Lemaître from the Université catholique de Louvain (2001), and the Eminent Scientist Award from the Japan Society for the Promotion of Science (2004).

He has published two books and more than 250 papers on subjects in geophysics, geology, geodesy, space science, celestial mechanics, environmental geoscience, and glaciology.

Professor Michelle Simmons FAA FRSN

Professor Michelle Simmons is a Federation Fellow and Director of the Atomic Fabrication Facility at the University of NSW. In the 1990s, she spent ix years as a Research Fellow working with Professor Sir Michael Pepper FRS at the Cavendish Laboratory in Cambridge, UK, in quantum electronics. Her research in nanoelectronics combines molecular beam epitaxy and scanning tunnelling microscopy to develop novel electronic devices at the atomic scale. She has published more than 260 papers in refereed journals (with over 3200 citations), published a book on Nanotechnology, four book chapters on quantum electronics, has filed four patents and has presented over 50 invited and plenary presentations at international conferences.

In 2005 she was awarded the Pawsey Medal by the Australian Academy of Science and in 2006 became the one of the youngest elected Fellows of this Academy. Professor Simmons is the only women in Australia to have twice received a Federation Fellowship, the Australian Research Council's most prestigious award of this kind. She was one of the first women to be made a professor of physics in Australia.

Emeritus Scientia Professor Eugenie Lumbers FAA FRSN

Professor Eugenie Lumbers is an internationally respected authority on foetal and maternal physiology. For many years she has worked in cardiovascular and renal physiology, with particular reference to blood pressure regulation in the renin-angiotensin system. She graduated MBBS in Adelaide in 1965 and received an MD in 1970. She was awarded a DSc at the University of NSW in1986 where she was given a personal chair in 1988. She received the Vice Chancellor's Award for Teaching Excellence in 1997, became Scientia Professor in 1999 and Emeritus Scientia Professor in 2003. She was elected Fellow of the Australian Academy of Science in 2002.

In 2007 she developed new research interests at the University of Newcastle and was awarded an NHMRC grant in 2008. She further expanded her research interests in 2009 with three other NHMRC grants. She received the Centenary Medal of Federation, Australia in 2001.

Announcing our Award Winners for 2010

The Society takes great pleasure in announcing its Award Winners for 2010. As in past years, we received outstanding nominations from many quarters. The winners will be presented with their Awards at our Annual Dinner on 18 February by our Patron, Professor Marie Bashir, AC CVO Governor of NSW. Congratulations to our three winners.

The Clarke Medal

Kenton Campbell

Professor Kenton Campbell is Emeritus Professor of Geology at the Australian National University. He is Australia's senior palaeontologist, with a special interest in neuroanatomy. His research began in stratigraphy, and moved into the study of fossils and evolution. He became an international authority on the nervous system of the lungfish and the way in which it has evolved. He began publishing his scientific research in 1952. He worked at the Universities of Queensland and New England before going to the Australian National University in 1962. While most of his work has been done in Australia, he worked for short periods in Cambridge, Harvard, Chicago and London. He became a Fellow of the Australian Academy of Science in 1982, and won the Academy's Mawson Medal in 1986. He gave the Clarke Memorial Lecture of the Royal Society of New South Wales in 1975.

The Edgeworth David Medal

Angela Moles

Angela Moles is an Associate Professor in the Evolution & Ecology Research Centre at the University of New South Wales. Her primary research goals are to understand the different ways in which plants grow and reproduce in different environments around the world, and to better understand the selective processes underlying plant ecological strategies.

Angela's main research projects at present are 1) "The World Herbivory Project", in which she travelled to 75 different ecosystems around the world to quantify global patterns in interactions between plants and animals, and the factors that affect these patterns, 2) Quantifying the extent to which introduced species have evolved since they arrived in Australia and 3) Using clonal plants to get new insights to the evolutionary advantages of sexual reproduction. At home, Angela and her partner Stephen are learning about the joys and sleep deprivation of parenting with their one year old son Sam.

Walter Burfitt Prize

Richard Shine

Rick is a Professor in Biology at the University of Sydney. His research spans a wide range of species, ecosystems and conceptual areas, but focuses most strongly on the ecology and evolution of reptiles and amphibians. In particular, his recent work explores ways in which fundamental field-based ecological research can be used to develop innovative approaches to conservation challenges. He has published more than 700 papers in scientific journals, and is among the world's most highly cited authors in his field. Rick has received numerous awards for excellence in research, including the E. O. Wilson Award by the American Society of Naturalists, the Mueller Medal by ANZAAS, the Eureka Prize for biodiversity research, and the Macfarlane Burnet Medal by the Australian Academy of Science. He was elected a Fellow of the Australian Academy of Science in 2003, and received an Order of Australia (AM) in 2005. He contributes regularly to media debates, and was included in the Sydney Magazine's list of Sydney's 100 most influential people for 2008.

For more information and lists of publications please see http://sydney.edu.au/science/biology/sites/Shinelab/ For a general website about the cane toad project please see http://www.canetoadsinoz.com

2010 Einstein Lecture

Each year the AIP NSW Branch nominates a distinguished speaker whose work has covered a wide range of topics with an emphasis on Einstein's ideas and their consequences for physics and technology today. This year the Einstein Lecture was held at the Powerhouse Museum on Monday 23 August 2010 and featured Dr Phil Dooley from the University of Sydney on the topic of "Einstein's Unruly Child". Phil completed a PhD in laser Physics at the ANU but decided that he would in the future 'by-pass' nasty long equations and move into the area of science communicator. Phil has been heavily involved with high schools, over a number of years, in conducting workshops for physics teachers and high school students. He has also travelled around NSW in 'Outreach' programs stimulating and entertaining audiences in physics shows.

The Einstein series consisted of a midday show geared to an upper high school audience and a night lecture for the general public. Both of these shows were very well attended (approaching 350) and professionally videoed.

Phil started the lecture by describing some of Einstein's little known background, that is, besides Relativity and E=mc2, for which he is best known to the general public. Phil explained that Einstein's insights into the photo-electric effect began a revolution in Physics that eventually led to Quantum Physics. This then set the scene for the audience to learn about some of Einstein's work through a series of fascinating but normally difficult to 'carry out' demonstrations and real experiments (from the HSC syllabus), as well as introducing the science that has, despite its strangeness, made some of the most accurate predictions of any theory.

The audience was thrilled in seeing high energy sound waves vibrate a crystal glass leading to it's destruction – a feat Phil's Opera singing was not able to do; levitation using superconductors; gas tube corona discharge as well as laser diffraction and wave harmonics.

Phil successfully explained, using chocolates, how quantum theory can help one visualize the quantum world. The consequences of Quantum Physics seem weird, but many of them flow from Einstein's proposition that light acts as particles as well as waves - we now know that matter also demonstrates this "wave-particle duality". With this key, then we can begin to make sense of some Quantum behaviour.

The day, overall, was very successful and Phil did a remarkable job in presenting a difficult and not well-understood area of physics. Phil's flair and communication skills in his presentations kept the audience engrossed from start to finish with question time reflecting their keen involvement and fascination in the lecture.

The talk was very well received and geared to scientists and members of the public alike with many discussions continuing later after the lecture. The NSW Branch of the Australian Institute of Physics thoroughly thanks our co-sponsor The Royal Society of NSW as well as the Powerhouse Museum, for their support and use of facilities on hosting the event and Dr Phil Dooley for delivering an outstanding and stimulating 2010 Einstein Lecture!

Photo from left to right: Dr Frederick Osman, Dr Phil Dooley and Dr Graeme Melville (AIP Branch Chair).

Frederick Osman

Australian Institute of Physics
NSW Branch

Lecture delivered for the Four Societies Meeting held on 24 February 2011

Geothermal Energy - Current State of Play and Developments

Dr. Stuart Mc Donnell, Chief Operating Officer for Geodynamics
Mr Stephen de Belle of Granite Power

The annual meeting of the "Four Societies" – the Royal Society of NSW, the Australian Nuclear Association, the Nuclear Engineering Panel of Engineers Australia (Sydney Division), and the Australian Institute of Energy – heard two perspectives on geothermal energy as a major energy source for the generation of electric power. The speakers were Dr Stuart McDonnell, chief operating officer of Geodynamics Ltd and Stephen de Belle, managing director of Granite Power Ltd. Both companies are developing "hot rocks" technology for the generation of electricity. The technological concept behind this technology is straightforward enough: a source of hot rock – typically granite at temperatures of 150-300° C at depths between 1500 m and 5000 m below the Earth's surface – is identified. The rock is fractured and water is pumped under high pressure from the surface down through the hot rock where it is heated to very high temperatures. When the water returns to the surface, the energy is used to drive turbines which in turn generate electricity. The thermal resources in Australia are huge – in the Cooper Basin alone, there are hot rock deposits capable of generating as much electricity as burning 750 million tonnes of coal or 16 trillion cubic feet of natural gas.

Of course, the devil is in the detail. It is technologically challenging and expensive to drill to these depths. In addition, there are other significant technological challenges that need to be resolved such as fluid chemistry when the hot water reacts with the minerals in the rock and the components in the system, the ability to manage multiple fracture-zones in order to extract the maximum amount of heat, the gradual reduction of the temperature of the resource over time, and the challenges in creating viable, efficient heat exchanger designs in rock several kilometres beneath the Earth's surface.

If these technological and economic issues can be overcome, geothermal generation is well placed to provide a substantial proportion of Australia's base-load electricity demand. This could be as high as 2,300 MW of base-load capacity by 2020. Some government and private funding has already been committed with the intention to seek further capital from institutional investors during 2011.

Donald Hector