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The Royal Society of New South Wales Bulletin and Proceedings 345

Future Events 2011

Lectures in Sydney are held on the first Wednesday of the month at 6.30pm.

Wednesday, 1 June 2011 at 6.30pm

1192nd OGM

Variation of Fundamental Constants from Big Bang to Atomic Clocks

Professor Victor Flambaum

Lecture Theatre 106, New Law Building, University of Sydney.

Wednesday 6 July 2011 at 6.30 pm

1193rd OGM

Stem Cells and Regenerative Medicine: Prospects for Realising the Prometheus Myth

Dr John Rasko

Centenary Institute, Sydney University
Lecture Theatre 106, New Law School,
University of Sydney.

Southern Highlands Branch

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

Thursday, 16 June 2011 at 6.30pm

Why Did I Do That?

A Fresh Look at the Psychology of Human Motivation

Dr Hugh Mackay

Drama Theatre at Frensham School,
Mittagong (enter off Waverley Parade)

Central West Branch

For further information please contact Kerry Madden at Charles Sturt University Orange on Tel: 02 6365 7500.

Variation of Fundamental Constants from Big Bang to Atomic Clocks

Professor Victor Flambaum

School of Physics, University of New South Wales

Wednesday, 1 June 2011 at 6.30pm, Lecture Theatre 106, New Law Building, Eastern Avenue, University of Sydney.

Modern unification theories suggest the fundamental constants (like speed of light) may change in an expanding Universe. The study of quasar spectra has indicated the variation of the fine structure constant α in space (α is the dimensionless combination of electron charge, speed of light and quantum Planck constant). This spatial variation can explain fine tuning of the fundamental constants which allows humans (and any life) to appear. If the fundamental constants were even slightly different, life could not exist. We appeared in the area of the Universe where the values of the fundamental constants are consistent with our existence.

These astrophysical results may be used to predict the variation effects for atomic clocks. These effects in atomic clocks are very small and require extremely high precision. Therefore, we are searching for the enhanced effects of the variation. One of our proposals is to use a nuclear clock where the effect is enhanced by five orders of magnitude.

Professor Flambaum is Head of the Department of Theoretical Physics at the University of New South Wales, a position he has held since 1991. He was created Scientia Professor at the university in 2003 and became an Australian Professorial Fellow in 2005.

Prior to coming to Australia, Professor Flambaum worked at the Institute for Nuclear Physics at Novosibirsk and at the Novosibirsk State University. He was elected a Fellow of Australian Academy of Science in 2000 and of the American Physical Society in 2010. He is also a Fellow of the Australian Institute of Physics. He has nine major international and Australian prizes, medals and awards, including Australia's Centenary Medal and the Lyle Medal from the Australian Academy of Science. In 2000 he was awarded the Templeton Prize. Professor Flambaum has over 300 publications, has delivered over 200 invited talks, and has over 100 articles published in international newspapers and magazines.



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

Report on the Society's 1191st OGM

Heading towards the world's largest telescope – the Square Kilometre Array

Professor Michael Burton - School of Physics, University of NSW
Wednesday, 4 May 2011



The President presents Professor Burton with a Speaker's Medal

What do the kinetic energy of a falling snow-flake and radio telescopes have in common? Well, as Professor Michael Burton pointed out in his talk on the Square Kilometre Array (SKA), the energy of a falling snowflake is about 30 micro joules and this is greater than all of the radio energy ever collected by all the radio telescopes in the world! These instruments are very sensitive! Radio astronomy looks at a part of the electromagnetic spectrum at wavelengths from 1 m to 1 km. Observations in the visible spectrum are badly affected by dust but this is not the case in the radio spectrum. Thus by combining information from optical, infrared and radio telescopes we can get a much more complete picture of what's going on in the universe. But because of the long wavelengths of radio waves, these instruments have to be very big. For example, the Parkes telescope with its 64 m diameter dish has an area of about 1000 m². This telescope can resolve galaxies but in order to increase the resolution to look inside galaxies, much larger instruments are needed.

The largest radio telescope in the world at the moment is the Very Large Array (VLA) in New Mexico. This instrument has 27 dishes each of 25 m diameter, with a total area of 10,000 m². These antennas are configured in a Y-shape that can deliver an effective maximum baseline of 32 km. Data from each array is integrated using interferometry techniques effectively giving a telescope of this aperture. This substantially increases the effective resolution of the instrument. The VLA is capable of looking at radio sources

such as pulsars, quasars and give insights into the formation of galaxies. If we are to be able to look further back through the history of the universe to the dust from which galaxies form, we need instrument orders of magnitude bigger than the VLA and that's where the SKA comes in.

The SKA will be the largest telescope ever built with a collection area of 1,000,000 m² and a baseline of at least 2,000 km. The SKA will be able to peer far back into the history of the universe to observe the first black holes and stars, to search for Earth-like planets, to test aspects of general relativity, and to explore the origins of cosmic magnetism.

The total cost of this project will be about \$3 billion and the telescope is expected to be in full operation by 2025. Because of the cost of the project, up to 20 countries will be involved in the investment. About \$450 million has been invested so far with prototype technologies being constructed in potential locations for the final instrument in southern Africa and Western Australia. The core instrument (where most of the dishes are located) needs to be sited in a "radio quiet" location. It needs to be flat, open, geologically stable and well away from man-made sources of radio waves. Final site selection is expected to be complete next year. The telescope will come on-line over a period of about 10 years, with the low and mid-frequency capabilities completed by 2023 and the whole instrument by 2025. Australia is well placed to be selected as the final site, given our leadership in radio astronomy and the "radio quietness" of outback Australia. If Australia is chosen, the core instrument will be located at the Murchison Radio Observatory about 500 km north-east of Geraldton and will have dishes extending from Western Australia to New Zealand, giving a total baseline of 5,500 km.

Donald Hector

Bequests

The Royal Society of NSW has existed before any of our members were born, and indeed we hope that it will exist long after any of our current members now. We are indeed lucky to have such a society in our times, and we hope that the society will continue to provide opportunities, support and encouragement to our future generations.

While your membership, support and encouragement of the society and the council already helps our society look to the future, there is perhaps something more that you can do. If you could leave a bequest to the society in your will, not only will your name be passed on to future generations as a contributor to their future, but your donation will also help to insure the future of the Royal Society of NSW as well as the future generations of NSW.

A Voice to be Heard

As you know we publish our journal every 6 months, and of course it is refereed, and has official recognition as an Australian Tier publication too. However, did you know that our Journal also goes to over 250 other societies, associations, institutions, government departments, and of course universities? We are always looking for papers, interesting contributions, and we look forward to helping you to present your research, experiences and articles to the rest of the world. Please contact Dr Donald Hector for more information.

Announcements

We are bringing back letters to the Editor. If you have any announcements, interesting items, or an opinion you would like to voice, then please email it to the office.

We have recently updated our computers in the office. We are now looking into other aspects where we can streamline and increase efficiencies. This will give the office and the RSNSW more opportunity to follow up on our new strategic plans for the coming years.

Southern Highlands Branch

Report of April 2011 Meeting: Genetics and Sudden Cardiac Death

Professor Jamie Vandenberg - Head, Mark Cowley Lidwell Research Program in Cardiac Electrophysiology, Victor Chang Cardiac Research Institute

Jamie Vandenberg began his lecture with the question, "What is sudden cardiac death (SCD)?" He defined it in two ways. In the case of a witnessed death, SCD is an unexpected death that occurs within one hour of the start of symptoms. When the death is unwitnessed, SCD is defined as occurring within 24 hours of the person being seen alive and well. Most deaths that meet these definitions are caused by cardiac arrhythmias, the commonest mode of death in western societies.

Despite a spectacular decline in age-adjusted rates of mortality due to heart disease in the last 40 years, cardiovascular disease remains the number one cause of death in Australia today. Over half of these deaths are due to abnormal heart rhythms, resulting in SCD. Research into its prevention relies on the understanding of the mechanisms of disordered electrical signaling in the heart, better identification of high risk patients and the development of effective anti-arrhythmic drugs. Professor Vandenberg's research team has now come one step closer to understanding how the rhythm of the heartbeat is controlled, and why many common drugs, including some antibiotics, antihistamines and anti-psychotics, can cause a potentially fatal abnormal heartbeat.

In the same way that a set of metal wires carry electricity to light up our streets, our body has a series of channels that carry tiny particles called ions, into and out of cells to trigger a heartbeat. These channels must be opened and closed by a series of "gates". Recent research at the Victor Chang Institute has focused on the method of operation of these "gates", and how they can be affected adversely by certain drugs.

Depending on the position of the gates, many common drugs bind, or attach themselves to these channels, blocking the ions from passing through. This causes what is known as Long QT syndrome, where the length of the

heartbeat is longer than usual, greatly increasing the risk of arrhythmia. The group of drugs most commonly associated with this side effect include anti-psychotic drugs, taken by patients with schizophrenia and other psychiatric disorders. Patients taking these drugs are three times more likely to die of sudden cardiac death due to an abnormal heart rhythm.

Professor Vandenberg's research team has studied the hERG potassium channel, an ion channel that determines how long each heartbeat lasts, and which is also most susceptible to being "blocked" by drugs. They describe the hERG channel as a particularly "sticky" channel, in that most drugs will bind to it when the outer gate is closed. They have now discovered how these outer gates operate, giving hope that future drugs can be designed to minimize unwanted side effects.

The vast majority of cardiac arrhythmias occur in the context of pre-existing heart disease. However in some patients, arrhythmias can occur in the absence of any structural abnormalities or damage to the heart. The commonest of these is the congenital Long QT syndrome (LQTS). This is a particularly devastating disorder as it typically results in the sudden death of young people who are otherwise fit and healthy. Congenital LQTS is caused by mutations in the ion channel genes that regulate electrical activity in the heart.

In the last part of his presentation, Professor Vandenberg described how genetic studies have contributed to a better understanding of SCD, and discussed how they may contribute to improved treatment options.

The 42-strong audience was most appreciative of Professor Vandenberg's excellent presentation. The vote of thanks was given by Ted Smith.

Anne Wood

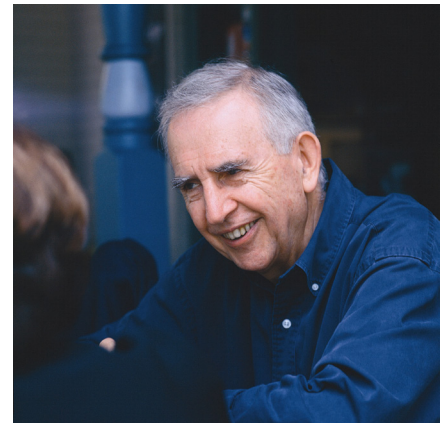
June 16th 2011 Lecture: Why Did I Do That? A Fresh Look at the Psychology of Human Motivation

Dr Hugh Mackay

Hugh Mackay is a psychologist, social researcher and novelist. He is the author of thirteen books, including six bestsellers. His latest book is *What makes us tick? The ten desires that drive us*.

In recognition of his pioneering work in social research, Hugh has been awarded honorary doctorates by Charles Sturt, Macquarie, NSW and Western Sydney universities. In 2004, he received the University of Sydney's alumni award for community service.

Hugh is an honorary professor of social science at the University of Wollongong, a former deputy chairman of the Australia Council, a former chairman of trustees of Sydney Grammar School, and was the inaugural chairman of the ACT government's Community Inclusion Board. He has been a newspaper columnist for over 25 years, and is a frequent guest on ABC radio.



Dr Hugh Mackay

As a social researcher, Hugh Mackay has spent the past 50 years listening to us talk about our dreams, our hopes, our fears, our disappointments and our passions. In this lecture, he identifies ten desires that drive our social behaviour and suggests that it is the dynamic interplay - the contest - between these desires that explains why we are so often puzzled by the apparently irrational things we all do.

Report on the Dirac Lecture

Beauty and truth: their intersection in mathematics and science

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

On 29 April 2011, Robert Lord May of Oxford, arguably the greatest mathematician that Australia has produced, was invested as a Fellow of the Royal Society of NSW by the Governor. Earlier that day, Lord May presented the Dirac Lecture at the University of New South Wales, jointly sponsored by the Society. The topic of Lord May's lecture was "Beauty and truth: their intersection in mathematics and science".



Lord May delivering the Dirac Lecture

He took us on an interesting exploration of some of the important concepts of mathematics, from Euclidean geometry via the concept of imaginary numbers to the mathematics of fractals and chaos theory and the extraordinary power of mathematics to describe observed real-world phenomena. Updating the observation by Galileo, "this grand book is written in the language of mathematics, and its characters are triangles, circles and other geometric objects", Lord May pointed out that rather than triangles and circles, today the mathematical objects are more likely to be fractals and "strange attractors". Nonetheless, as Galileo observed, and referring to the examples of Julia sets and Mandelbrot sets, there is great beauty in the elegance with which we can both describe and understand the immense complexity of the universe. He went on to explore the paradigm shift that Einstein divined from the results of the Michelson-Morley experiment that had found that the speed of light was the same for all observers. Einstein's

formulation of the special theory of relativity led to a profound shift in our understanding of the relationships between momentum, mass and energy that has enabled extraordinary insights and understanding of the nature of the universe, from gravity to nuclear fission.



L to R Dr Fred Osman, Em. Prof. Heinrich Hora, Lord May and the President after the Dirac Lecture

Lord May pointed out that, regrettably, many of the great contributions do not get the recognition that they deserve. In his view, Paul Dirac was such a person – his formulation of the Dirac equation and its implication of the existence of positrons was one of the greatest steps forward in theoretical physics in the 20th century, yet his name is nowhere near as well known as that of Einstein.

Quoting Keats "beauty is truth, truth beauty – that is all ye know on earth and all ye need to know", Lord May observed: well yes, but not really.



Lord and Lady May (centre) with Her Excellency the Governor and the President following Lord May's investiture as Fellow of the Society at Government House Sydney

Strategic Planning for the Society

Council of the Society held a strategic planning workshop on the afternoon of Saturday 7 May 2011 at the Society's rooms. Most members of Council were able to attend. The aim was to re-examine our charter and to develop strategies to enable the Society to fulfil this charter even more effectively and efficiently over the next few years.

In re-examining our charter, the starting point must be our Act of Incorporation and our Rules and By-laws. Our Act of Incorporation states that the Society exists:

"... for the encouragement of studies and investigations in Science Art Literature and Philosophy..."

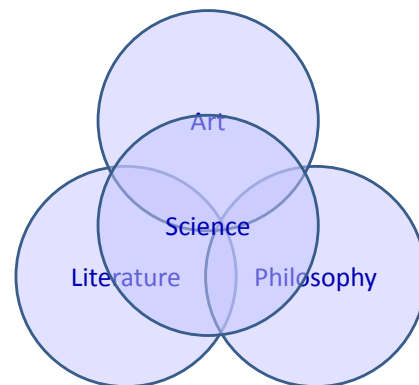
Our Rules and By-laws state that we exist:

"...to promote and further the development of Science and allied disciplines and their applications, to facilitate the exchange of information and ideas amongst the members of the Society and others on Science and kindred topics and to disseminate knowledge relating to Science and allied disciplines..."

Council's interpretation of this in today's environment is that:

"We exist to bring science to art, literature, and philosophy; and to bring art, literature, and philosophy to science."

This concept is rendered in simplified diagrammatic terms in the Venn diagram below where science is shown as central to our existence.



Following discussion of our strengths and weaknesses, Council examined a range of possible candidates for strategic programmes/activities. Out of this emerged five Strategic Programmes which were agreed should be adopted by Council as our focus for the next 2-3 years. They are:

1. Schools Programme

Establish a programme to engage with schools that have strong educational performance in order to foster an interest in science and its relationship with other disciplines.

- Establish a mentoring programme.
- Establish Archimedes.
- Encourage schools to engage with the Society.
- Utilise our membership base to conduct talks/seminars in schools.

Target market: selective schools; schools that offer the IB programme; wealthier independent schools.

2. Membership Programme

Gain and maintain a membership base that can sustain financially the Society's operational requirements.

- Membership drive.
- Tap the existing membership base to attract new members.
- Establish alliances with other professional bodies (e.g. Engineers Australia, Royal Australian Chemical Institute, Australian Institute of Physics etc).
- Offer membership discounts.

3. Fund-Raising Programme

Establish a programme to attract funds that will:

- cover the cost of current operations, and
- form a capital base for the Society to ensure long-term sustainability.

To achieve this:

- Explore the possibility of both NSW and Federal government grants.
- Approach foundations for financial support.

4. Profile and Relationships Programme

Achieve a substantial public profile for the RSNSW and develop and maintain critical strategic alliances.

- Maintain and further develop the relationship with the NSW Chief Scientist and Scientific Engineer.
- Propose independent advisory panels to government and business made up of RSNSW members.
- Establish strategic alliances with the Art Gallery of NSW, the Australian Museum, and the Powerhouse Museum.
- Strengthen and further develop key relationships at all levels at the University of Sydney: Senate, Vice-Chancellor/Pro Vice-Chancellors, and Deans.
- Develop key relationships with other professional bodies (in conjunction with the Membership Programme).

5. Publications and Historical Assets Programme

Strengthen and further develop the unique assets of the Society, in particular the Journal and Proceedings, the library and the archives.

- Develop a publication model for the Journal that includes moving its ARC ranking from Tier C to Tier B.
- Develop web and social networking capability.
- Catalogue and preserve the library and archival resources.
- Develop a commercial strategy for utilising our historical assets (e.g. merchandising programme).

Each programme will have a Council member as a champion/sponsor. Council meeting agendas will be restructured to include a Strategic Programme report from each champion/sponsor. Success factors to the end of 2012 were determined for each programme. Detailed action plans for each programme will be complete within two months to flesh out the details of each programme. Committees for each programme will be formed from both Council and non-Council members. I encourage all members to seriously consider offering themselves for one of these committees in order to ensure that these programmes are successful.

John Hardie

Nominations for Fellows of the Royal Society of NSW

Members of the RSNSW are invited to nominate new candidates for consideration for the award of Fellow of the Society for the 2011 round. Nominations should be forwarded together with the signature of a seconder confidentially to the President, Mr John Hardie on or before 30 June 2011 for consideration by the Fellows Committee of Council. Nominees should have some link to NSW. General information about Fellows of the Society can be found on our website.

Emeritus Professor Heinrich Hora, Chairman of the Fellows Committee of Council

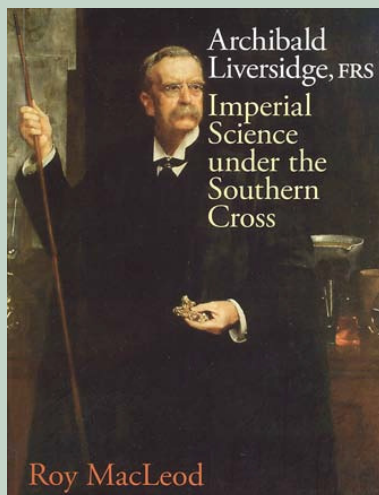
Liversidge Book - Special member's Discount

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

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

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

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



From the President



The first month of the Society's year has been a busy one. It began with the very public exposure of the Society to the wider world at the Dirac Lecture held in conjunction with the University of NSW and the Australian Institute of Physics at UNSW on 29 April. As predicted, Lord May's lecture was superb and this reflected very favourably on the Society.

This event was followed by the formal investiture of Lord May as Fellow of the Society by our Patron, Professor Marie Bashir, Governor of NSW, at Government House, Sydney. The presence at the event of several leaders in the scientific world in NSW was testament to the value that is placed on excellence and achievement in science. Our Society is at the forefront of this philosophy. Full reports of these two events can be found elsewhere in this issue of the Bulletin.

I am pleased that we have been part of the current push to ignite interest and support behind Australia's bid to be the host nation, along with New Zealand, of the Square Kilometre Array. With the kind assistance of Questacon in Canberra, we were able to obtain the professionalism and expertise of Professor Michael Burton from UNSW to present our last monthly lecture. This excellent talk is described elsewhere in this Bulletin.

The Society's Council held a successful strategic planning workshop on Saturday 7 May in order to help guide us through the next five years. Our previous strategic planning session had been held six years previously! I would like to thank Dr Donald Hector for his efforts in making this important activity happen.

Once again I was honoured to be invited to the Presidents' Dinner of the Royal Australian Chemical Institute, also on 7 May. This was a special event as it celebrated the International Year of Chemistry 2011 and honoured past Presidents of the Institute, some of whom also played key roles in the Royal Society of NSW.

We have successfully upgraded our computer capability in the office which provides greater security for our ever-expanding data and systems. This should allow us to do more to maximise our information management capability in order to be able to provide better services to members.

John Hardie

From the Hon. Librarian



The council has approved our library to become a member of Libraries Australia. We are attending to the paper-work now. This will allow you to search our library catalogue online, as well as giving us the opportunity to speed up our cataloguing of the collection.

We have also created our own Facebook page. The council is keen for the Society to embrace the social networking opportunities of today. If you are on Facebook, and you would like to be added to the group then please email me at tony@g3n1u5.com

Finally, for this Bulletin, I would like to bring to your attention some open source software called Rattle. Rattle is a statistical / data mining software package available at www.togaware.com. Rattle is used all round the world, and it is an Australian development. It has too many features to list here. You can find a summary at http://en.wikipedia.org/wiki/Rattle_GUI

Tony Nolan

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