



The Bulletin 427

The Royal Society of New South Wales

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Happy
Holidays
&
Safe
Travels

Watch this space
for more announcements
of Society events
in the next *Bulletin*,
which will be distributed
late January 2019



Patron of The Royal Society of NSW
His Excellency General The Honourable
David Hurley AC DSC (Ret'd)
Governor of New South Wales

Open Lecture, Jak Kelly Award,
and Christmas Party

**'Hydroxyl as a Probe of the
Molecular Interstellar Medium'**

Anita Petzler

Department of Physics and Astronomy
Macquarie University



See page 3 for more information

Date: Wednesday 5th December 2018

Time: 6:00 pm for 6:30 pm

Venue: Gallery Room, State Library of NSW
(Entrance: Shakespeare Place, Sydney)

Dress: Business

Entry (OGM and Lecture only): \$15 for Members, Fellows and Associate Members of the Society, \$5 for full-time Students, \$25 for Non-Members (including a welcome drink and nibbles)

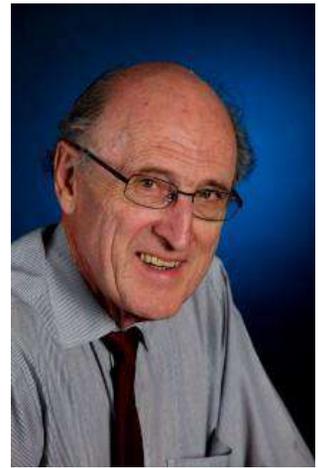
Christmas Party (buffet style, including drinks): \$50 for Members, Fellows and Associate Members, \$60 for Non-Members, \$25 full-time students.
Reservations must be made at least 2 days before.

Reservations: <https://nsw-royalsoc.currinda.com/register/event/54>

Enquiries: royalsoc@royalsoc.org.au Phone: 9431 8691

All are welcome.

From the President – A Library on the Move



The Royal Society of New South Wales has long had an obligation to make its extensive library resources available to its members, but in recent years that promise could not be honoured, because for the past 15 years most of the Society's library has been sealed in 324 boxes, impossible for anyone to consult. In a landmark event all of those books and journals were a few weeks ago moved to the State Library of New South Wales, where they are now awaiting sorting and cataloguing by our newly recruited volunteers. Eventually they will form a distinct collection within the Library, still belonging to the Society, but accessible to Society members, and to everyone else, through the State Library's catalogue. This to me this is a wonderful development, and a testament to the rapidly strengthening relationship with the State Library of New South Wales. Such a development does not happen without the effort of many people. I particularly want to acknowledge the efforts of Vice Presidents John Hardie FRSN and Judith Wheeldon FRSN, and at the receiving end the State Librarian John Vallance FRSN together with Mark Stevenson and other staff members of the State Library.

It is always a pleasure to acknowledge the success of our members and Fellows. Recently Council member Dr Chris Bertram FRSN was presented with the David Dewhurst Award at the Australian Biomedical Engineering Conference. The David Dewhurst Award is given annually by Engineers Australia (Australia's peak body for engineers, representing over 100,000 members) to a biomedical engineer who has made exceptional, sustained and significant contributions to the field. Professor Anthony Weiss FRSN won the Premier's Prize for Science and Engineering Leadership in Innovation. Tony Weiss holds the Samuel McCaughey Chair in Biochemistry and is Professor of Biochemistry and Molecular Biotechnology at Sydney University, and heads the Charles Perkins Centre Node in Tissue Engineering and Regenerative Medicine. His discoveries are on human elastic materials that accelerate the healing and repair of arteries, skin and 3D human tissue components.

Ian H. Sloan AO FAA FRSN
President, Royal Society of New South
Wales
President@royalsoc.org.au

Anita Petzler, Jak Kelly Award Winner for 2018

Department of Physics and Astronomy

Macquarie University

‘Hydroxyl as a Probe of the Molecular Interstellar Medium’

The interstellar medium is the collection of gas and dust between the stars of a galaxy and is the raw material from which new stars are formed. Its physical properties as well as a complex set of internal and external influences determine the mass distribution of stars formed. By observing the interstellar medium, we can begin to unravel these complex interactions and build robust models of star formation in galaxies. The interstellar medium consists of atomic gas traced by 1420 MHz hydrogen emission and molecular gas, traditionally detected by 115 GHz carbon monoxide emission.

Anita Petzler’s research recognises the limitations of carbon monoxide as a tracer of more diffuse molecular gas and employs an alternate: hydroxyl. Hydroxyl is expected to coexist with molecular hydrogen in all environments, including those not well detected by carbon monoxide. The ground state of hydroxyl is split into four levels due to lambda doubling and hyperfine splitting. There are four allowable transitions between those levels at 1612, 1665, 1667 and 1720 MHz. The relative population of hydroxyl molecules in each level is determined by the local gas conditions which in turn determines the relative intensity of absorption or emission. Petzler measures the emission and absorption in the transitions of hydroxyl along sightlines towards bright background continuum sources to define the local conditions of the intervening hydroxyl gas. Modern observation techniques, including large scale surveys using telescopes with unprecedented resolution such as the Square Kilometre Array, will give us an overwhelming wealth of data. Therefore, Anita Petzler is developing an automated analysis pipeline that will allow us to quickly extract our target parameters from these observations in a physically and statistically rigorous way. This work will allow us to take full advantage of these remarkable new facilities to complete our understanding of the mechanisms of star formation.



(Source: Anglo-Australian Observatory)

After growing up in Southern California, Anita Petzler moved to Australia at the age of 18 to complete a Bachelor of Science in Physics and Astrophysics at Monash University in Melbourne. This was followed by a Graduate Diploma of Education, an 8-year career as a High School Physics and Science teacher, and a move to Sydney. She returned to her studies in 2013, completing Honours at UNSW, a Masters by Research at Macquarie University, and then began a PhD in July of this year. ‘Ever since the age of 5, when my kindergarten teacher introduced me to the science of space, I’ve known that I wanted to be an Astronomer.’

**Report of the 1268th OGM
Wednesday 7th November 2018**

Associate Professor Tara Murphy
School of Physics, University of Sydney

‘Breakthrough! The Detection of Gravitational Waves from a Neutron Star Merger’



Associate Professor Tara Murphy started her talk with playing the ‘chirp’ received on 17th August 2017, i.e., the first radio emission from a gravitational wave event caused by the merger of two neutron stars. Professor Murphy, an astrophysicist at the University of Sydney, leads an international team of researchers working with the MWA (Murchison Widefield Array) and ASKAP (Australian Square Kilometre Array Pathfinder) radio telescopes in Western Australia to study astrophysical phenomena. As the LIGO-Virgo interferometer detected gravitational waves from a neutron-star merger in a galaxy 130 million light years away there was a frenzy of activity as astronomers around the world worked to detect electromagnetic radiation with conventional telescopes. Her team detected the bright flash with their telescope in a normal (old) galaxy, 130 million light-years away. She then illustrated in various animations what happens when two neutron stars collide.

Neutron stars are extremely dense objects although their exact composition is unknown. Due to their extreme density, the energy of a neutron-star merger is unbelievably high: $\sim 1 \times 10^{45}$ J (total energy of merger emitted in gravitational waves), compared to $\sim 1 \times 10^{34}$ J the total energy output of the sun each year, or $\sim 4 \times 10^{15}$ J energy release by the explosion of a megaton of TNT.

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Gravitational waves can be measured using interferometers. Although the physics of an interferometer is not difficult, the engineering is incredibly complicated because such a weak signal needs to be measured. As part of the collaboration measuring gravitational waves, LIGO-Virgo, independent detectors were built in the US and Italy. The first observations of gravitational waves are from merging black holes. Gravitational waves are ripples in space-time; they confirm a final prediction of Einstein's relativity theory.

Professor Murphy then explained how radio astronomy is used to study gravitational waves, and, in particular, to understand how black holes form and the physics of neutron-star mergers. In question time Professor Murphy explained that you cannot really hear gravitational waves, but that the observed signal was converted into an equivalent range of sound frequencies. If a neutron-star merger were to happen in our galaxy we would be wiped out. She explained that LIGO could not really measure dark matter. The award of the 2017 Nobel Prize for the detection of gravitational waves remains controversial in the community as there is the view that it should be awarded to a project and not individuals.

Jonathan Berengut presents 'Bio-Nano Robo-Mofos'



The 2018 winner of UNSW's 3 Minute Thesis Competition Mr Jonathan Berengut presented 'Bio-Nano Robo-Mofos' at the OGM. His research centres around the design and synthesis of DNA-nanobots that assemble into specific formations such as rows of fixed length. This research furthers our control of matter at the nanoscale and thus may lead to novel nanomaterials, nanoelectronics and nanomedicines. After his three-minute presentation, he was awarded his Associate Membership Certificate by the President.

Report of 15 November 2018

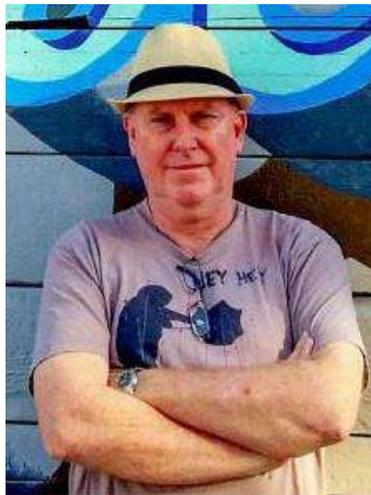
Royal Society Southern Highlands Branch

Associate Professor Brent Jacobs

Institute for Sustainable Futures
University of Technology, Sydney

'Sydney's Food Future'

An audience of 50 people arrived for this Royal Society Southern Highlands Branch last lecture in 2018. Also present was RSNSW President Ian Sloan and his wife Jan who joined the group on this occasion to hear Associate Professor Brent Jacobs deliver his address on the research projects he and his team are conducting into the future of Sydney's food production. Local food production in the Sydney Basin provides many benefits, from employment to buffering against climate change, and underpins the resilience of the city. Yet competing priorities for Sydney's fertile farmland could threaten future supplies of fresh local food.



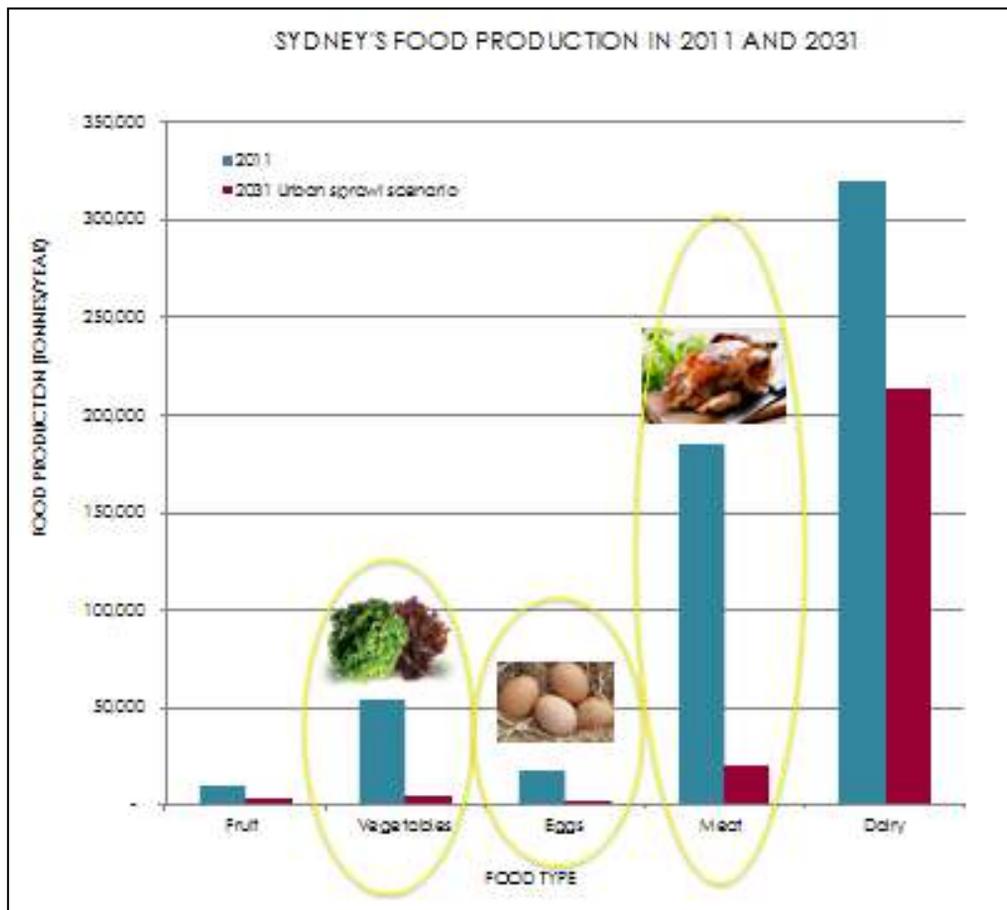
Unfortunately, Sydney stands to lose many of the benefits that local food production brings as peri-urban local government areas lose significant proportions of their agricultural production. There are enormous benefits to growing fresh food in the Sydney Basin: growing perishable and high-value produce like Asian greens and eggs close to market reduces food spoilage, supply chain waste and food miles, and buffers against transport fuel price shocks. Agriculture and food processing are labour intensive, providing significant job opportunities.

In total, the benefit of Sydney's agriculture to the economy is estimated at upwards of \$4.5 billion, accounting for multiplier effects. Sydney's comparative advantage is expected to grow under a changing climate: the Basin's relatively high rainfall and fertile soils will become even more suitable for growing food, while Australia's major food bowls such as the Murray Darling are predicted to become more vulnerable under climate change.

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Jacobs and his team have conducted detailed research on the balance that must be found in the city of Sydney to accommodate the needs of a rapidly increasing population and yet retain protection for agriculture. In their key findings, they have shown that if we do not change the path the city is on, Sydney stands to lose 60% of the fresh food that is produced in the Basin. The proportion of the city's food supplied from within that Basin could drop from 20% of total food demand down to a mere 6%. Vegetables, meat and eggs will be hardest hit: 92% of Sydney's current fresh vegetable production could be lost, with losses for meat production of 91%, and for eggs 89%.



It is clear that Sydney needs to implement policies and strategies that seek to balance additional housing requirements with environmental protection, resident health standards and food production. Jacobs emphasized that creating a resilient food future for Sydney means that strategic metropolitan planning needs to value and better protect agriculture from urban sprawl. Farmers need viable commercial operations, a fair price for produce, land security and a social license to operate. The people of Sydney need access to affordable housing, social services and other infrastructure. But they equally need access to nutritious and affordable food, reversing the high rate of obesity and diabetes, and 'food deserts' (grocery dead zones) particularly prevalent in Western Sydney.



(From left to right) Professor Ian Sloan; Dr Erik Aslaksen; Anita Petzler; Lewis Martin; Karina Hudson; Grace Causer; Tibor Molnar; A/Prof Richard Read; and Dr Frederick Osman. Front row: Chathura Bandutunga and Hanh Duong

Australian Institute of Physics, Royal Australian Chemical Institute and Royal Society of NSW

New South Wales Postgraduate Awards Day and Lecture

The NSW Branch of the Australian Institute of Physics, in conjunction with the Royal Australian Chemical Institute and the Royal Society of NSW, held its annual Postgraduate Awards Day on Tuesday 13 November 2018 at the University of New South Wales. Each New South Wales University was invited to nominate one student to compete for the \$500 prize and Postgraduate medal on that day. These awards have been created to encourage excellence in postgraduate work. The winner of the Australian Institute of Physics Postgraduate Presentation for 2018 was Chathura Bandutunga, Australian National University, Research School of Physics for ‘Encoding Light: Digital Interferometry for High Precision Optical Metrology’.

In addition, the NSW Branch of the AIP recognised the work of Dr Scott Martin, CSIRO Lindfield, as winner of the Community Outreach to Physics Award 2018. Dr Martin has done an outstanding job organising the annual Physics Industry Day at Lindfield for several years. Over recent years Scott has worked tirelessly connecting industry people with scientific researchers. He has been actively involved in establishing the Lindfield Collaboration Hub, an innovation incubator housing start-ups and SMEs, and supported by the NSW Government’s Department of Industry.

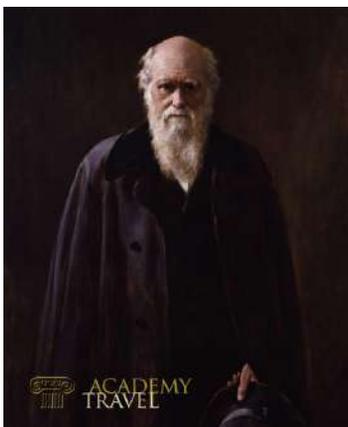
The Postgraduate Awards day was followed by a talk from invited speaker Tibor Molnar on the topic ‘Alice and Bob in Wonderland’. The talk focussed on the problem of ‘making sense’ of data, and suggests that a little metaphysics – so-called ‘Analytic Philosophy’ – might actually help to achieve it.

The History of Science:

Padua – Florence – Paris – London

A tour for the Royal Society of NSW in conjunction with the
State Library of NSW Foundation

19 September – 4 October 2019



Overview

Explore the history of science from Vesalius in Padua, to Galileo in Florence and the flourishing of modern science in Paris and London. This 16-day private tour for the Royal Society of NSW in conjunction with The State Library of NSW Foundation includes guided visits to many exceptional museums, rare access to collections, libraries and archival material, and the expert guidance of specialists and curators. It follows the great story of modern science, taking you from Padua, to Florence, Paris and London and includes day trips to Bologna, Siena and Cambridge. A four-night pre-tour extension to Venice is also available.

Discover

- The birth of modern science, from Galileo's telescopes to Darwin's theory of evolution
- The history of medicine: Vesalius in Padua, Pasteur in Paris and the medical collections of London
- The transmission of knowledge, from rare books and manuscripts to the modern museum
- The history of the university at Padua, Bologna, Paris and Cambridge
- Interaction between the arts and sciences in moments of great change from the Renaissance to the modern world.

Tour Details

Dates: 19 September – 4 October 2019

Price: \$9,270 pp. twin share; \$2,280 single supplement

For more information and to register your interest contact: Academy Travel, 9235 0023

info@academytravel.com.au.

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The History of Science (contin.)

Tour Highlights

- Padua: the world's first anatomy theatre, the oldest botanic garden and Giotto's Scrovegni Chapel
- Special access to library collections in Florence, Paris and London
- Private tour of the Pompidou Centre, Paris' modern art museum
- Day trips to Siena, Bologna, Cambridge and Greenwich
- Specialist museums dedicated to Pasteur, Curie, Galileo & Darwin
- London science: from the manuscripts of the Wellcome Library to the National Science Museum.

Itinerary



Days 1–3: Arrive Padua; visit the world's oldest anatomy theatre and oldest botanic garden, visit Scrovegni Chapel, Giotto's masterpiece; day trip to Bologna.

Days 4–6: Explore Florence, including the Galileo Museum, Uffizi, and special access to rare collections; day trip to Siena and the wonderful cuisine of Chianti.

Days 7–10: Discover a different side of Paris, from special museums dedicated to Pasteur and Curie to a private tour of the Pompidou Centre.

Days 11–15: Arrive London. Enjoy visits to Down House, the home of Charles Darwin, the National Observatory and prime meridian at Greenwich, and a range of museums from the Museum of Natural History, to the private collection of the Royal College of Physicians; day trip to Cambridge.

Day 16: Departure.

Tour Leader

Emeritus Prof Robert Clancy AM FRSN has a distinguished career in medical research and has published books on the early mapping of Australia. He has led many similar successful expeditions. Expert guides will meet the group in each destination.

Maximum Group Size: 20



The Royal Society of New South Wales

RSNSW Event December 2018

Date	Event	Speaker	Topics and Presentations	Location
5-Dec-18	Ordinary General Meeting	Anita Petzler	2018 Jak Kelly Award Presentation & Christmas Party	State Library of NSW

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