



# The Bulletin 404

The Royal Society of New South Wales

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26 October 2016

## For Your Diary:

15 November 2016

Australian Institute of Physics  
Annual Awards Day

2 pm -7:35 pm

Room G64 Old Main Building  
UNSW

*See pages 7-9 for more information*

17 November 2016

Southern Highlands Branch  
Lecture

Professor Gordon Wallace  
"3-D Printing of Body Parts"

6:30 pm start

Chevalier College, Bowral  
*See page 5 for more information*

29 November 2016

Second Society Forum  
"Society as a Complex  
System"

Government House  
9 am - 6 pm

*See page 6 for more information*



**Patron of The Royal Society of NSW**

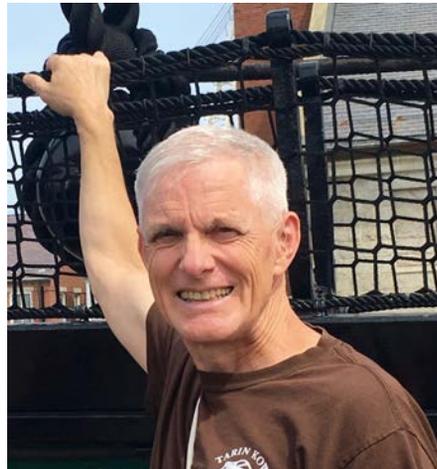
His Excellency General The Honourable  
David Hurley AC DSC (Ret'd)  
Governor of New South Wales

Public Lecture & 1248<sup>th</sup> OGM  
Wednesday, 2 November 2016

**Professor E. James Kehoe**

Professor of Psychology  
University of New South Wales

**"Finding the Right Course for the Right Horse:  
Advances in Instructional Design"**



Students of all ages and stages can readily become disengaged in a new subject area, often right out of the starting gate. While a few top students forge ahead, many others progressively accept mediocrity or failure. Different types of one-size-fits-all solutions have been attempted, usually with little reduction in the wide variation in student progress. *(For more information, see page 5)*

**Date:** Wednesday, 2 November 2016: 6:00 for 6:30 pm

**Venue:** Union, University and Schools Club, 25 Bent Street, Sydney  
Entry: \$20 for Non-Members, \$10 for Members and Associate Members of the Society, which includes a welcome drink. **Dress:** Business

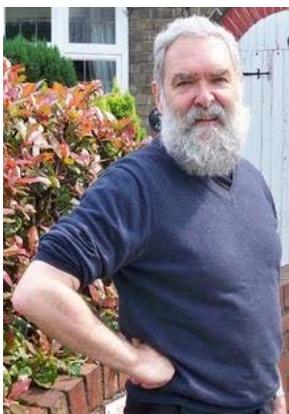
**Dinner** (including drinks): \$80 for Members and Associate Members, \$90 for Non-Members. Reservations must be made at least 2 days in advance

**Reservations:** <https://nsw-royalsoc.currinda.com/register/event/22>

Enquiries: [royalsoc@royalsoc.org.au](mailto:royalsoc@royalsoc.org.au) Phone: 9431 8691

**All are welcome.**

# From the President



I might have guessed, but my column from last month generated responses from those who felt sufficiently incensed to write in at my remarks concerning Senator Robert's lack of understanding of basic chemistry and physics. I passed contributions on to our climate change Fellows (Professors Pitman, England and Sherwood), not improving anyone's month, as by the end of an exchange of emails none of the protagonists seemed to have shifted their stance. The editor of the Bulletin has offered to publish short, civil pieces. and I await with interest to read more. My chemist's view (fossil fuels contain carbon which burns to CO<sub>2</sub>, humans have burnt a lot of fossil fuels since the 18<sup>th</sup> C, there is now more CO<sub>2</sub> in the atmosphere than in recent years, CO<sub>2</sub> has spectral and thermal properties that make it a 'greenhouse gas', so why are we surprised the Earth is warming?), was dismissed by one correspondent "The relevant issue is - how much warming." I take it that this is at least one step beyond Senator Roberts' views.

Meanwhile Vice President Hector has written to *New Scientist* of 21<sup>st</sup> September 2016 complaining about an article "Revealed: The renewable energy scam making global warming worse." His letter is reproduced in this Bulletin.

Back that morning from the USA, I attended the presentation of the Premier's Science Awards at Government House on Friday 17 October. The NSW Governor, our patron, His Excellency General The Honourable David Hurley AC DSC (Ret'd), mentioned the role of the Royal Society and gave a

plug for the upcoming Forum. An award of note was to Professor Mike Archer AM Dist FRSN for Excellence in Biological Sciences. The citation noted his leadership of the new field of Paleoconservation which uses knowledge of prehistory to develop practical strategies for conserving climate-change threatened species.

Another Distinguished Fellow to be internationally honoured for her pioneering research in quantum physics, UNSW Scientia Professor Michelle Simmons has been awarded a €100,000 international *L'Oréal-UNESCO For Women in Science Award*. Professor Simmons, Director of the ARC Centre of Excellence for Quantum Computation and Communication Technology, CQC2T, is one of five eminent female researchers from around the world named as 2017 [L'Oréal-UNESCO laureates in the Physical Sciences](#). She is the winner of the Asia-Pacific region, "for her pioneering contributions to quantum and atomic electronics, constructing atomic transistors *en route* to quantum computers".

Writing of Distinguished Fellows, I am pleased to announce that Dame Marie Bashir AD CVO Dist FRSN, will be presented with her Distinguished Fellowship at the start of the next OGM on November 2<sup>nd</sup>.

We now have eight speakers for the Forum, "Society as a complex system: Implications for Science, Practice and Policy", to be held on Tuesday 29 November: John Finnigan, Stephen Simpson FRSN, Brian Spies, John Williams, Paul Griffiths, Mikhail Prokopenko FRSN, Fazal Rizvi, and Joan Leach. Mary O'Kane FRSN will set the scene, there will be Q & A sessions and Len Fisher FRSN will be our Rapporteur. Details of registration will appear soon.

I apologise to those members and fellows who were not able to register for the Reception on Monday 28 November. We were strictly limited in numbers and I understand the registrations were full within a very short time of the web site opening. There is a waiting list, so you never know.

Brynn Hibbert FRSN

# Report of 20 October 2016 Meeting

## Royal Society – Southern Highlands Branch

**Speaker: Professor Gordian Fulde**

**Director of Emergency Medicine, St Vincent's Hospital, Darlinghurst**

**Topic: "Do We Have a Problem?"**



Professor Gordian Fulde is the longest serving Director of Emergency Medicine in Australia, holding the position at St Vincent's Hospital Darlinghurst since 1983. During this time, St Vincent's Emergency Department has grown to be one of Australia's largest and busiest, designated as a major trauma centre by the NSW Department of Health and responsible for an extensive program of emergency specialist training. Gordian is responsible for all aspects of administration and for a staff of over 200 members. In addition to this administrative role, he is actively involved in the care of patients who present to the Department. He is also Director at Sydney Hospital Emergency Department and Professor of Emergency Medicine at the University of New South Wales and Notre Dame University.

On 24 February 2014, the NSW Government introduced changes to liquor regulations in the central district of the City of Sydney, the so-called "party precinct". These legislative changes were enacted in response to community outrage after a series of adverse events reported in the media, particularly the deaths of two young men associated with alcohol-fuelled violence. St Vincent's Hospital, with its major emergency department in the heart of the area where the changes were instituted, was an ideal location for Gordian Fulde to base a study on any observed changes in violence after the introduction of the new legislation.

The main change introduced by law was that from 1:30 am to 3:30 am, hotels, registered clubs, nightclubs, and licensed karaoke bars were subject to "lock-outs", for which there was no entry for patrons nor re-entry for those who had exited during the lock-out period. Drinks could not be served after 3 am. Other changes meant that all takeaway alcohol sales had to cease at 10 pm and that there was to be no service of "shots" (alcoholic spirits) after midnight.

Professor Fulde's study covered a two-year period, with data being examined in the 12-month period before the legislation was introduced, and again in the 12-month period after the legislation. After the introduction of the regulatory changes, there was a

significant decrease in the number of seriously injured patients during the high-alcohol time from 6 pm Friday to 6 am Sunday. The number of presentations before the change was 10.4% of all presentations. After the change, the presentations of serious injuries resulting from alcohol misuse dropped to 7.8% of all presentations, a relative reduction of 24.8%. It was noted that there was a small increase in the number of patients presenting with alcohol-related injuries between 9 pm and midnight, possibly due to people "preloading" to compensate for the lesser amount of alcohol available later in the night. Overall, the improvement was observed throughout the week, but was especially marked at weekends.

The audience of 65 persons showed huge interest in the many statistics available from studies into the complex questions associated with alcohol consumption. In one study on the impact of alcohol on emergency services, it was found that drinking a single glass of wine doubled the risk of presentation to an emergency department; after three glasses, there was a 5-fold increase. The same study found that, after 10 standard drinks, the risk of needing to attend an emergency department was increased 10-fold for men and 14-fold for women.

Alcohol causes more than twice as many deaths as road accidents. It kills 15 Australians each day and 5554 each year. It also hospitalizes 430 Australians every day and 157,132 each year. Alcohol contributes to the 3 major causes of teen death: injury, homicide, and suicide. There is one encouraging statistic: the proportion of young people (12-17 years) choosing not to drink rose from 63.6% in 2010 to 73.3% in 2013.

Professor Gordian Fulde has dedicated the last 33 years of his life to his position as Director of St Vincent's Emergency Department. His two daughters have followed him into the same profession. In 2016 he was awarded the honor of Australian of the Year (Senior).

Anne Wood FRSN

# Professor Ann Williamson FRSN Recognised with Prestigious Australasian Road Safety Award



"Professor Williamson has contributed enormously to excellence in road safety research and to providing a strong evidence base for effective road safety interventions. Her dedication to developing and sharing road safety knowledge has been shown through her tireless efforts to work collaboratively in the field with various injury prevention and accident research centres and researchers who work in the field of road safety".

Professor Williamson was the founding Director of both the Injury Risk Management Research Centre and the Transport and Road Safety Research Centre. She is Australia's leading expert on driver fatigue and heavy vehicle safety.

Professor Williamson's personal commitment has seen her contribute her own time to various road safety and injury prevention committees and to State and Federal Parliamentary road safety inquiries. She regularly engages with media on a range of road safety topics as an independent expert voice to help reduce road trauma. Professor Williamson has also contributed greatly to the development of the field through teaching, including PhD supervision.

"It is an honour to be awarded the ACRS Fellowship and I look forward to continuing to support the great work of the College as we aim to halve road deaths and injuries by 2020," Professor Williamson said.

With the 2016 award, Professor Williamson joins an elite group of eminent road safety professionals who have all been bestowed the honour of an ACRS Fellowship. The College first instituted the award of Fellow in 1991 to enable colleagues to nominate a person recognised by their peers as outstanding in terms of their contributions to road safety.

Congratulations to leading road safety advocate, Professor Ann Williamson, Director, Transport and Road Safety (TARS) Research Centre at the University of New South Wales, who was recently presented with the prestigious 2016 Australasian College of Road Safety (ACRS) Fellowship at a glittering ACRS Award Ceremony at Australia's Parliament House. The ceremony took place in front of 550 of Australasia's foremost road safety professionals and advocates, and is deserved recognition of Professor Williamson's profound commitment to the reduction of road trauma.

The award was presented by Hon. Darren Chester, Federal Minister for Infrastructure and Transport, and ACRS President Mr Lauchlan McIntosh AM, during the 2016 Australasian Road Safety Conference (ARSC2016). In detailing the award, ACRS President Mr Lauchlan McIntosh AM said, "Professor Williamson continues to be an outstanding advocate for road safety both in our region and internationally.



**Prof E J Kehoe ... Continued from page 1**

Fortunately, over the past 25 years, rigorous experimental research on instructional design – much of it originating in New South Wales – has revealed a set of principles for improving the speed and consistency of individual learning. These principles are themselves founded in earlier research that defined the “cognitive architecture” of human memory.

This talk will describe human cognitive architecture and the key principles for instructional design, which include (a) recognise and optimise demands on short-term memory; (b) help learners to organise their long-term memories rather than rote memorise the material; (c) help learners to actively interact with the learning material; and (d) provide instructive feedback as well as knowledge of results. These principles have proved applicable in an adaptive way as learners gain proficiency.

Professor Kehoe came to the School of Psychology at the University of New South Wales (UNSW) in 1977 after completing his PhD in experimental psychology at the University of Iowa. Apart from sabbatical appointments, he has remained at UNSW, rising from Lecturer to Professor in 1994. Although now part-time, he continues as a member of the academic staff.

His research has concerned pure and applied research in learning and memory. His early career was devoted to the laboratory study of associative learning in animals and their neural mechanisms. He has also been a leader in the mathematical modeling of associative learning. Over the last two decades, he has increasingly turned his attention to applied research on learning and memory in humans in contexts ranging from frontline management to military populations to older adults. He is a project officer in the Australian Army, currently holding the rank of lieutenant colonel.

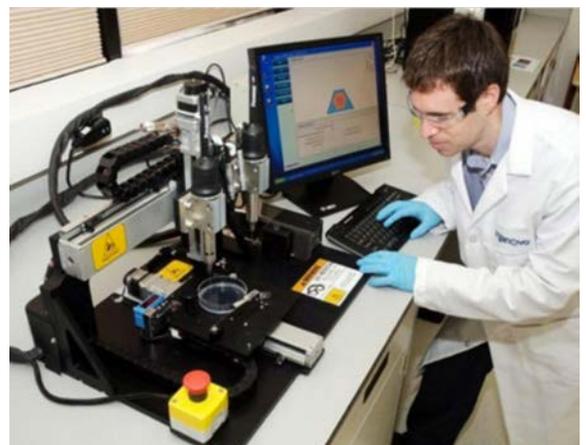
**Professor Gordon Wallace  
“3-D Printing of Body Parts”**

**17 November 2016  
Southern Highlands Branch Lecture**

As an additive fabrication tool, 3-D printing has provided a means to integrate highly active materials with structural supports and indeed with electronic materials. The electronic materials provide a communication pathway between wearable/implantable devices and monitors as well as controllers. Coupled with the fact that 3-D printing provides a means to personalise wearables or implants, this means we are witnessing an extraordinary impact on the field of medical bionics.

In the field of wearable devices, monitoring and/or controlling human movement or physiology provides benefits for sports training and rehabilitation. Here we will show how 3D printing has facilitated the development of a knee sleeve and the bionic bra.

In the field of implantable devices structural support in the form of wearable or implantable prosthetics can be personalised using 3-D printing. The inclusion of bioactive entities within the 3-D structure provides a means of facilitating regenerative processes to repair damaged tissue. In our work, we are in pursuit of 3-D printed implants to facilitate cartilage, nerve and muscle regeneration.





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



Academy of the Social Sciences in Australia



## The Royal Society of NSW and Four Academies Forum 2016

### Hosted by:

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

### **"Society as a Complex System: Implications for Science, Practice and Policy"**

**Date:** Tuesday 29 November, 9:00 am (8:30 registration) – 6:00 pm

**Venue:** Government House, Sydney

We live in an increasingly complex world, where the challenges of complexity must be taken seriously. The problems to be confronted challenge existing institutional structures because they cross national and interdisciplinary borders and cannot be reduced to component problems to be solved independently – they are intrinsically inseparable and interdependent. They include: the world's developed economies struggling to deliver the growth and prosperity that was achieved in the second half of the 20th century; increasing discrepancies between rich and poor sparking flight and fight; the impact of people on the environment in which they live; the pace of technological change. These "wicked problems" challenge traditional policy-making process leading to policy paralysis. Decisions about economic policy, migration and refugees, environmental challenges, health, education and infrastructure development are delayed or abandoned because of the difficulty in gaining public acceptance. Conflicting philosophical positions, widely differing worldviews and belief-systems, the increasing globalisation of firms and industries, the increased influence of special-interest groups made louder through new social media, the polarisation of political views, conflicting policy objectives coupled with an avalanche of data are among the many contributors to this policy paralysis. The complex systems nature of these challenges mean that small changes can have disproportionate effects, the future is impossible to predict, and multiple feedback loops multiply and accelerate in myriad ways.

How we can understand, cope, and adapt to these challenges is the focus the 2016 Royal Society of NSW and Four Academies Forum to be held at Government House, Sydney in November. Prof. Mary O'Kane, NSW's Chief Scientist and Engineer, and eminent speakers from learned societies will alternate with Q&A opportunities

For up-to-date information about attendance at the event, please go to:  
<<http://www.royalsoc.org.au/blog/2016-four-societies-forum>>.



# Australian Institute of Physics Postgraduate Awards Day

**2:00 pm – 7:35 pm, Tuesday, 15 November 2016**  
Room G64, Old Main Building, Kensington Campus  
University of New South Wales

The NSW branch of the Australian Institute of Physics will hold its annual Awards Day on Tuesday, 15 November, 2016 at UNSW. Each New South Wales university has been invited to nominate one student to compete for the prize and Postgraduate Medal on that day. The nominated students will each make a 20-minute presentation on their postgraduate research in physics. The presentations will be judged on the criteria of (1) content and scientific quality, (2) clarity, and (3) presentation skills.

These awards have been created to encourage excellence in postgraduate work, and all nominees who participate in the Postgraduate Awards Day will receive a special certificate recognising the nominee's high standing. The Royal Society of NSW will also award the Jak Kelly Scholarship prize as a separate award category for this event.

Members and guests who are unable to attend the presentations are invited to join us from 6 pm, for the Australian Institute of Physics NSW Branch AGM, also in Room G64 Old Main Building. The Australian Institute of Physics NSW AGM will be followed by a talk at 6:35 pm by Professor Iver Cairns from the University of Sydney on "Space Weather and Solar Radio Bursts." See also the next two pages for information about Prof. Cairns's talk and his biography.

Entrance is FREE to the awards competition and talk by Professor Iver Cairns. For more information, please contact Dr Fred Osman on [fosman@trinity.nsw.edu.au](mailto:fosman@trinity.nsw.edu.au) or 0418 444 477.

The Branch's Annual Dinner will be held at the Giovanna Restaurant, 285 Anzac Parade, Kingsford, 8:00 pm to 10:00 pm. Please RSVP to Dr Fred Osman on ([fosman@trinity.nsw.edu.au](mailto:fosman@trinity.nsw.edu.au)).

This event is proudly sponsored by the Australian Institute of Physics, The Royal Australian Chemical Institute and the Royal Society of New South Wales.



Joint Lecture Sponsored by

Australian Institute of Physics, The Royal  
Society of New South Wales & Royal Australian  
Chemical Institute

## ‘Space Weather and Solar Radio Bursts’

**Professor Iver Cairns**

**School of Physics, University of Sydney**

**6:35 pm Tuesday 15 November 2016**

**University of New South Wales, Room G64, Old Main  
Building, Kensington Campus**

### *Summary*

Solar activity produces coronal mass ejections (often abbreviated to CMEs), whose fast plasma and enhanced magnetic fields can impact Earth's magnetosphere, leading to space weather events that significantly affect Earth's space environment and human technology. The predicted consequences of large space weather events can be immense, at the \$1 trillion per year level for up to 10 years due to damage to national electricity grids. More generally, Australia's government, economy, and society are increasingly dependent on data and services provided by space assets, and so on Earth's space environment and space weather. Coronal mass ejections drive most large space weather events at Earth. They also produce type II solar radio bursts, first identified and studied in detail by Australians almost 70 years ago. These involve the fundamental physics of shocks, electron acceleration, plasma waves, and radio emission. This talk will first introduce the nature and importance of space weather and solar activity, as well as summarising some of the history and characteristics of type II bursts. It will then demonstrate a new theory and simulation capability, globally state-of-the-art that can accurately predict the evolution of coronal mass ejections from the Sun to the Earth and can explain the type II emission as well. This capability positions us to soon predict whether specific CMEs will reach the Earth, what their properties will be, and whether they will produce large space weather events.

*Continue to next page for biography of Prof. Cairns*

## *Brief Biography of Prof. Cairns*

Professor Cairns received his PhD from the University of Sydney (Australia) in 1987. He worked at the University of Iowa (1986-1998) before taking up a prestigious 5-year Senior Research Fellowship at the University of Sydney, one of only 20 awarded over all research fields. In 2004 he was awarded a similarly competitive Australian Professorial Fellowship and in 2009 was appointed Professor in Space Physics (Teaching & Research) at U. Sydney. Professor Cairns has over 240 refereed papers published or in press in books and journals, a Hirsch index of over 28, given over 3 plenary and 75 invited papers at international conferences, and obtained over US\$7 M in competitive funding (excluding spacecraft projects) from Australian and US funding agencies. He has great experience leading international and national scientific societies (e.g., AOGS, the International Association for Geomagnetism and Aeronomy [IAGA], and the Australian Institute of Physics' Solar Terrestrial and Space Physics [STSP] Group). He is Australia's national representative to both

the ICSU Committee on Space Research (COSPAR) and IAGA. Nationally Professor Cairns is the past Chair (2005-2011) of the Australian Academy of Science's National Committee for Space Science. As such he led the development of Australia's first Decadal Plan in space science, published by the Academy of Science in 2010. He also played a major role in the joint Academy's Strategic Plan for Earth Observation from Space, released in late 2009.



### *Detailed Schedule for Tuesday, 15<sup>th</sup> November 2016:*

- 5.30-6.00 pm **REFRESHMENTS, UNSW Room G64 Old Main Building**
- 6.35-7.35 pm **LECTURE by Professor Iver Cairns**
- 8.00 pm **ANNUAL DINNER with the Speaker at Giovanna Restaurant, 285 Anzac Parade, Kingsford. E-mail Dr Fred Osman ([fosman@trinity.nsw.edu.au](mailto:fosman@trinity.nsw.edu.au)) if you will be able to join us for dinner.**

### *Parking:*

UNSW, located in the eastern suburbs, is just minutes away from the city and is easily accessible from Central Station and other major transportation hubs located throughout Sydney. If driving, enter through Gate 14, Barker St. Park in multi-level parking station.

## Letter from Dr. Donald Hector FRSN sent to *New Scientist*

"In your article, "The great carbon scam", by Michael Le Page, the example "Why bioenergy can be bad" is poorly chosen. In virtually any environment, using coal for space-heating is a bad decision unless burnt in a well-designed, high-efficiency combustion unit – rare other than in big industrial burners – because of the combustion by-products, most notably hazardous particulate emissions. On the other hand, even small-scale, domestic wood-heaters can be designed to produce low emissions. More often, the decision is whether to burn wood or use coal-generated electricity.

Black coal (anthracite) has a calorific value of about 33,000 kJ per kilogram; lignite is much less, about 16,000. Dry wood has about the same calorific value as lignite. Burning lignite is a bad decision because in addition to the particulate emissions, much of the energy goes into driving off the water in the coal that then disappears up the chimney. If anthracite is used to generate electricity and that is used to provide space-heating, there are substantial inefficiencies that need to be considered.

Coal-fired power stations have an efficiency of about 33%. In round numbers, when transmission losses are taken into account, the available energy from a kilogram of anthracite is about 30% of its calorific value. So, if the electricity delivered to the premises is converted to heat with 100% efficiency – a reasonable assumption for radiative heating – only about 11,000 kJ are available from the 33,000 produced from burning the coal, compared to the

*Continued on page 11*

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### Letter to the Editor Fatal flaws in the climate models\*

It has been known for a long time that the climate computer models are inaccurate. But I doubt that many people understand just how unreliable they are. The simple fact is that vast amounts of time and effort have been wasted on climate models whose structure is so invalid that they can never work.

That may seem like a bold assertion, but the logic (see website link below) is straightforward and compelling: The climate models are upside-down. They attempt to operate bottom-up from weather to climate on timescales of multiple decades. This is completely impossible, as demonstrated by the inability of the much more accurate weather models to forecast weather more than a few days ahead.

A recent report by NCAR (The US National Center for Atmospheric Research) shows just

how useless the models are. In a model run where an initial state is changed by just a trillionth of a degree – ridiculously far below the accuracy to which the global temperature can be measured – the results change by several times as much as the entire 20<sup>th</sup> century global warming.

The really sad fact is that the modelers should have known, before they started to write their models, that it would be an exercise in futility. This was all explained by mathematician Edward Lorenz way back in 1963, in his famous *Chaos Theory* paper. Today's butterfly wing flap is a trillionth of a degree in a climate model.

<http://members.iinet.net.au/~jonasl@westnet.com.au/InsideTheClimateComputerModels.pdf>

Mike Jonas

*\* The views expressed here are those of the writer and do not necessarily represent those of the Royal Society of NSW or its members.*

*Hector, continued from p. 10*

16,000 available from burning a kilogram of dry wood. Clearly, wood-heating can be a viable option to reduce carbon emissions in some circumstances. Of course it is more complex than this simple analysis suggests – the wood has to be harvested from fast-growing species and the emissions accounting has to be rigorous. It also needs to be borne in mind that if the electricity comes from sources such as wind or photovoltaic, clearly the argument does not hold.

The problem is that "sound-bites" like "Why bioenergy is bad" are seized upon by climate-change-deniers to justify the burning of coal and thus we continue our descent into long-term environmental catastrophe."

Donald Hector FRSN  
Vice-President, Royal Society of NSW  
Sydney, Australia

## Schedule of RSNSW Events 2016

Date	Event	Speaker	Topic	Location
2-Nov-16	<b>1248th OGM: Jak Kelly Award</b>	Prof. E. James Kehoe	Horses for Courses: Advances in Instructional Design	Union, University & Schools Club
15-Nov-16	<b>AIP Postgraduate Awards Day</b>	Award Commendations	Australian Institute of Physics Annual Awards Day, 2 pm -7:30 pm	Room G64 Old Main Building, UNSW
29-Nov-16	<b>Second Society Forum</b>	Contributors from Learned Societies	Society as a Complex System	Government House
7-Dec-16	<b>1249th OGM: Jak Kelly Award</b>	TBA	TBA	Union, University & Schools Club

## Southern Highlands Branch - 2016

Date	Event	Speaker	Topic	Location
17-Nov-16	<b>Lecture</b>	Prof. Gordon Wallace	3D Printing of Body Parts	Chevalier College, Bowral

*Future lectures and other events will be scheduled, usually for the third Thursday in each month*

### Contacts for Your Officer Bearers and Council Members

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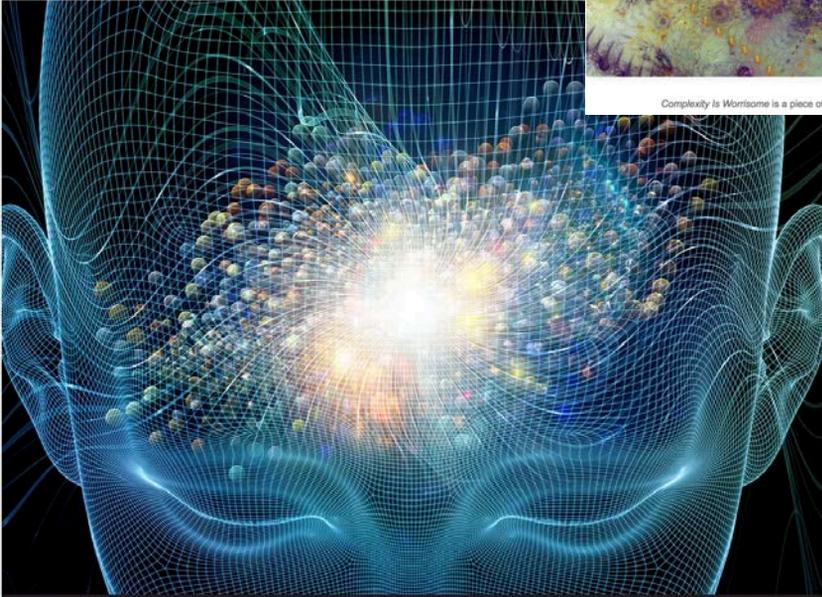
Mailing Address: The Royal Society of NSW, PO Box 576, Crows Nest NSW 1585, Australia

For further information: <http://www.royalsoc.org.au/>

# Images of Complexity

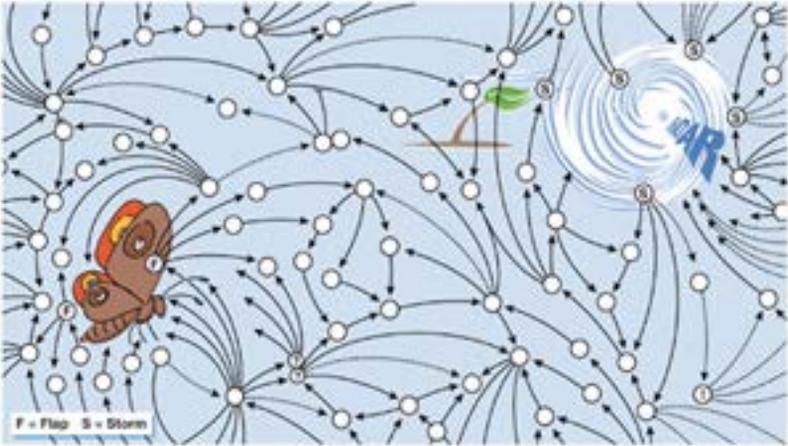


Complexity Is Worrisome is a piece of digital artwork by Casey Kotas which was uploaded on July 2nd, 2010.



John H. Miller posits that any large network of interacting pieces, whether an anthill or a nation, could perform the sort of work that we think of a brain as doing.

Image by agsandrew/Thinkstock



Complexity in biology: Exceeding the limits of reductionism and determinism using complexity theory Fulvio Mazzocchi (2008)