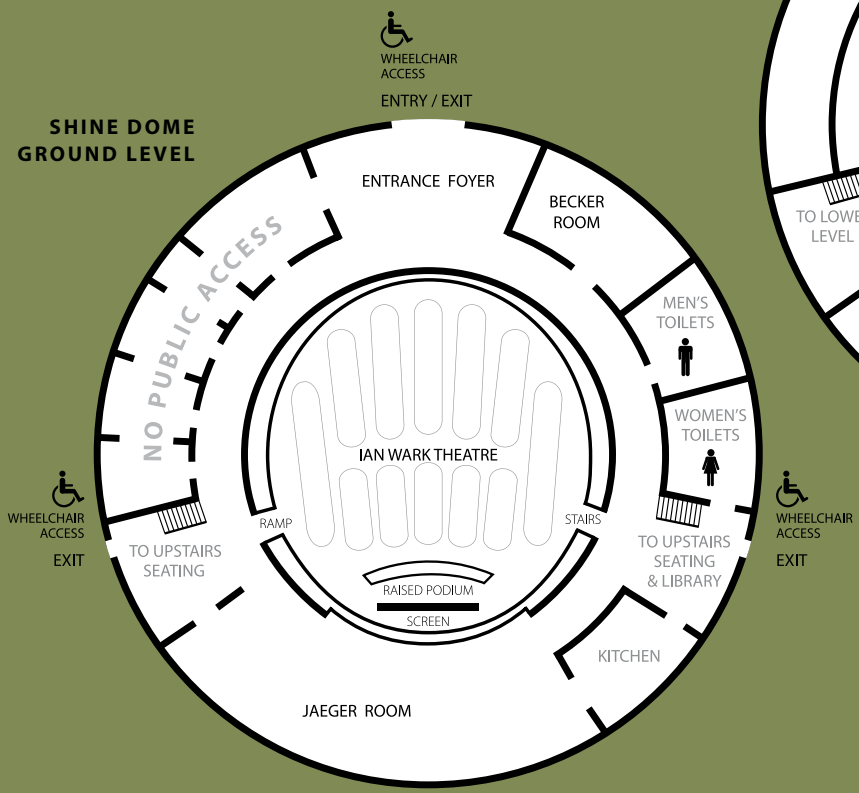
Australian Academy of Science

Life on the loose:
species invasion and control

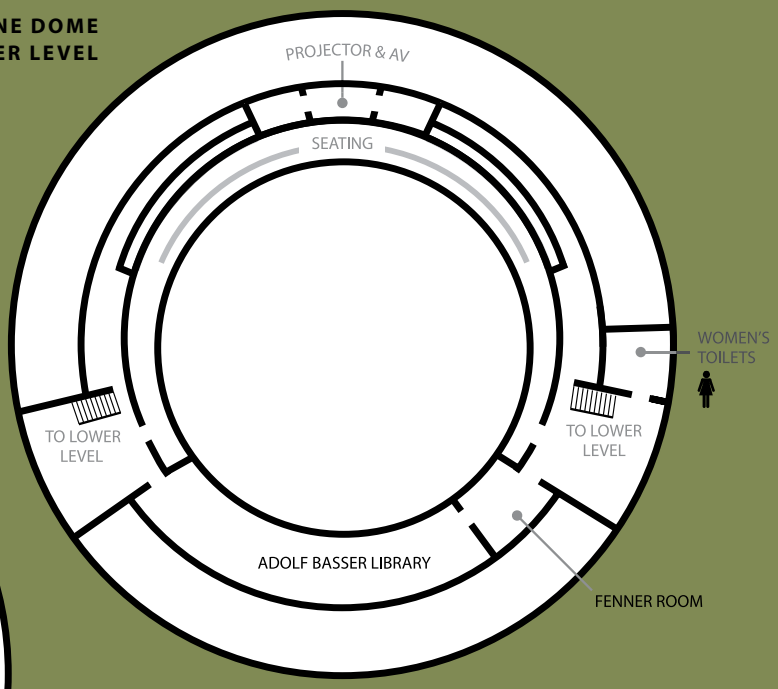
Science at the Shine Dome 2017

PROGRAM 23–25 MAY

SHINE DOME GROUND LEVEL



SHINE DOME UPPER LEVEL



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@Science_Academy
#ShineDome17
@ShineDome

HEALTH AND BIOSECURITY
www.csiro.au

Biosecurity

Ensuring Australia is protected from biological threats

B&M | 17-00156

President's welcome

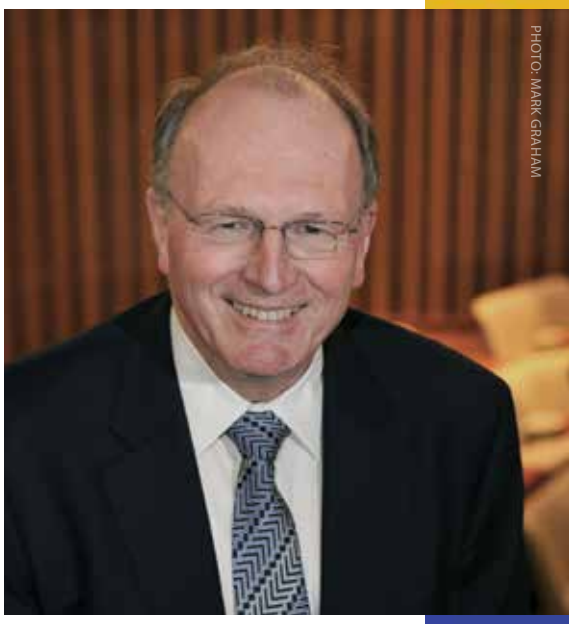


PHOTO: MARK GRAHAM

I am delighted to welcome Fellows of the Australian Academy of Science, members of Parliament, special guests, early- and mid- career researchers, policy makers, our generous sponsors and other friends of science to our flagship annual event, *Science at the Shine Dome*.

At this year's event our 'Life on the loose' symposium brings together a diverse set of players in the fight to understand, eradicate or control invasive species in Australia. There is so much we can learn from the giant ecological experiment taking place on our shores here in Australia in real time. The symposium features prominent researchers who will explore why and how species were introduced, the point at which they became invasive, the impacts they are having and the management controls being implemented.

Recently the Academy released a 'gene drive' discussion paper. Gene drive technology could allow scientists to wipe out, or at least better control, malaria-carrying mosquitoes, cane toads and other pests and plant diseases within much shorter time frames than current methods. However, as with any new technologies, there are also uncertainties and risks. The Academy plays a crucial role in stimulating dialogue about the potential of exciting new technologies, and informing policy discussions. *Science at the Shine Dome* is an important meeting of minds that assists the Academy to identify areas where our expertise and advice are needed and produce the appropriate information to aid decision making.

I offer my warmest congratulations to the new Fellows elected this year. Election to the Fellowship recognises their important contributions to advancing the sum of human knowledge. I look forward to inviting the 2017 Fellows to sign the charter book and to hearing them present their outstanding work.

During the awards ceremony, the Academy recognises a number of scientists for their extraordinary lifetime achievements, and for highly significant early- and mid-career attainments. I congratulate these recipients and wish them well.

The Academy is committed to nurturing the careers of young scientists and we warmly welcome the participation in *Science at the Shine Dome* of early- and mid-career researchers (EMCRs) from around Australia, 17 of whom have been supported to attend through the generosity of sponsors. The Academy supports the EMCR Forum that comprises more than 3000 Australian EMCRs, and is actively working to promote the interests of EMCRs.

Science at the Shine Dome also sees the involvement of young scientists who have been selected to participate in the annual meeting of Nobel Laureates in Lindau, Germany later this year. And for the first time we welcome two scientists from Indonesia and one from Papua New Guinea (PNG), who have been selected by the Indonesian Academy of Sciences and the Office of the Chief Scientist in PNG respectively because of their excellent work in the area of invasive species.

The Academy is proud of its efforts to support Australia's next generation of science leaders and to ensure they can work within a system free of the barriers currently faced by women and researchers from diverse backgrounds. With the Science in Australia Gender Equity, or SAGE, program, for example, we are working with most of Australia's higher education and research organisations to promote and retain women and researchers from diverse backgrounds. We strive to champion, celebrate and support science through our education programs, public events, international participation and involvement in public policy making. You are very welcome to find out more while you're here.

I am pleased you could join us for the 63rd annual *Science at the Shine Dome* and associated events of the Australian Academy of Science, and wish you all an enjoyable week.

Professor Andrew Holmes
AC PresAA FRS FTSE

Vice-Presidents' welcome

Professor Jim S Williams

Dr TJ Higgins

We are delighted that you able to join us in welcoming our new Fellows into the Academy, congratulating our award recipients and thanking our generous sponsors and donors to the Academy.

The role of Vice-Presidents (Secretary A and Secretary B) includes responsibility for the nomination and election process of new Fellows into the Academy, the Academy's awards, the AGM Agenda and the program for *Science at the Shine Dome*. We will be supporting the President, Professor Holmes, in his role as host of the various events throughout the week, so you will also be seeing a lot of us!

We hope that you take the opportunity this week to catch up with your colleagues, make some new friends and meet some of this country's outstanding early-and-mid career researchers who are with us this week. We also look forward to seeing Fellows at the AGM and to seeing all of you at the Academy's annual dinner to be held at the National Arboretum on Wednesday evening.

Professor Jim Williams AM FAA FTSE
Secretary Physical Sciences (A)

Dr TJ Higgins AO FAA FTSE
Secretary Biological Sciences (B)

Program

Tuesday 23 May

• AWARD PRESENTATION • NEW FELLOW PRESENTATIONS

9.00 am	**Welcome** **Professor Andrew Holmes AC PresAA FRS FTSE** President, Australian Academy of Science
9.05 am	**2017 Matthew Flinders Medal and Lecture** **Professor Barry Ninham AO FAA** Australian National University *The physical and biological sciences divide*
	New Fellow presentations
9.40 am	**Professor Igor Bray FAA** Curtin University *Atomic and molecular collisions: what are they and what are they good for?*
	Professor Ian Chubb AC FAA FTSE The Australian National University *A different path*
	Associate Professor Jane Elith FAA University of Melbourne *Species, distributions and models*
	Professor Simon Foote FAA FTSE The Australian National University *Peculiarities of the host response to malaria*
10.40 am	**Morning tea** EMCR group photo. EMCR awardees and Lindau participants group photos. Please meet in foyer
11.10 am	**Professor David Gardner FAA** University of Melbourne *Dynamics of embryo metabolism and its function beyond ATP synthesis*
	Professor Jozef Gécz FAA University of Adelaide *Sex and X-chromosome architecture of neurodevelopmental disability*
	Professor Karl Glazebrook FAA Swinburne University of Technology *Massive galaxies across cosmic time*
	Professor Justin Gooding FAA University of NSW *Transforming materials into new measurement devices using well-defined surface chemistry*
	Dr Anita Hill FAA FTSE CSIRO *The role of free volume in membranes for gas and vapour separations*
	Professor Philip Hugenholtz FAA University of Queensland *Exploration of microbial dark matter*
	Professor Cameron Jones FAA Monash University *Modern main group chemistry: from fundamental advances to functional molecules*
1.00 pm	**Lunch** New Fellows group and individual photos Please meet in foyer
2.00 pm	**Dr Anna Koltunow FAA** CSIRO *Fruits and seeds, with and without sex*
	Professor Evans Lagudah FAA CSIRO *Multiple pathogen resistance genes in crops*
	Professor Melissa Little FAA Murdoch Children's Research Institute *Rebuilding a kidney from stem cells: applications in regenerative and personalised medicine*
	Professor Jennifer Martin FAA Griffith University *The name's bond...disulfide bond*
	Professor Dietmar Müller FAA University of Sydney *Charting the evolution of Earth through deep time*
	Emeritus Professor John Patrick FAA University of Newcastle *Beyond photosynthesis: resource partitioning and crop yield*
3.30 pm	**Afternoon tea** New Fellow individual photos continue. Please meet in foyer
4.00 pm	**Professor Timothy Ralph FAA** University of Queensland *Optical quantum information*
	Professor Lois Salamonsen FAA Hudson Institute of Medical Research *Fertile ground: human endometrial remodelling in health and disease*
	Professor Mark Smyth FAA QIMR Berghofer Medical Research Institute *Immunotherapy—the fourth pillar of cancer treatment*
	Professor Nicholas Wormald FAA Monash University *Random networks: order and chaos*
5.00 pm	**Close**
6.30 pm–9.00 pm	**EMCR and Fellows BBQ reception** Jaeger Room, Shine Dome Participating early- and mid-career researchers are invited to a special BBQ reception at the Shine Dome. This is an informal opportunity to get to know one another, make connections and perhaps even meet a mentor; some Fellows of the Academy will attend.

Colour code New Fellows | Fellows | EMCRs/Lindau participants | Awardees | Symposium speakers

Wednesday 24 May

• AWARDS PRESENTATIONS • EARLY- AND MID-CAREER RESEARCHER WORKSHOPS
• ANNUAL GENERAL MEETING • ANNUAL BLACK TIE DINNER

9.00 am

President's Address

Professor Andrew Holmes AC PresAA FRS FTSE
President, Australian Academy of Science

9.30 am

Career Honorific Awards

2017 David Craig Medal

Professor David St Clair Black AO FAA
University of NSW
Molecular design and synthesis

2017 Hannan Medal

Dr Frank Robert de Hoog FTSE
CSIRO Data61
Simple mathematical and computational models for solving complex processes

2017 Jaeger Medal

Emeritus Professor Ross William Griffiths FAA
The Australian National University
The role of convection in global circulation of the oceans

2017 Thomas Ranken Lyle Medal FAA

Professor Joss Bland-Hawthorn FAA
University of Sydney
Cosmology in the near field

10.30 am

Morning tea

Awardees from morning session individual photos. Please meet in the foyer

11.00 am

Early- and mid-career Honorific Awards

Gustav Nossal Medal for Global Health

Professor Barend Marais
University of Sydney
The rise of drug-resistant tuberculosis and how children are affected by the global epidemic

Jacques Miller Medal for Experimental Biomedicine

Professor Jian Li
Monash University
Targeting bacterial 'superbugs': from bed to bench to bed

Nancy Millis Medal for Women in Science

Professor Kerrie Ann Wilson
University of Queensland
Conservation decision making in complex social-ecological systems

Anton Hales Medal

Associate Professor Juan Carlos Afonso
Macquarie University
Towards a grand unified theory of Earth's interior

Dorothy Hill Award

Dr Joanne Whittaker
University of Tasmania
The underwater landscape of ocean basins

12.00 pm

Short stretch break

12.10 pm

Fenner Medal

Professor Simon Ho
University of Sydney
The evolutionary timescale of the Tree of Life

Gottschalk Medal

Associate Professor Kathryn Elizabeth Holt
University of Melbourne
Microbial genomics and antimicrobial resistance

John Booker Medal

Distinguished Professor Dayong Jin
University of Technology, Sydney
Photon upconversion super dots lighting biomedical devices

Moran Medal

Associate Professor Joshua Ross
University of Adelaide
Characterising the epidemiology of pandemic influenza

Pawsey Medal

Associate Professor Igor Aharonovich
University of Technology, Sydney
Quantum emitters in flatland

Ruth Stephens Gani Medal

Associate Professor Sarah Medland
QIMR Berghofer Medical Research Institute
The genetic architecture of the human brain

Inaugural Max Day Environmental Science Fellowship Award

Recipients

Mr Nicholas Leseberg
University of Queensland

Dr Marta Yebra
The Australian National University

Highly commended

Dr Hugo Harrison
James Cook University

Dr Kerensa McElroy
CSIRO

Mr Max Worthington
Flinders University

1.30 pm

Lunch

Awardees group and individual photos. Please meet in foyer

2.30 pm–5.30 pm

Early- and mid-Career researcher workshops

Topic 1: Storytelling for researchers

Chaired by Patricia McMillan
Venue: University House

Colour code New Fellows Fellows EMCRs/Lindau participants Awardees Symposium speakers

Topic 2: How to pitch your research to the media
Chaired by Michael Hopkin
Venue: University House

Topic 3: Fostering partnerships with industry
Chaired by Distinguished Professor Dayong Jin and Associate Professor Drew Evans
Venue: Becker Room, Shine Dome

Topic 4: Perfecting grant writing
Chaired by Professor Stephen Buckman and Associate Professor Kathryn Holt
Venue: Ian Potter House

2.30 pm–5.00 pm **Annual General Meeting**
Closed sessions for Fellows of the Academy
Ian Wark Theatre

6.45 pm **Annual Gala Dinner**
Australian National Arboretum
Pre-dinner drinks: 6.45 pm
Dinner: 7.30 pm
Dress code: Black tie/cocktail

Dinner address
Representing the Hon Malcolm Turnbull MP Prime Minister of Australia,
Senator the Hon Arthur Sinodinos AO
Minister for Industry, Innovation and Science

Award presentation
Matthew Flinders Medal to
Professor Barry Ninham AO FAA

Thursday 25 May

• ANNUAL SYMPOSIUM: LIFE ON THE LOOSE

9.00 am **President's Address**
Professor Andrew Holmes AC PresAA FRS FTSE
President, Australian Academy of Science

9.10 am **Platinum sponsor welcome**
Dr Andy Sheppard
CSIRO

9.20 am **Session 1**

Chair **Professor Bob Pressey FAA**

Keynote speaker
Professor David Richardson
Stellenbosch University
A global historical perspective on invasion science

Dr Jane Catford
University of Southampton
Understanding the causes and consequences of plant invasions

10.50 am **Morning tea**

11.20 am **Session 2**

Chair **Associate Professor Jane Elith FAA**

Professor Rick Shine AM FAA
The University of Sydney
The impacts of and prospects for vertebrate invasions in Australian terrestrial ecosystems

Dr Beth Cookson
NAQS, Department of Agriculture and Water Resources
Biosecurity in the north—threats to human and animal health and their management

Professor Kerrie Wilson
University of Queensland
Invasive species and threatened species management

12.55 pm **Lunch**
Group photo of Symposium committee, chairs and speakers. Please meet in foyer

1.45 pm **Session 3**

Chair **Professor Mark Westoby FAA**

Professor Emma Johnston
University of NSW
Understanding and managing invasive marine species

Dr Aaron Dodd
University of Melbourne
Plant invasion in Australia and decision-theoretic approaches to their management

Associate Professor Phil Cassey
University of Adelaide
The ecological and conservation implications of biological invasions

3.20 pm **Closing remarks**
Professor Mark Westoby FAA

3.30 pm **End**

3.45 pm Coaches to the airport, departing from the front of the Shine Dome

Colour code New Fellows | Fellows | EMCRs/Lindau participants | Awardees | Symposium speakers

New Fellow presentations

Professor Igor Bray FAA

Professor Igor Bray received his PhD, entitled 'Gravitational lens effect of galaxies and black holes' from the Department of Mathematical Physics at the University of Adelaide in 1986. He then moved to Flinders University where he co-developed the convergent close-coupling theory for solving few-body collision problems in atomic and molecular physics. He moved to Murdoch University in 2001 and then to Curtin University in 2007. He has been awarded the Walter Boas, Pawsey and David Syme medals, won five ARC Fellowships, and published around 450 peer-reviewed publications attracting more than 10,000 citations.

Atomic and molecular collisions: what are they and what are they good for?

Atomic and molecular collisions go on all around us and inside us. All chemical reactions are examples of such collisions. Consequently, there is no shortage of applications that benefit from their quantitative understanding. However, until recently they have been particularly difficult to calculate. Professor Bray will explain how, with the development of the convergent close-coupling theory, many previously unsolved problems can now be routinely calculated to the desired level of precision. Applications include generating abundant clean energy via nuclear fusion with seawater as fuel, creating neutral antimatter, and progressing cancer imaging and therapy.

Professor Ian Chubb AC FAA FTSE

Professor Ian Chubb was Australia's Chief Scientist from 2011 to 2016. He was Vice-Chancellor of the Australian National University (2001–2011); Vice-Chancellor of Flinders University of South Australia for six years and the Senior Deputy Vice-Chancellor of Monash University for two years. He was the Deputy Vice-Chancellor of the University of Wollongong and Honorary Professor of Biology (1986–1990). Professor Chubb was Chair of the Commonwealth's Higher Education Council (1990–1994) and Deputy Chair of the National Board of Employment, Education and Training. He has been awarded six honorary doctorates and was elected a Fellow of the Australian College of Education in 2008 and a Fellow of the Australian Academy of Technology and Engineering and Fellow of the Royal Society of New South Wales in 2014.

A different path

As Professor Chubb got older he was regularly asked an apparently simple question: how do you get a job like yours? Whether it was as a Vice-Chancellor or as Chief Scientist, people wanted to know. Professor Chubb will describe the influences on his life, from living on a farm as a child, surrounded and intrigued by nature, to his first teacher who was the most influential one he ever had. He has been forever curious—initially about the natural world and later about people, systems, institutions and politics—and always challenged himself to do more or do better. He's had opportunities, excellent and caring mentors, great colleagues and a supportive family. Without any of them, little of it would have happened, and he is grateful to them all.

Associate Professor Jane Elith FAA

PHOTO: ALEX ELITH

Associate Professor Jane Elith is Associate Professor in Biodiversity Modelling at the University of Melbourne. First trained in agricultural science in the 1970s, she completed her PhD in 2003 in quantitative ecology in the School of Botany, University of Melbourne. Professor Elith has achieved international distinction for her research, as evidenced by international awards and citation rates of her publications that place her among the world leaders in the fields of environment and ecology. Elith was named a Thomson Reuters highly-cited researcher in 2014, 2015 and 2016, placing her in the top 1% of scholars internationally. In 2016, she was awarded the Fenner Medal from the Australian Academy of Science and the Australian Ecology Research Award from the Ecological Society of Australia. In 2015, she received the Prime Minister's Frank Fenner Prize for Life Scientist of the Year.

Species, distributions and models

Knowledge about where plants, animals and diseases occur is limited by available data for the vast majority of species. Yet understanding species distributions is critical when managing threatened species, controlling threatening processes, predicting changes in distribution, and managing landscapes and biological invasions. Species distribution models, statistical models that describe relationships between the occurrence and abundance of species and the environment, have become fundamental to these predictions. Associate Professor Jane Elith will talk about the models, their application, and challenges and progress in using these with typically available data.

Professor Simon Foote FAA FTSE

(Elected 2016)

Professor Simon Foote is a molecular geneticist. He is Director of the John Curtin School of Medical Research at the Australian National University. He has been Dean of the School of Medicine at Macquarie University, Director of the Menzies Research Institute at the University of Tasmania and Divisional Head at the Walter and Eliza Hall Institute, Melbourne. He was a postdoctoral fellow at the Whitehead Institute at the Massachusetts Institute of Technology. Professor Foote has a medical degree and PhD from Melbourne University and a DSc from the University of Tasmania. He is a Fellow of the Australian Academy of Science, the Australian Academy of Technology and Engineering and the Australian Academy of Health and Medical Sciences. Professor Foote is interested in the genetic control of susceptibility to disease, with particular focus on infectious disease. His laboratory has identified loci governing the response to leishmaniasis and malaria. However the major focus of the laboratory is on identifying new drugs to combat malaria. His laboratory has found genes, that when mutated, prevent growth of malarial parasites. These genetic changes point the way to the creation of a new type of treatment that will be steadfast against the development of drug resistance. His laboratory is also interested in the genetic susceptibility to other diseases of humans. He is currently working on investigating the reasons that renal disease is so common in Aboriginal communities and in the genetic changes that underpin the familial nature of some of the common cancers.

Peculiarities of the host response to malaria

The human genome initiative began in the late 1980s with funding from the NCHR to map whole chromosomes. Under this scheme the human Y chromosome was the first human chromosome to be physically mapped. This was followed by the generation of a physical map of the human genome that allowed the consequent shot-gun sequencing of the entire human genome. Upon Professor Foote's return to Australia he began mapping the host response to infectious disease and identified dozens of loci contributing to outcome in the Red Queen's game of resistance to parasitic infection. More recently his group has worked on the role played by the platelet in controlling the early rise of parasitaemia in malaria, and has also run an ENU mutagenesis screen to identify genes important in the response to malarial infections. Professor Foote will present some of these.

Professor David Gardner FAA

Professor David Gardner graduated in biological sciences from the University of York, UK, then undertook postgraduate training in embryology and biochemistry. After receiving his DPhil he became a Fellow of Cellular and Molecular Physiology at Harvard Medical School. He then moved to the

Centre for Early Human Development, Monash Medical Centre in 1989, where he worked on methods for the successful culture and diagnosis of human embryos conceived through IVF. In 1997 he moved back to the USA as Scientific Director of the Colorado Centre for Reproductive Medicine in Denver. His work on human embryo culture conditions revolutionised how human IVF is performed today and has resulted in a doubling of success rates worldwide. His research on human embryo development also paved the way for the generation of the world's first human embryonic stem cells. In 2007 he returned to Australia as Chair of Zoology at the University of Melbourne, and in 2008 became Head of the Department of Zoology until 2014. In 2015 he took a position as a Research Professor in the newly formed School of BioSciences. Professor Gardner has trained dozens of graduate students and Research Fellows, and has published more than 250 scientific papers and chapters. He has published 15 books on embryology and human IVF, and his textbook on assisted human conception is the definitive text in the field of human IVF.

Dynamics of embryo metabolism and its function beyond ATP synthesis

Analysis of metabolic functions of the embryo during the first week of life has revealed key information relevant not only to developmental biology, but also for other cell types from stem cells to cancers. From fertilisation to implantation, the mammalian embryo undergoes complete metabolic remodeling, from the quiescent fertilised oocyte, which can only use pyruvate, to one of the most active tissues in the body the blastocyst, which utilises glucose both oxidatively and through aerobic glycolysis. Understanding these stage-specific metabolic requirements and the regulation of metabolic activity has not only facilitated the development of more suitable culture conditions for human IVF, thereby significantly increasing the success rate, but also provided promising biomarkers for embryo selection. Further, the lactate produced by the blastocyst through aerobic glycolysis creates a microenvironment at implantation to regulate the key events of tissue modulation, angiogenesis and immunomodulation of the maternal endometrium. It appears that cancers have adopted the metabolic phenotype of the blastocyst in order to achieve their goals of tissue invasion. Evidently metabolism has several functions beyond the synthesis of ATP during the initial phases of life.

Professor Jozef Gécz FAA

Professor Jozef Gécz is an NHMRC Senior Principal Research Fellow and Professor of Human Genetics at the Adelaide Medical School, the University of Adelaide. In 2016 he was appointed to the Inaugural Channel 7 Children's Research Foundation Chair for the Prevention of Childhood Disability. His career spans 30 years of international research in human genetics and molecular biology of childhood onset neurological disorders. He discovered or contributed to the discovery of more than 100 genes for various forms of neurodevelopmental disabilities. Professor Gécz communicated his research through more than 260 peer-reviewed publications and many key national and international meetings. The Neurogenetics Research Program he established in 2000 at the Adelaide Women's and Children's Hospital focuses on gene identification and functional, cellular and molecular modelling of intellectual disabilities, epilepsies, autisms and cerebral palsies for better understanding, management and eventual treatment of these conditions.

Sex and X-chromosome architecture of neurodevelopmental disability

More than 3% of the world populations suffer from disorders of the development of the central nervous system, so called neurodevelopmental disabilities (NDDs). Among these are some of the most genetically heterogeneous and clinically variable groups of disorders such as intellectual disabilities, epilepsies, autisms and cerebral palsies, and more males than females are affected. The completion of the reference Human Genome in 2001 had a transforming impact and opened new era in human disease genomics. Professor Gécz will describe his work in NDD and the many surprising findings that have been made. Ongoing research is helping to explain why females are generally more robust to tolerate genetic mutation than males. While finding the causes of NDDs has been an amazing journey, finding a treatment for any of these is his ultimate goal.

Professor Karl Glazebrook FAA

Professor Karl Glazebrook is a Distinguished Professor at the Swinburne University of Technology. His career has spanned the UK, USA and Australia including professorships at Johns Hopkins University and

Swinburne and the award of a Packard Fellowship. His most notable scientific accomplishments are the development of the nod and shuffle spectroscopic technique, characterising the bimodal colour and environmental distributions of local galaxies, the study of the morphological and spectroscopic evolution of galaxies at high-redshift using Gemini, Hubble and Keck telescopes, and the development of innovative cosmological techniques such as baryonic acoustic oscillations. Professor Glazebrook is an ISI highly cited researcher and has won the Muhlmann Award for his work on instrumentation. He is Chair of the International Facilities Working Group of the Australian Astronomy Decadal Plan 2016–25 and a member of the Australian Research Council College of Experts.

Massive galaxies across cosmic time

In the universe we are surrounded by galaxies which are much more massive and older than the Milky Way. In our hierarchical model of galaxy formation, massive galaxies are built up gradually across cosmic time, and we can observe this process with large telescopes. Professor Glazebrook will explain that as we peer across space to the distant/early universe, massive galaxies become much rarer. At the very earliest times—a billion years after the big bang—we still observe galaxies more massive than the Milky Way. Such observations are extremely challenging but actually find a higher abundance than predicted raising interesting challenges to our standard picture of galaxy formation.

Professor Justin Gooding FAA

(Elected 2016)

Scientia Professor Justin Gooding is an ARC Australian Laureate Fellow, the co-director of the Australian Centre for NanoMedicine and the co-director of the New South Wales Smart Sensing Network. He became a Fellow of the Australian Academy of Science and of the International Society of Electrochemistry in 2016. He is also editor-in-chief of ACS Sensors. He graduated in science from Melbourne University before obtaining a DPhil from the University of Oxford and received post-doctoral training at the Institute of Biotechnology in Cambridge University. He returned to Australia in 1997 as a Vice-Chancellor's Post-Doctoral Research Fellow at UNSW, where he became a professor in 2006. Awards include the NSW Young Tall Poppy award, RACI Lloyd Smythe Medal for Analytical Chemistry, Eureka Prize for Scientific Research, RACI HG Smith Medal for contributions to chemistry, RACI RH Stokes Medal for electrochemical research, NSW Science and Engineering Award for Emerging Research, Faraday Medal of the Royal Society of Chemistry Electrochemistry Division, Biosensors and Bioelectronics Award, and a Walter Burfitt Prize for Science and Archibald Liversidge Medal for Chemistry. He has also received an Alexander von Humboldt Fellowship and been an ARC Australian Professorial Fellow and Royal Society of Chemistry Australasian Lecturer. Professor Gooding's team is researching surface modification and nanotechnology for biosensors, biomaterials, electron transfer and medical applications.

Transforming materials into new measurement devices using well-defined surface chemistry

Self-assembled monolayers are a single molecule thick layer on a surface that can transform how that material interacts with its environment without affecting the bulk properties of the material. With the ability to incorporate multiple different molecular species into the monolayers, molecular level control over the modification of a surface can be obtained. By exploiting that molecular level control either better performing or completely new measurement tools can be developed for both fundamental and applied research. Professor Gooding will cover the types of chemical systems that can be used and the level of spatial control that can be achieved. He will describe the applications of such well-defined surface chemistry and how this can take us from measurement of many molecules to obtain a single measurement to being able to detect single molecules and single cells. It is expected such approaches will give us the next generation of sensors operated by molecular counting.

Dr Anita Hill FAA FTSE

PHOTO: NICK PITSAS

Dr Anita Hill is the Executive Director of Future Industries at CSIRO and she also serves as Chief Scientist for CSIRO.

She has held many senior roles in CSIRO including acting Chief Executive. She is a Fellow of the Australian Academy of Technology and Engineering and former Chair of the Victorian Division. She is a member of several advisory boards and is a former member of advisory boards for the Victorian Centre for Sustainable Chemical Manufacturing, the Australian eHealth Research Centre, the National Centre of Excellence in Desalination Australia, and the Institute for Frontier Materials at Deakin University. Dr Hill's research is in materials and process engineering and, more specifically, in transport of atoms, ions and small molecules in condensed matter. She has a Bachelor of Engineering and a Doctor of Philosophy in Mechanical Engineering and Materials Science from Duke University, USA.

The role of free volume in membranes for gas and vapour separations

Membranes are becoming the technology of choice for gas and vapour separations because they are cost-effective, have a small footprint, and are simple to operate and maintain. Ideally, membranes should exhibit high selectivity (product purity) and high permeability (productivity). For most membranes, however, as selectivity increases, permeability decreases, and vice versa, creating a performance trade-off. Professor Hill will discuss the role of free volume in the trade-off between high permeability and high permeability selectivity of membranes. Diffusivity and permeability, and therefore permeability selectivity can be predicted using a free volume model. Membranes with tailored free volume architectures are shown to be able to overcome the performance trade-off. She will compare theory and experiment for polymers and other membrane materials, and suggest avenues for further research exploration.

Professor Philip Hugenholtz FAA

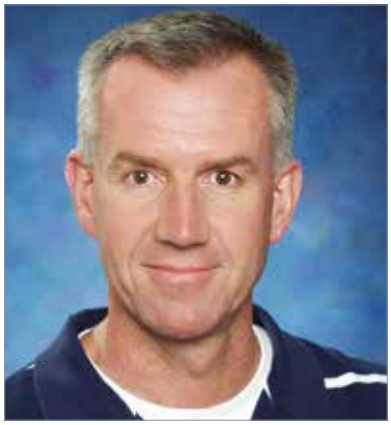
PHOTO: ANJANETTE WEBB

Professor Phil Hugenholtz is at the University of Queensland and has worked in microbiology and genomics in the USA and Australia. In the USA he was a Staff Scientist from 2004 to 2010 at the DOE Joint Genome Institute. He returned to Australia to establish the Australian Centre for Ecogenomics, now comprising over 50 research and support staff. The centre conducts culture-independent, sequence-based research across a wide range of environmental, engineered and clinical ecosystems underpinned by a genome-based evolutionary framework. Professor Hugenholtz received the Young Investigators Award from the International Society of Microbial Ecology and was elected as a Fellow of the American Academy of Microbiology in 2012. He is a Fellow of the Australian Academy of Health and Medical Sciences and was awarded an ARC Laureate Fellowship to systematically organise the rapidly expanding microbial genome database into a phylogenetic framework.

Exploration of microbial dark matter

Despite decades of concerted microbiological endeavour, the great majority of microorganisms have not been cultured and characterised. Professor Hugenholtz will explain how this 'microbial dark matter' is now being revealed by sequence-based culture independent methods. In the past few years, thousands of near complete genomes of uncultured microbes have been assembled from sequence data obtained directly from environmental and clinical sources providing the opportunity to fully articulate microbial diversity for the first time. Current estimates suggest that cultured microorganisms only capture around 15% of total microbial diversity based on evolutionary divergence of marker genes. Professor Hugenholtz will give examples of evolutionary and ecological insights from this rapidly expanding genomic database.

Professor Cameron Jones FAA



Professor Cameron Jones worked as a Research Officer at the University Department of Surgery, Royal Perth Hospital after graduating in science from the University of Western Australia. He obtained his PhD from Griffith University for work on Group 13 metal hydrides, and was a postdoctoral fellow at Sussex University. He held a lectureship at the University of Wales before becoming Reader in Inorganic Chemistry at Cardiff University. There, he held a Personal Chair in Inorganic Chemistry. At Cardiff he founded and co-directed The Centre for Fundamental and Applied Main Group Chemistry. In 2007 Professor Jones moved to Monash University as an ARC Australian Professorial Fellow and Professor of Chemistry. He is currently the RL Martin Distinguished Professor of Chemistry at Monash and the Director of the Monash Centre for Catalysis (MonCat), which he co-founded in 2015.

Modern main group chemistry: from fundamental advances to functional molecules

The explosion of activity that has occurred in main group chemistry over the past two decades has stemmed from the realisation that compounds containing main group elements in very low oxidation states are capable of existence under ambient conditions. This renaissance in the field has led to numerous fundamental breakthroughs, many of which have significantly altered our perception of chemical structure, bonding and reactivity. However, more than being just chemical curiosities, the high reactivity of low oxidation state main group compounds has recently resulted in them finding an expanding array of applications, especially in chemical transformations normally only achievable with the platinum group metals. It is clear from this work that cheap and essentially non-toxic main group compounds hold significant potential for the replacement of expensive and toxic transition metal systems in many areas of synthesis and catalysis that are important to both academia and industry. Achieving this goal is a major current challenge for main group chemists. Professor Jones will summarise contributions to this field over the last decade.

Dr Anna Koltunow FAA

(Elected 2016)

Dr Anna Koltunow is a leading researcher in the field of plant reproduction. Using a multidisciplinary approach in model plants and in crops, her findings have advanced our understanding of pathways involved in sexual and asexual seed and fruit formation. She has uncovered mechanisms leading to seedless fruit formation and shown they can be applied in crops. She has developed and used a non-agronomic model plant to study asexual seed formation enabling identification of the similarities and differences in the mechanisms controlling asexual and sexual seed formation. Her current work in asexual seed formation aims to preserve hybrid vigour in seed crops so high yielding hybrid seed can be saved and economically sown in the next growing season by smallholder farmers in developing countries. A graduate of the University of Adelaide, with postdoctoral work at UCLA, she joined CSIRO as an ARC Fellow to focus on seed and fruit formation working with a number of laboratories in the USA, Europe, China, India and Brazil in multiparty projects. A past president of the International Plant Reproduction Society, she holds affiliate professorships at the University of Adelaide and La Trobe University, has served terms as Deputy Chief of Plant Industry at CSIRO and has supported science in the wider research community through work on the ARC college of experts, directorships on various CRC research boards and New Zealand Crown Research Institutes.

Fruits and seeds, with and without sex

Fruits and seeds which are critical to human food supply are usually the outcome of sexual reproduction in plants. This involves gamete development via meiosis in male and female floral organs. Fertilisation then stimulates the coordinate development of seeds and also the fruits facilitating seed dispersal. Molecular events leading to fruit and seed formation can be uncoupled from fertilisation so that seedless fruits form. Remarkably, seeds and fruits can form asexually without meiotic gamete formation and fertilisation, and the resulting seeds are genetically identical. Dr Koltunow will describe how discoveries in pathways involved in sexual and asexual seed and fruit formation have been used to generate seedless fruits, and are being used to develop crops with transformational productivity improvements in developing countries.

Professor Evans Lagudah FAA

Professor Evans Lagudah is a Chief Research Scientist at CSIRO. He received his BSc from the University of Ghana and PhD from The University of Melbourne. He is also an adjunct professor at the University of Sydney with the School of Life and Environmental Sciences. Professor Lagudah leads a team covering basic studies on the molecular basis of race non-specific resistance, adult plant rust resistance, cloning of wheat resistance genes, genomic analyses of targeted disease resistance traits and the identification and utilisation of molecular markers for disease resistance breeding. He defined the molecular basis of adult plant rust resistance genes which represent novel classes of plant defence genes that function broadly in cereal crops against multiple pathogens. He also led the team that isolated one of the first genes that confer resistance against the highly virulent Ug99 stem rust pathogen. In addition, he has contributed to advances in mutational genomics for the rapid isolation of resistance genes from complex genomes. Professor Lagudah operates at the interface between agriculture and fundamental molecular research. His research

ensures the rapid translation of new molecular discoveries into practical agriculture in the global grains industry. He is a co-recipient of the Borlaug Gene Stewardship award.

Multiple pathogen resistance genes in crops

The search for and deployment of pathogen resistance genes has been an integral part of improvement programs in most crop species for more than a century. Most resistance genes encode plant immune receptors, and their introduction and utility from crop gene pools and sexually compatible wild relatives have seen great advances as well as spectacular breakdowns in curbing crop losses caused by mutations in virulence gene products from a wide range of pathogens. Professor Lagudah will explain how certain forms of plant defense genes provide more durable resistance. Transgenic studies with certain wheat multi-pathogen resistance genes have shown that they function in other crop species—the world's top five cereals—in conferring resistance to diverse pathogen species that are un-adapted to wheat. Combining multi-pathogen resistance genes with different plant immune receptor genes provide sustainable solutions towards achieving more durable disease resistance; a desirable component in addressing global food security.

Professor Melissa Little FAA

Professor Melissa Little is the Theme Director of Cell Biology at the Murdoch Childrens Research Institute in Melbourne. An NHMRC Senior Principal Research Fellow at MCRI, she is also Program Leader of Stem Cells Australia and Professor, Faculty of Medicine, Dentistry and Health Sciences, University of Melbourne. Professor Little is also President of the Australasian Society for Stem Cell Research. She is internationally recognised for her work on the systems biology of kidney development. This fundamental research has underpinned her pioneering studies into potential regenerative therapies for kidney disease. As a result, her team developed approaches for directing the differentiation of human pluripotent stem cells to human kidney organoids. Her group is applying this knowledge to disease modelling, drug screening, cell therapy and tissue engineering. Professor Little is a Fellow of the Australian Academy of Health and Medical Sciences. Her work has been recognised by many awards, including the GlaxoSmithKline Award for Research Excellence, the AAS Gottschalk Medal in Medical Sciences, an Eisenhower Fellowship, the ANZSCDB Presidents Medal, a Boerhaave Professorship, Leiden University and the UNSW Eureka Prize.

Rebuilding a kidney from stem cells: applications in regenerative and personalised medicine

Having a detailed understanding of how your organ of interest develops at the level of the gene, cell and tissue is critical for both accurate modelling of disease and advances in regenerative medicine. This has been recently highlighted by advances in the directed differentiation of human pluripotent stem cells to a variety of cell and tissue types, including the formation in vitro of complex multicellular organoids representing accurate models of the developing brain and intestine. Based on understanding of kidney morphogenesis in the mouse, Professor Little's group has developed a stepwise differentiation protocol that allows the formation of kidney organoids from human pluripotent stem cells. These models of a developing human kidney contain all of the progenitor populations present in the fetal kidney, including collecting ducts, nephrons, stroma and blood vessels. Professor Little will discuss how the capacity to generate models of the human kidney provides many opportunities, including nephrotoxicity screening, functional genomics, cellular therapies and bioengineering of replacement organs.

Professor Jennifer Martin FAA

Professor Jennifer Martin is the Director of the Griffith Institute for Drug Discovery (GRIDD) at Griffith University. She is a pharmacist, and was awarded the Gold Medal of her year. She subsequently did research degrees in computational chemistry and protein crystallography (MPharm VCP, DPhil Oxon) and was a postdoctoral fellow at Rockefeller University. In 1993 she returned to Australia to set up the first protein crystallography lab in Queensland at the University of Queensland. In 2016 she was appointed GRIDD Director. Professor Martin has held several nationally competitive Fellowships during her career including an inaugural ARC Australian Laureate Fellowship. She is the recipient of many awards including the ASBMB Roche Medal, the Queensland Smart Women Smart State Research Scientist Award, the Women in Biotechnology Outstanding Achievement Award and the Wunderly medal of the Thoracic Society of Australia and New Zealand. She is the President of the

Asian Crystallographic Association, a former president of the Society of Crystallographers in Australia and New Zealand, and a former chair of the National Committee for Crystallography of the Australian Academy of Science.

The name's bond... disulfide bond

Disulfide bonds between sulfurs of cysteine residues are critical for the folding and function of many secreted proteins. Bacteria have evolved a unique set of enzymes that catalyse the introduction, proof-reading and editing of protein disulfides. Professor Martin will describe how this set of disulfide bond (DSB) enzymes may prove to be a key vulnerability that can be exploited to overcome antibiotic resistance.

Professor Dietmar Müller FAA

Professor Dietmar Müller received his undergraduate degree from the Christian-Albrechts University in Kiel, Germany and his PhD in Earth Science from the Scripps Institution of Oceanography in La Jolla, California. After joining the University of Sydney he started building the EarthByte e-research group. The EarthByters are pursuing open innovation, involving the collaborative development of open-source software as well as global digital data sets made available under a creative commons license. One of the fundamental aims of the EarthByte Group is geodata synthesis through space and time, assimilating the wealth of disparate geological and geophysical data into a four-dimensional Earth model that links the deep Earth to surface processes and environmental change.

Charting the evolution of Earth through deep time

The EarthByte Group leads an international research effort to develop a Virtual Earth Laboratory to 'see' deep into Earth in four dimensions (space and time). This laboratory produces interactive, open-access models and visualisations of Earth's dynamic history, particularly the last 200 million years. Professor Müller will describe how the group's work has led to numerous discoveries that have transformed our fundamental understanding of Australia's and Earth's evolution and surface environments, in particular ocean basins, continental movement and mountain formation. He will show how new machine-learning methodologies for reconstructing deep Earth resources to their original geological environments enabled advances in understanding the dynamic processes that lead to mineral deposits. Applications include the creation of prospectivity maps for iron ore in Western Australia, precious opal in the Great Artesian Basin, and the delineation of porphyry-gold deposits along the Pacific rim.

Emeritus Professor John Patrick FAA

Emeritus Professor John Patrick graduated in agricultural science from Sydney University in 1966. He completed a PhD in plant physiology at Macquarie University. Postdoctoral experience in plant development (1970–1972) was gained by joining the research group led by Professor Phillip Wareing FRS at the University College of Wales, Aberystwyth. In 1973, Emeritus Professor Patrick returned to Australia to take up a lectureship in the newly established Department of Biological Sciences at the University of Newcastle, where he has remained throughout his career. Since retiring in 2007, he has continued to pursue an active research program with his long-term collaborator, Professor Christina Offler.

Beyond photosynthesis: resource partitioning and crop yield

Current analyses of crop yield show that the beneficial impact of dwarfing genes, introduced into grain crops during the 1960s, appears to have plateaued. Can resource transport and partitioning offer opportunities to secure further gains in crop yield by increasing fruit or grain numbers per plant and/or their individual weights? Answers to these questions reside in discovering mechanisms regulating resource unloading from the vascular pipelines into fruits and grains to fuel their development. Emeritus Professor John Patrick will describe open- and closed-loop control mechanisms that coordinate unloading of resources in response to metabolic demand by the developing fruit or grain. Based on these insights, he will canvass several scenarios that may provide novel opportunities to improve crop yield.

Professor Timothy Ralph FAA

Professor Timothy Ralph is a graduate of Macquarie University and obtained his PhD from ANU. He was awarded an ARC QEII Fellowship in 2000 and an ARC Professorial Fellowship in 2006. He is currently a Professor at the University of Queensland. Professor Ralph has extensive experience in quantum optics as well as optical implementations of quantum information techniques. His research involves both purely theoretical investigations and close collaborations with experimental groups. He has been on the leadership team of the ARC Centre of Excellence—Centre for Quantum Computation and Communication Technology since its inception.

Optical quantum information

The storage, communication and processing of information using quantum mechanical systems can achieve outcomes not possible with current information systems. Professor Ralph will discuss quantum optical approaches and describe how these can lead to applications such as ultra-secure communications and more powerful computers.

Professor Lois Salamonsen FAA

Professor Lois Salamonsen has a PhD in reproductive biology from Monash University. She was Senior Principal NHMRC Research Fellow, Director of the Centre for Reproductive Health at the Hudson Institute for Medical Research, and is adjunct Professor in the Department of Obstetrics and Gynaecology at Monash University. Now partly retired, she heads the Endometrial Remodelling laboratory at the Hudson Institute. Her team is recognised for its contributions to our understanding of endometrial remodelling, the mechanisms underlying menstruation and abnormal uterine bleeding, uterine receptivity and embryo implantation, along with new approaches to female contraception, with strong emphasis on translational research. Her current research focuses on the microenvironment of implantation, which should lead to changes in clinical practice and improved IVF outcomes. Professor Salamonsen has acted as Associate Editor for Biology of Reproduction and Reproductive Sciences and was President of the Society for Reproductive Biology. She subsequently received the society's prestigious Founders' Award for scientific excellence. She has also held an honorary Fellowship of the Royal Australia and New Zealand College of Obstetrics and Gynaecology for her contributions to women's health. Her passion for and success in mentoring young scientists and clinicians was recognised by the Beacon award from Frontiers in Reproduction. She is a life member and Fellow of Society for Reproductive Biology and of the Society for the Study of Reproduction, USA.

Fertile ground: human endometrial remodelling in health and disease

The maternal contribution to the embryo-maternal interactions essential for a pregnancy is provided by the endometrium. In women, this remarkable tissue is shed, regenerated and highly differentiated during each menstrual cycle: up to 400 times during the reproductive life of modern women. In a conception cycle, when the embryo attaches to and invades the endometrial epithelium, the stromal compartment of the tissue then provides the maternal component of the placenta. Professor Salamonsen will describe how disturbance of normal remodelling can lead to a range of reproductive complications, include endometriosis (affects 1:10 women), infertility (affects 1:6 couples), abnormal uterine bleeding, pre-eclampsia, early miscarriage and endometrial cancers. She will explain how the processes involved, including hormone action, tissue breakdown and repair, inflammation and cellular differentiation have broad applications to other fields.

Professor Mark Smyth FAA

PHOTO: TONY PHILLIPS

Professor Mark Smyth is a Senior Scientist and Immunology Coordinator at QIMR Berghofer Medical Research

Institute. He completed his PhD at the University of Melbourne and trained at the NCI before commencing his independent research career in Australia. Over the last 20 years he rekindled world-wide interest in cancer immune surveillance, defined immune-mediated dormancy of cancer, and studied the role of the host in chemotherapy and targeted therapy responses in mice and humans. More recently, he has provided new means of classifying natural killer cell (NK) subtypes and two new targets for cancer immunotherapy. He is a winner of the Coley Medal and Brupbacher Foundation Prizes in Cancer Research. He is the highest cited immunologist in Australia and is a Senior Editor and Advisory Board Member for Cancer Research and Science, respectively. Hi is a Fellow of the Australian Academy of Health and Medical Sciences.

Immunotherapy—the fourth pillar of cancer treatment

Professor Mark Smyth will describe his work on the immune reaction to cancer over the past two decades and define current progress and future directions in the field.

Professor Nicholas Wormald FAA

Professor Nick Wormald is a Professor of Mathematics at Monash University. He specialises in random graphs and probabilistic combinatorics, graph theory, enumeration, the analysis of graph algorithms, Steiner trees, the analysis of real-life networks, and other areas in combinatorics, as well as the optimisation of underground mine access networks. He has a PhD in mathematics from the University of Newcastle. After appointments at the University of Waterloo, Louisiana State University, University of Newcastle (Q.E.II Fellowship), University of Auckland, and then University of Melbourne, he returned to Waterloo as a tier 1 Canada Research Chair. This was followed by an Australian Laureate Fellowship at Monash University. He was awarded the 1993 research medal of the Australian Mathematical Society and the 2006 Euler Medal from the Institute of Combinatorics and its Applications.

Random networks: order and chaos

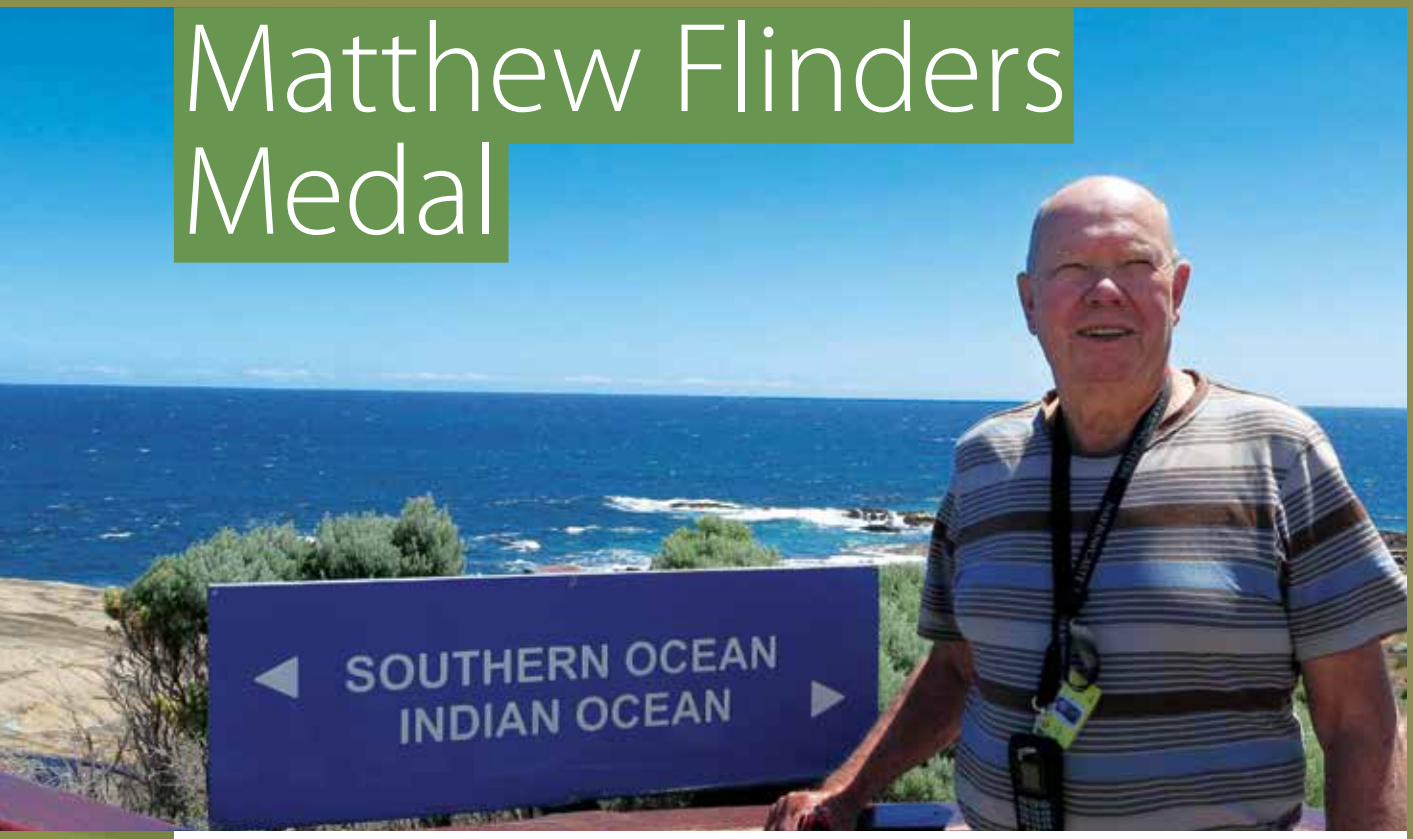
Some networks are physically obvious in our daily life, including roads, rail and utilities. Others have less tangible links, such as computer networks, airline route maps, social networks, and schematics for algorithm design or food webs. Raising the level of abstraction further, we have just a set of nodes with links between them, capable of representing any particular network. Professor Wormald will describe how such conceptual networks are studied in our quest to understand universal properties of structures. Introducing randomness mixes things up in a way that at first sight seems chaotic, but many strong and interesting features emerge. Some of these theoretical discoveries also have ramifications in other areas of science and technology.

Absent new Fellows

Also elected this year, but unable to join us for the New Fellow Presentations, are:

- **Professor Thomas Davis**
  Monash University
- **Dr John Volkman**
  CSIRO
- **Professor Branka Vucetic**
  University of Sydney

Matthew Flinders Medal



Professor Barry Ninham AO FAA

Professor Barry Ninham's discoveries have had a revolutionary impact on the field of colloid science, a discipline that underpins chemical engineering, cell and molecular biology and nanotechnology. He developed the theory of amphiphilic molecular self-assembly that underlies modern materials science. It is a fundamental principle of self-assembly in nanotechnology, impacting on modern molecular-based technologies, and slow-release technology for in-vivo pharmaceutical drug delivery. He revealed that the discipline of physical chemistry failed to take account of key 'ion specific effects' and dissolved atmospheric gas. Professor Ninham was founder and head of the Applied Mathematics Department at the Australian National University and currently works with a team at the Australian Defence Force Academy. They discovered simple new technologies for purification of recycled water, desalination, low temperature chemical reactivity, catalysis, and removal of pollutants such as arsenic.

The physical and biological sciences divide

Professor Ninham will discuss how the classical theories of physical chemistry that underpin our intuition about the deepest levels of biology, while initially useful, have become rigid and inhibiting to progress. By bringing together a number of advances in related fields, he will give an account of the complexities that are missing from classical theories of physical chemistry (such as Lifshitz theory, Hofmeister (specific ion) effects, 'non-Hofmeister' effects on the surface of bubbles, and the effects of dissolved atmospheric gas). When we include them, a different intuition and new vistas emerge that open up new technologies, for example in desalination, water purification and sterilisation.

Academy Awards 2017

CAREER HONORIFIC AWARDS

David Craig Medal

Professor David St Clair Black
AO FAA

Professor David Black studied chemistry at the University of Sydney and received a PhD at Cambridge. After researching at Columbia University, he joined Monash University then moved to the chair of organic chemistry at the University of New South Wales. He has studied at the ETH Zürich, Würzburg University and Cambridge University and held visiting professorships in Tokyo, Auckland, Göttingen, Innsbruck and Kobe. Professor Black has won the Rennie, Smith, Birch and Leighton Medals of the Royal Australian Chemical Institute, of which he served as National President in 1998. He has also contributed to international science as Secretary General of the International Union of Pure and Applied Chemistry 2004–11, and Secretary General of the International Council for Science 2011–2018.

Molecular design and synthesis

Synthetic organic chemistry is a creative area of science involving the transformation of existing molecules into completely new ones, possibly leading to new drugs or materials. Once the target structure has been chosen, a synthetic route must be determined. A new target molecule must combine originality of structure with feasibility of synthesis. The process is one of molecular architecture followed by molecular construction; in addition to science there is an artistic element in this field of research. Professor Black will illustrate these principles in the case of indoles, where he has investigated the chemical reactions of specifically activated indoles and generated a wide range of interesting, novel structures.

Hannan Medal

Dr Frank Robert de Hoog FTSE

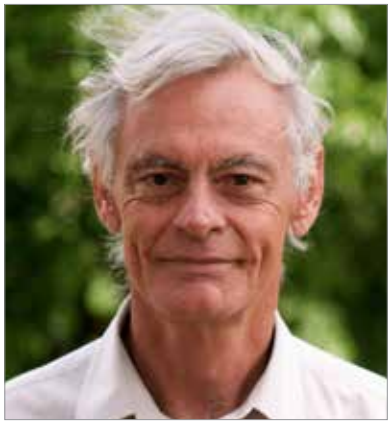
Dr Frank de Hoog is a CSIRO Post Retirement Fellow at Data61. He received a PhD from the Australian National University in 1973. He has worked on the theory of computational and applied mathematics and made research contributions documented in over 120 refereed journal papers. A number of algorithms that he co-developed have been incorporated into commercial software libraries, examples being algorithms for Laplace transform inversion and smoothing splines. Since 1977, Dr de Hoog has worked in the areas of mineral and industrial processing, including modelling of blast furnaces, gravity separation, alumina precipitation, mill modelling, roll coating, structural vibrations, coil handling and financial risk. His work has been incorporated into industrial control systems and design tools.

Simple mathematical and computational models for solving complex processes

For 40 years Dr de Hoog has worked with CSIRO, academia and industry, applying simple mathematical models and computational algorithms to understand and solve complex industrial and scientific problems. These have included using dimensional analysis to design new mineral separation equipment, such as the Kelsey jig, and compressive sensing to improve the operation of hyper-spectral cameras. Dr de Hoog will explain that the use of simple and computational models is a consequence of the fact that seemingly highly complex industrial process are often robust. He will highlight how advances in mathematics, numerical algorithms, hardware and software have yielded substantial economic and industrial impact.

Jaeger Medal

Emeritus Professor Ross William Griffiths FAA



Professor Ross Griffiths received his PhD from the Australian National University. He spent three years as a postdoctoral researcher in applied mathematics and theoretical physics at the University of Cambridge, and a year at the University of Grenoble before returning to the ANU Research School of Earth Sciences. He is a Fellow of the American Geophysical Union, American Physical Society and Australian Academy of Science. He has contributed to ocean modelling, physical volcanology and the understanding of convection in Earth's interior and developed the first mathematical model of hot plumes in Earth's mantle. In oceanography his work has led to new understanding of the role of surface heat fluxes in governing the temperature stratification and global circulation of the oceans.

The role of convection in global circulation of the oceans

Convection is commonly responsible for transport of heat. In Earth's core it also drives the dynamo generating the earth's magnetic field, in the solid mantle it drives motion manifest at the surface as plate tectonics, and in the atmosphere it drives the global circulation. For the oceans there is not yet a clear picture of its significance. Professor Griffiths will outline how his team's laboratory experiments have led to a new approach in computational simulation, broadening the range of modelled processes from the planetary scale to fully resolved turbulence and convection. The evidence indicates that the global ocean circulation has comparable sensitivity to surface buoyancy forcing and wind stress.

Thomas Ranken Lyle Medal

Professor Joss Bland-Hawthorn FAA

Professor Joss Bland-Hawthorn is an ARC Laureate Fellow, Professor of Astrophysics at the University of Sydney and Director of the Sydney Institute for Astronomy. He obtained his PhD in astrophysics from the Royal Greenwich Observatory and the University of Sussex, then spent a decade in the US and 14 years at the Anglo–Australian Observatory, Sydney. In 2007, he took up an ARC Federation Fellowship at the University of Sydney. With Ken Freeman, he has been developing the fields of galactic archaeology and near field cosmology where old nearby objects are used to unravel events in the early universe. He leads the field of astrophotonics, has won many awards in optics and astronomy and is a co-author on 500 refereed papers.

Cosmology in the near field

Cosmology is the study of the origin and evolution of the universe. At the dawn of modern astronomy, most of what we knew about the universe came from the near field. Professor Bland-Hawthorn will describe how, for the past 80 years, astronomers have chased after celestial sources at ever increasing distances and redshifts. The far field crowd came to dominate the subject, leaving the stellar astronomers mostly detached from the great advances. He will discuss how, in recent years and with Australians leading the way, the near field has come back into focus with the realisation that key insights into how the early universe unfolded are only measurable in our galactic neighbourhood.

Gustav Nossal Medal for Global Health

Professor Barend (Ben) Marais

Professor Ben Marais is a paediatrician at The Children's Hospital Westmead. His research helped to measure and characterise the tuberculosis disease burden suffered by children, highlighting the absence of care in places where it is needed most. Increased awareness led to a strong focus on children in the World Health Organization's ambitious 'End TB' strategy. His work also raised awareness that multi-drug-resistant tuberculosis is actively transmitted within endemic communities, requiring urgent containment strategies. Ongoing research is focused on feasible strategies to improve TB diagnosis and care, as well as using new advances in pathogen genomics to provide evolutionary insights and guide better targeted public health interventions.

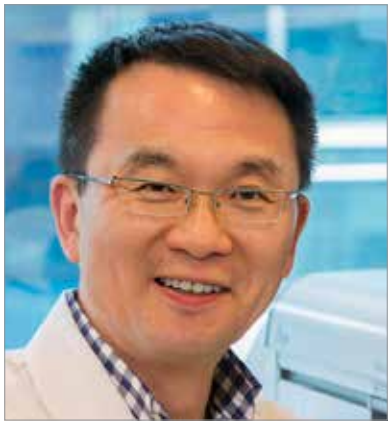
The rise of drug-resistant tuberculosis and how children are affected by the global epidemic

Tuberculosis is the biggest infectious disease killer on the planet. The fact that young children suffer high rates of disease and death is rarely appreciated, since they have limited access to diagnosis and care in TB endemic areas. Professor Marais will discuss how descriptions of the natural history of *Mycobacterium tuberculosis* infection in young children emphasised their vulnerability and assisted accurate disease burden estimates. The emergence and spread of drug-resistant (DR)-TB in the Asia–Pacific region is a major concern, with active transmission of DR-TB within communities putting young children at risk. Australia is well placed to provide strong leadership within the region to contain the spread of DR-TB and meet the targets of the 'End TB' strategy.

Jacques Miller Medal for Experimental Biomedicine

Professor Jian Li

PHOTO: STEVE MORTON



Professor Jian Li is a highly cited researcher and an NHMRC Senior Research Fellow at the Monash Biomedicine Discovery Institute. His research spans from the preclinical to clinical areas of the pharmacology and drug discovery of polymyxins, the last-line therapy against Gram-negative 'superbugs'. His group reported the majority of modern polymyxin pharmacology data, which led to the first scientifically based dosing recommendations in patients and changed clinical practice globally. Professor Li also employs systems pharmacology to elucidate the mechanisms of polymyxin activity, resistance and toxicity, and to develop virtual bacterial cells. His group has discovered novel compounds with superior efficacy and safety compared to the current polymyxins. He has been awarded six large grants by the American National Institutes of Health.

Targeting bacterial 'superbugs': From bed to bench to bed

By 2050 antimicrobial resistance will cause 10 million deaths every year worldwide and cost the global economy approximately US$100 trillion. No novel antibiotics will be available in the near future against Gram-negative 'superbugs'. 'Old' polymyxins are increasingly used as the last-line therapy against life-threatening infections, but as their use ceased in the 1970s there was very little information to inform their current use. Professor Li will explain how the majority of modern polymyxin pharmacology data were reported by his group. A post-antibiotic era is a very real possibility for our century and a systems approach is essential to address this significant global medical challenge.

Nancy Millis Medal for Women in Science

Professor Kerrie Wilson

PHOTO: ANJANETTE WEBB

Professor Kerrie Wilson is an ARC Future Fellow at the University of Queensland (UQ), Chief Investigator of the ARC Centre of Excellence for Environmental

Decisions, Deputy Director of the UQ Centre for Biodiversity and Conservation Science, and an Affiliated Professor in Conservation Science at the University of Copenhagen. Professor Wilson holds a DPhil from The University of Melbourne. She has previously held leadership positions with non-government organisations including Director of Conservation for The Nature Conservancy Australia. She has a particular interest in applied conservation resource allocation problems, such as where to invest limited resources to protect or restore biodiversity and the role of ecosystem services in achieving conservation goals. Her research into the socio-economic aspects of conservation involves collaborations with governments and NGOs at local, national and global levels.

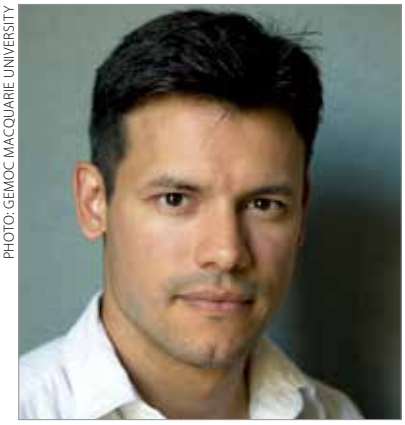
Conservation decision making in complex social-ecological systems

Natural resource managers commonly face the problem of achieving conservation goals with limited funds, and of balancing needs for nature conservation with competing demands from society. Conservation therefore requires an understanding of both the ecological and the socio-economic system. Professor Wilson will describe new methods for prioritising where, when, and how to invest funds for protecting biodiversity and ecosystem services. She will profile new approaches to plan for multi-functional landscapes and the delivery of diverse outcomes, systematically evaluate the impact of conservation strategies, and forecast the impacts of alternative policy options and alternative futures.

Anton Hales Medal

Associate Professor Juan Carlos Afonso

PHOTO: GEMOC MACQUARIE UNIVERSITY



Associate Professor Juan Carlos Afonso is Associate Professor in the Department of Earth and Planetary Sciences at Macquarie University and Adjunct Professor at the University of Oslo. He works on the thermochemical structure and evolution of tectonic plates, their mechanical and chemical interactions with the underlying mantle, and the effects these interactions have on small- and large-scale tectonic processes. Associate Professor Afonso has pioneered new techniques that combine different disciplines such as mineral physics, thermodynamics, nonlinear inversion and thermomechanical modelling into a single conceptual and computational framework, significantly improving understanding of the inner workings of Earth. Among other awards, he received the 2013 Outstanding Young Scientist Award from the Geodynamics Division of the European Geoscience Union.

Towards a grand unified theory of Earth's interior

The conversion of surface observations such as gravity, seismic records and rock composition into estimates of the true constitution and physical state of Earth's interior is a fundamental goal of the geosciences. Progress has been made by analysing each observation within individual disciplines, but the resulting Earth models can be incompatible with each other. Work on understanding the models' origin and reconciling them has been slow. Associate Professor Afonso will discuss a new unifying approach that can iron out the incompatibilities and provide self-consistent pictures of the physical and chemical state of the deep Earth in space and time.

Dorothy Hill Award

Dr Joanne Whittaker

Dr Joanne Whittaker is a marine geophysicist. She researches the ocean floor to understand how continents form, how tectonic plates move, and how the hot, deep centre of the planet interacts with the surface. Dr Whittaker uses marine data from satellites and data collected by research vessels from the largely unknown ocean floor around Australia to constrain models of the evolution of ocean basins. In particular, she is interested in reconstructing how the Indian, Australian and Antarctic tectonic plates separated over the past 160 million years. Dr Whittaker obtained her PhD from the University of Sydney in 2008. She joined the University of Tasmania in 2013.

The underwater landscape of ocean basins

The bottom of the ocean is not a vast, flat expanse. It is a complex underwater 'landscape' of mountains and plains, volcanoes and deep trenches. Dr Whittaker will describe how the formation of the textured ocean basins occurs over millions of years through the interaction of plate tectonics and the deep mantle, and how they can influence ocean circulation, species distribution and climate.

Fenner Medal

Professor Simon Ho

PHOTO: LOUISE M COOPER

Professor Simon Ho is a computational biologist who is interested in answering evolutionary questions using genome data. His research aims to describe how evolutionary rates vary at the genomic level and to estimate the timescale of the Tree of Life. His contributions to the field of molecular evolution include developments in molecular clocks and in understanding why evolutionary rates vary across species. Professor Ho received his PhD at the University of Oxford in 2006, then worked at Oxford and the Australian National University before joining the University of Sydney in 2010. Awards for his work include the Edgeworth David Medal from the Royal Society of NSW, NSW Young Tall Poppy of the Year, and Eureka Prize for Outstanding Early Career Researcher.

The evolutionary timescale of the Tree of Life

The fossil record has shed light on when animals first evolved, when plants colonised land, and when we shared ancestors with our primate cousins. But what about organisms that have left few or no traces in the fossil record? These evolutionary timescales can be estimated using molecular clocks, which are statistical models that describe the evolutionary process at the genetic level. The availability of genomic data provides excellent opportunities for improving estimates of evolutionary timescales, but they also present some major challenges for molecular clocks. Professor Ho will describe the role of molecular clocks in the genomic era and recount some of the evolutionary insights they have provided in recent studies.

Gottschalk Medal

Associate Professor Kathryn Holt

PHOTO: PETER CASAMENTO

Associate Professor Kathryn Holt is a computational biologist who uses genomics to investigate microbial populations and their impact on human disease. She pioneered the use of high throughput DNA sequencing to study bacterial pathogens and the evolution and dissemination of antibiotic resistance, establishing population genomic frameworks for several key organisms of importance to human health including *Salmonella typhi* (typhoid fever), *Shigella* (dysentery) and *Klebsiella pneumoniae* (a leading cause of hospital-associated infections). These frameworks, coupled with software tools developed by Associate Professor Holt and her team for data analysis and visualisation, are supporting the widespread translation of microbial genomics for public health applications including outbreak investigation, pathogen surveillance and infection control. Associate Professor Holt has also made significant contributions in microbiome research, identifying a key role for bacterial colonisation of the airways in the severity and long-term consequences of respiratory illness in infants.

Microbial genomics and antimicrobial resistance

Antibiotics have revolutionised human health, transforming what used to be lethal bacterial infections into treatable ailments. Unfortunately bacterial pathogens have evolved mechanisms to resist each new antibiotic drug. Large-scale comparative genomics allows us to see into the world of microbial evolution, to observe the molecular genetic basis for the rapid emergence and spread of drug resistant pathogens that threaten global health. Associate Professor Holt will highlight recent insights into the evolution and spread of highly drug-resistant bacterial pathogens, and the role of genomic epidemiology in the fight against antibiotic resistance.

John Booker Medal

Distinguished Professor Dayong Jin

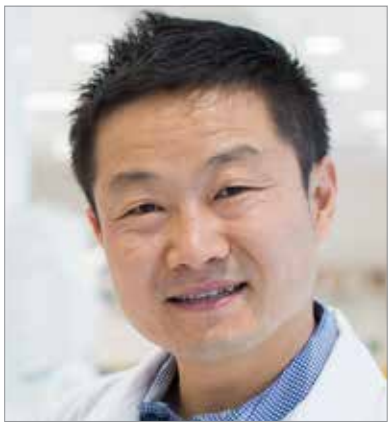


PHOTO: ANNA ZHU PHOTOGRAPHY & FILM

Professor Dayong Jin is an ARC Future Fellow and director of the ARC Research Hub for Integrated Device for End-user Analysis at Low-levels (IDEAL) and the UTS Institute of Biomedical Materials and Devices. With a background in optoelectronics engineering, Professor Jin has produced the world's brightest nanocrystals for single molecule detection, fibre-based remote sensing and point-of-care diagnostics, pioneered time-domain multiplexing technology for high throughput biotechnology discoveries, and created the largest library of contrast agents for multi-functional bio-imaging. He leads the world in engineering time-resolved photonics devices and reagents to up-convert low-energy infrared photons into more useful visible light. While his research opens up many opportunities in biomedical devices, early diagnosis

and light triggered nanomedicine, his dots can also be made into an 'invisible ink' to protect pharmaceuticals, medical courier supplies, passports, banknotes and more.

Photon upconversion super dots lighting biomedical devices

Professor Jin will describe his contributions by engineering time-resolved photonics devices and reagents to find disease cells earlier, quicker and with better resolution. These include the discovery of the world's brightest nanocrystals—super dots—for single molecule detection, fibre-based remote sensing and point-of-care diagnostic; demonstration of a time-domain multiplexing technology for high throughput biotechnology discoveries, data storage and anti-counterfeiting; creation of the largest library of contrast agents for multi-functional bio-imaging and nanomedicine; and invention of a low-power high contrast super resolution microscopy by achieving the highest optical resolution of 1/36 of the excitation wavelength.

Moran Medal

Associate Professor Joshua Ross

Associate Professor Joshua Ross has made important contributions to applied probability and statistics, and to biology and public health. His research focuses on mathematical modelling, statistical calibration and practical implementation. Although he has focused on problems in infectious disease epidemiology and conservation biology, his methodological solutions are widely applicable. Associate Professor Ross was awarded his PhD in 2007 from the University of Queensland and was a Junior Research Fellow at King's College, the University of Cambridge, returning to Australia in 2010. He has published over 55 journal articles and secured several grants. He has undertaken consulting projects for the Australian Government, is an ARC Future Fellow and leads the 'Development of innovative methodology' theme in the NHMRC Centre of Research Excellence PRISM2.

Characterising the epidemiology of pandemic influenza

The emergence of a novel strain of influenza poses an ever-present threat to our health and wellbeing. While vaccines provide protection against a variety of viruses, the development and production of a vaccine for a novel strain of influenza typically takes at least five months. The characteristics of the virus pertinent to its threat and control are obviously largely unknown. Mathematics and statistics are key to determining the best response to such a threat. Dr Ross will provide an overview of some of his contributions to this topic.

Pawsey Medal

Associate Professor Igor Aharonovich

PHOTO: ANNA ZHU PHOTOGRAPHY & FILM

Associate Professor Igor Aharonovich received his PhD in 2010 from the University of Melbourne working on color centers in diamond, and then spent two years at Harvard University researching optical resonators. In 2013 he joined the University of Technology Sydney, where he is currently leader of the nanophotonics laboratory. Associate Professor Aharonovich's research is focused on exploring single emitters in wide band gap semiconductors, and their implementation in quantum information and communications. He discovered new ultra-bright emitters in solid state systems including diamond, zinc oxide and silicon carbide. More recently, he led a team of researchers that for the first time engineered single emitters in two dimensional atomically thin material.

Quantum emitters in flatland

Engineering solid state quantum systems is one of the grand challenges for the realisation of scalable quantum technologies. While several 3D systems (such as diamond, silicon carbide, zinc oxide) have been thoroughly studied, solid state emitters in two dimensional (2D) materials have not been observed. Associate Professor Aharonovich will discuss the recently discovered single photon emitters in 2D hexagonal boron nitride (hBN). He will present several avenues to engineer these emitters in large exfoliated sheets as well as promising directions in the field of quantum emitters and nanophotonics with 2D materials.

Ruth Stephens Gani Medal

Associate Professor Sarah Medland

Associate Professor Sarah Medland is a statistical geneticist working in the genetics of neuroimaging, psychiatry and women's health. She was instrumental in the formation of the global ENIGMA brain imaging genetics consortium, and her work has advanced understanding of how genetics influences the structure and function of the human brain. Recent work has identified numerous genetic variants influencing the volumes of sub-cortical brain structures, and the consortium is identifying variants influencing the morphology of the human cortex. Associate Professor Medland's work mapping the genetic architecture of the human brain helps characterise healthy variation with the aim of improving the detection of pathological changes and the diagnosis and treatment of psychiatric and neurodegenerative conditions.

The genetic architecture of the human brain

There is substantial individual variation in brain structure morphology and brain functions. Large well-powered imaging studies are required to identify associations with genetic variants or psychiatric conditions. Within the ENIGMA consortium, Associate Professor Medland and her team conduct collaborative large-scale genetic analyses of phenotypes derived from magnetic resonance imaging (MRI) scans. They focus on how genetic variants influence brain structure and function, and on the identification of disease correlates. Associate Professor Medland will discuss her recent findings, focusing on genetic variants influencing the morphology of subcortical and cortical structures. These studies highlight the role of common genetic variation in influencing the structure of the human brain and the importance of collaboration and cooperation in advancing neuro imaging studies.

Inaugural Max Day Environmental Science Fellowship Award: recipients

Mr Nicholas Leseberg

ECOLOGY AND CONSERVATION BIOLOGY OF THE NIGHT PARROT

After nearly 15 years as an officer in the Royal Australian Air Force, Nick quit the RAAF to pursue his passion for birds. After working as a tour guide, author and ornithological consultant, Nick was accepted into the PhD program at the University of Queensland and is now studying the ecology of the endangered Night Parrot.

Dr Marta Yebra

PHOTO: EVA VAN GORSEL

FLAMMABILITY WARNING FROM SPACE

Dr Marta Yebra is Research Fellow at the Water and Landscape Dynamics Group in the Fenner School of Environment and Society, Australian National University.

Her main background is in remote sensing of vegetation biophysical properties, such as fuel load and moisture content for spatial fire risk analysis, and canopy conductance for carbon sequestration and water balance studies. From 2004–2010 she was employed at the University of Alcalá, where she was involved in two large multidisciplinary projects which assessed and integrated the main fire risk factors, validated the results and analysed fire risk trends, considering potential changes in socio-economic factors as well as foreseen impacts of global climate change. During her research, she spent time at the Centre for Spatial Technologies and Remote Sensing (University of California at Davis, USA); the National Institute of Agricultural Technology (INTA, Argentina) and the School of Environmental and Life Sciences of Salford (UK). From 2010 to 2013 Dr Yebra was a postdoctoral fellow at CSIRO Land and Water, developing innovative methods to integrate satellite and in-situ observations from micro-meteorological tower sites with models to predict carbon-water coupling.

Inaugural Max Day Environmental Science Fellowship Award: highly commended

Dr Hugo Harrison

PHOTO: TANE SINCLAIR-TAYLOR

MANAGING AUSTRALIA'S CORAL REEFS FOR RECOVERY AND PERSISTENCE

Dr Hugo Harrison is a molecular ecologist working at the interface of coral reef ecology, fisheries sciences and populations genetics. Dr Harrison's work on larval dispersal has led to major advances in our understanding

of movement patterns in marine fishes, which is relevant to the optimal design of networks of marine protected areas. His research brings a unique perspective and a unique set of tools to resolve the population dynamics of marine organisms that have real impact in the conservation of marine ecosystems and the sustainable use of marine resources. Dr Harrison was recently awarded an ARC DECRA Fellowship to develop a mechanistic understanding of connectivity and dispersal in marine organisms. His research aims to identify critical regions that will enhance the value of marine resources and identify vulnerable regions in the conservation and management of Australia's Great Barrier Reef Marine Park and Coral Sea Commonwealth Marine Reserve.

Dr Kerensa McElroy

THE 'DNA FOOTPRINT' OF NEAR EXTINCTION: INTERROGATING 100 YEARS OF BLACK-THROATED FINCH DECLINE BY SEQUENCING CONTEMPORARY AND HISTORICAL SPECIMEN

Dr Kerensa McElroy's research combines population genomics, field work, experimental evolution, and biostatistics to understand genetic adaptation. Currently, she is using a population genomics approach to understand climate adaptation in Australian finches. The 17 species of Australian finch—including the tropical Blue-faced Parrot finch, the arid Zebra finch, and the highly endangered Gouldian finch—occur across diverse climatic zones, making them an ideal model system for this project. Previously, she has used population genomics to discover an arms race between the bacterium *Pseudomonas aeruginosa* and its phage, and to show that hepatitis C virus can evolve rapidly within a patient to escape from immune system attack.

Mr Max Worthington

RENEWABLE POLYMERS FOR AGRICULTURE AND THE ENVIRONMENT

Mr Max Worthington completed his BSc in Chemistry with a first class Honours degree at Flinders University in 2015. He is currently a PhD student at Flinders University where he is investigating renewable polymers for applications in environmental remediation, biochemistry, and agriculture. His research in sulfur polymers that capture mercury pollution has garnered wide attention, with profiles in international news and documentaries, and several on-going collaborations with both industry and environmental agencies.

Fellows of the Academy

If you would like to update your photograph on the Academy's website, please make your way to the main foyer during lunchbreak on Tuesday or Wednesday.

Early- and mid-career researcher workshops

Topic 1: Storytelling for researchers

Chaired by Patricia McMillan

Being a successful researcher is not just about doing great research. It's also about communicating that research in a way that will engage and inspire just about anyone. Why are a few researchers able to do this so effectively, amplifying their reach and impact, and opening opportunities for collaboration and funding? These researchers have learned to tell their story, not just to inform. Stories show the why of your research. Stories invite the listener into rapport with you and show them the possibilities of what you could achieve together. Stories go where information can't; they influence people's feelings, and therefore they influence people's decisions and actions. The good news is that storytelling is a skill anyone can learn and develop. In this workshop, we'll explore the four types of stories you need to have at your fingertips to engage others in your research. You'll have an opportunity to practise your own stories, and you'll create a 3-minute selfie video you can share through social media. Bring your video-enabled phone or device.

Patricia McMillan

Patricia McMillan is a speaker, a storyteller and an experienced information technology leader. Drawing on her background in mathematics, 20 years experience in information technology and her lifelong fascination with stories, she helps experts tell their own stories in a way that's memorable, meaningful, real and engaging. She is the author of Make IT Matter: The Surprising Secret for Leading Digital Transformation. Her career began at Carnegie Mellon University in Pittsburgh, and she's helped leaders in organisations like the University of Sydney, the University of Melbourne, La Trobe University, the University of Auckland, the University of Queensland, Intersect Australia, the Queensland Cyber Infrastructure Foundation, the Australian Cyber Security Centre, and the National Library of Australia.

Topic 2: How to pitch your research to the media

Chaired by Michael Hopkin

Want to get your research out to a wider audience but you're not sure how to get the attention of journalists? Michael Hopkins, Section Editor: Energy + Environment at The Conversation, will talk about how to pitch your research to a range of different media outlets, and how to talk about your work once you have their attention. He will talk about what journalists and editors are looking for in a story, how to frame your research so it appeals to their audience, and practical tips on how to communicate with journalists and avoid some common pitfalls.

Michael Hopkin

Michael Hopkin is The Conversation's Section Editor: Energy + Environment, and he's also its only editor based in the distant wilds of Western Australia.

Previously a senior news and features writer with Nature, as well as stints with Fairfax and The West Australian, he has more than a decade's experience as a specialist science and environment journalist.

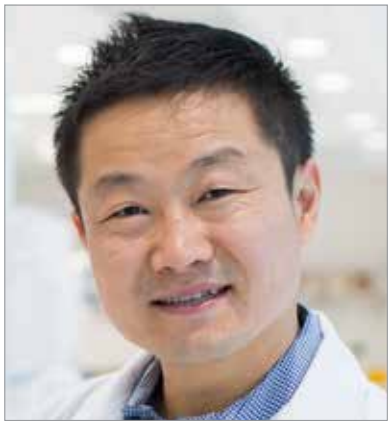
Topic 3: Fostering partnerships with industry

Chaired by Distinguished Professor Dayong Jin and Associate Professor Drew Evans

Collaborations between people working in academia and those working in industry have become highly valued. So how do you find an industry partner? And once you have one, how will it change the way you work? Between your two facilitators, Professor Dayong Jin and Associate Professor Drew Evans, they have experience working in academia, working in industry, transitioning back to academia and collaborating extensively with different industry partners. They will explain the challenges and opportunities that come with collaborating with industry and help you develop strategies for fostering your future partnerships with industry.

Distinguished Professor Dayong Jin

PHOTO: ANNA ZHU PHOTOGRAPHY & FILM



Professor Dayong Jin is an ARC Future Fellow and director of the ARC Research Hub for Integrated Device for End-user Analysis at Low-levels (IDEAL) and the UTS Institute of Biomedical Materials and Devices. With a background in optoelectronics engineering, Professor Jin set out to enable optical instruments to find disease cells earlier, quicker and with better resolution. In his quest, he has produced the world's brightest nanocrystals for single molecule detection, fibre-based remote sensing and point-of-care diagnostics, pioneered time-domain multiplexing technology for high throughput biotechnology discoveries, and created the largest library of contrast agents for multi-functional bio-imaging. Professor Jin leads the world in engineering time-resolved photonics devices and reagents to up-convert low-energy infrared photons into more useful visible light. While his research opens up many opportunities in biomedical devices, early diagnosis and light triggered nanomedicine, his dots can also be made into an 'invisible ink' to protect pharmaceuticals, medical courier supplies, passports, banknotes and more.

Associate Professor Drew Evans

PHOTO: BEN MCPHERSON

Associate Professor Drew Evans is a passionate advocate for high-tech manufacturing in Australia. After completing his PhD at the Australian National University, he worked for a private R&D company on new digital print technology before returning to academia. His team at the University of South Australia's Future Industries Institute researches thin film materials science and translates it into commercial reality with industry partners—such as the world's first plastic automotive mirror, of which more than three million have been exported to the US. Associate Professor Evans holds a Future Fellowship from the Australian Research Council to research plastic that conducts electricity. In parallel with this are commercial projects to integrate these polymers into new agriculture and biomedical devices. He has published many scientific papers, holds several patents, and is partnered with industry exploring scale-up manufacturing in commercial products. He is a member of the SA Science Council, and was awarded the SA Tall Poppy of the Year award in 2013 and the BioSA Young Achiever Award in 2016.

Topic 4: Perfecting grant writing

Chaired by Professor Stephen Buckman and Associate Professor Kathryn Holt

This workshop will focus on strategies for applying for national funding from the Australian Research Council and the National Health and Medical Research Council. It will be led by Professor Stephen Buckman, the ARC's Executive Director for Engineering and Physical Science and Associate Professor Kathryn Holt, an NHMRC Career Development Fellow who leads a research group in the Department of Biochemistry and Molecular Biology at the University of Melbourne. They will offer insights into the grant review process and how to respond to reviewers. The interactive session will also help you improve your grant writing and provide a forum for the group to share tips and advice.

Professor Stephen Buckman

Executive Director for Physical Sciences, Engineering, Mathematics and IT at the Australian Research Council. He was former Director of the Research School of Physics and Engineering at the ANU, and has research expertise in experimental atomic physics.

Associate Professor Kathryn Holt

PHOTO: PETER CASAMENTO

Associate Professor Holt is a computational biologist who uses genomics to investigate microbial populations and their impact on human disease. She has pioneered the use of high throughput DNA sequencing to study bacterial pathogens and the evolution and dissemination of antibiotic resistance, establishing population genomic frameworks for several key organisms of importance to human health including *Salmonella Typhi* (typhoid fever), *Shigella* (dysentery) and *Klebsiella pneumoniae* (a leading cause of hospital-associated infections). These frameworks, coupled with software tools developed by Associate Professor Holt and her team for data analysis and visualisation, are supporting the widespread translation of microbial genomics for public health applications including outbreak investigation, pathogen surveillance and infection control. Associate Professor Holt has also made significant contributions in microbiome research, identifying a key role for bacterial colonisation of the airways in the severity and long-term consequences of respiratory illness in infants.

Annual dinner

The Australian Academy of Science welcomes Senator the Hon Arthur Sinodinos AO, Minister for Industry, Innovation and Science, *representing the Hon Malcolm Turnbull MP*, Prime Minister of Australia, as keynote speaker at the Academy's Annual Science at the Shine Dome Gala Dinner on Wednesday 24 May 2017, at the National Arboretum Canberra.

The Arboretum features 94 forests of rare, endangered and symbolic trees from around Australia and the world. Many of the trees are still young but two of the forests are nearly 100 years old. The Arboretum provides an opportunity to conserve threatened species and learn about their growing preferences. It also provides a place for community recreation and culture, and ongoing education and research.

Senator Sinodinos is joining the President of the Academy, Professor Andrew Holmes AC PresAA FRS FTSE, to present one of the Academy's highest honours, the Matthew Flinders Medal. The Medal is being awarded to Professor Barry Ninham AO FAA.

We are delighted to be able to bring this event to you in such a stunning venue, with generous sponsorship from the Future Industries Institute (FII), UniSA.

FII represents UniSA's largest investment in research—an institute of sufficient scale to meet current and future challenges in engineering and the physical sciences. FII brings business, academia and the community together to address real-world issues and build economic growth through innovation and genuine partnerships.

Drinks and canapes: 6.45 pm
Dinner: 7.30 pm
Dress code: Black tie/cocktail

Symposium

COMMITTEE

Professor Mark Burgman FAA

Associate Professor Jane Elith FAA

PHOTO: ALEX ELITH

Professor Pauline Ladiges AO FAA

Professor Bob Pressey FAA

Professor Edward Holmes FAA FRS

Professor Mark Westoby FAA

Professor David Richardson

Professor Dave Richardson is Director of the DST-NRF Centre of Excellence for Invasion Biology and is a Distinguished Professor of Ecology at Stellenbosch University, South Africa. His research focuses mainly on plant invasions, especially trees and shrubs. He is interested in the biogeography, ecology and management of invasions. He is author or co-author of more than 350 peer-reviewed journal papers and chapters in edited books. He has edited or co-edited six books, including *Fifty Years of Invasion Ecology*, and is co-author, with Cang Hui, of the forthcoming book *Invasion Dynamics*. He was Editor-in-Chief of the journal *Diversity and Distributions* between 1998 and 2015. Professor Richardson was awarded the Hans Sigrist Prize for 2006 by the University of Bern, Switzerland. In 2012 he received the John F.W. Herschel Medal, the senior medal of the Royal Society of South Africa.

A global historical perspective on invasion science

Invasion ecology, the study of human-mediated introductions of organisms, deals with all aspects relating to introduced organisms, their capacity to naturalise and invade, and the many types of interactions with resident biota. The term 'invasion science' embraces invasion ecology, but increasingly involves non-biological lines of enquiry, including environmental ethics, political ecology, environmental history, ecological economics, and traditional ecological knowledge. Invasion science is one of the most vibrant sub-disciplines of ecology. Professor Richardson will trace the development of invasion ecology and science, discussing key themes, controversies and challenges from the 19th century to the present day. He will cover the important contributions made by naturalists including Charles Darwin, ecologists in the first half of the 20th century, and the mid-century book *Ecology of Invasions by Animals and Plants* by Charles Elton. Other milestones are the SCOPE Programme on the Ecology of Biological Invasions in the 1980s, and a 1996 conference in Norway which spawned the Global Invasive Species Programme.

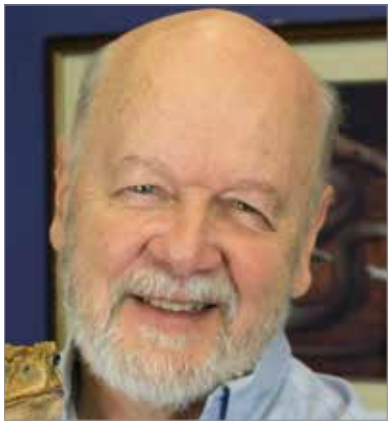
Dr Jane Catford

Dr Jane Catford is a Lecturer in Community Ecology at the University of Southampton, UK. She is a plant ecologist with an interest in community assembly and invasion ecology. She is particularly interested in how environmental, biological and geographic factors affect the functional composition of plant communities. Her work covers both the practical and theoretical aspects of biological invasions, and she always seeks to link the two—typically in terrestrial or freshwater environments. Before moving to the UK in 2016, Jane was a Research Fellow at the University of Melbourne and an Honorary Fellow at both the Australian National University and the University of Minnesota. Thanks to an ARC Discovery Early Career Research Award, she established what will become a 20-year invasion experiment at Cedar Creek Ecosystem Science Reserve in the US in 2012.

Understanding the causes and consequences of plant invasions

The introduction and success of alien species are both a cause and consequence of global environmental change. It has been argued that species biogeographic origin cannot explain or predict ecological impacts and the origin of a species should not influence ecosystem management. This rejection of 'origin' is overly simplistic. Origin effects can arise through biased sampling of the types of species transported, the environmental and evolutionary context of their source environments, and the communities and environments to which they are introduced. Dr Catford will discuss how alien plants are able to invade and dominate, why the ecological responses and effects of alien species might differ to natives, and why alien plants can potentially drive native plants to extinction.

Professor Rick Shine AM FAA



Professor Rick Shine is a Laureate Fellow of the Australian Research Council, and a Professor of Biology at the University of Sydney. He has conducted extensive

field-based research on reptiles and amphibians in many parts of the world. When invasive cane toads arrived at his research site in tropical Australia in 2005, where he had studied snakes for over 20 years, he set out to understand the risk posed by these alien amphibians. Since then, Professor Shine has spear-headed a research initiative on the biology, impact and control of cane toads in Australia. The major thrust of his current research involves approaching conservation challenges from an evolutionary perspective, and embedded within a detailed understanding of reptile and amphibian biology. In 2016, Professor Shine received the Prime Minister's Prize for Science.

The impacts of and prospects for vertebrate invasions in Australian terrestrial ecosystems

Australia's terrestrial ecosystems have been severely affected by invasive species, with several recent extinctions of mammal and amphibian species apparently due to invader impacts. Some of these effects are direct—for example, feral cats consume marsupial prey, and cane toads fatally poison native predators. Other pathways of effect are more complex; for example, they may be mediated by pathogens brought to Australia by invasive vertebrates, or flow-on consequences of direct impacts of the invader on other native species. The separation of Australia from other landmasses over evolutionary time has created great vulnerability, with many globally widespread faunal lineages absent from Australia until they are brought in by humans. Even with rigorous quarantine, further incursions are inevitable. Invaders can induce evolutionary as well as ecological changes, and managers need to recognise the dynamic nature of these interactions when planning impact mitigation. Using the cane toad invasion as an example, Professor Shine will outline how recent research is revealing new and sometimes surprising perspectives on the ways in which invaders affect terrestrial ecosystems, and how and why those impacts vary through time and space.

Dr Beth Cookson

Dr Beth Cookson is an Australian Government Department of Agriculture and Water Resources veterinary officer. Beth graduated from the University of Queensland in 2004, and since 2006 has worked on animal health surveillance programs in northern Australia, with a focus on the detection of transboundary pests and diseases. During this time Beth has worked as a field-based vet in the Northern Territory and far north Queensland, as well as in Indonesia, East Timor and Papua New Guinea; and now leads the Department's post-border animal health surveillance program across the north. Beth became a member of the Epidemiology chapter of the Australian and New Zealand College of Veterinary Scientists in 2013. She is passionate about science communication and works closely with community, industry, researchers and government to design and implement practical, risk-based biosecurity surveillance.

Biosecurity in the north—threats to human and animal health and their management

The north of Australia has a unique risk profile including vast, remote geography, tropical climate and proximity to neighbouring countries that makes biosecurity management a complex task. Over time the region has been vulnerable to the introduction and subsequent establishment of pests and diseases, and their vectors, that have the potential to impact human and animal health, the environment and trade. An integrated and responsive approach to biosecurity including pre-border, border and post-border measures is required to identify and mitigate such threats. In this presentation, Dr Cookson will explore the potential impact of some of our smallest invasive species threats—insect vectors and virus pathogens—and the battle across borders to identify, detect and control them.

Professor Kerrie Wilson

PHOTO: ANJANETTE WEBB

Professor Kerrie Wilson is an ARC Future Fellow at The University of Queensland (UQ), Director of the Australian Research Council Centre of Excellence for Environmental Decisions, and an Affiliated Professor in Conservation Science at The University of Copenhagen. Kerrie holds a degree in Environmental Science from UQ and a Doctor of Philosophy from The University of Melbourne. Kerrie has previously held leadership positions with non-government organisations including Director of Conservation for The Nature Conservancy Australia. Her research interests include applied conservation resource allocation problems, analysing the socio-political and institutional factors that influence investment success in conservation, and quantifying the conservation benefits of investments. Her research has been published in high impact journals such as Nature and Science and involves collaborations with governmental and NGOs at local,

national and global levels. She has received numerous national awards, including two Australian Research Council Research Fellowships, an Australian Museum Eureka Prize for Outstanding Young Researcher, the Prime Minister's Prize for Life Scientist of the Year.

Invasive species and threatened species management

Invasive species present unique challenges to the preservation of threatened species. They also impact the planning, implementing, and monitoring of on-ground management actions. Invasive species complicate budget predictions for threatened species management, necessitating a mechanism for adjusting management budgets for unanticipated increases in costs. Additionally, management actions can interact; that is, the cost, benefit and feasibility of one action can change when another action is undertaken. Threatened species management that does not consider this interactivity may result in misplaced investments or misguided expectations of the effort that will be required to mitigate threats. Finally, because of the limited evaluation of past activities to manage threatened species, management may be prescribed without evidence of a beneficial conservation outcome. Associate Professor Wilson will explore these issues, and how we can quantify the likely return on investment of management actions, leading to better decisions for managing threatened species when invasive species are on the loose.

Professor Emma Johnston

Professor Emma Johnston is Pro Vice-Chancellor (Research) at UNSW Australia and head of the Applied Marine and Estuarine Ecology Lab (AMEE). Her group investigates the ecology of human impacts in diverse marine systems, combining ecology, microbiology and ecotoxicology. Professor Johnston has produced more than 100 peer-reviewed publications and was an ARC Research Fellow from 2010 to 2014. Her research awards include the inaugural Australian Academy of Science Nancy Millis Medal for Women in Science (2014), the NSW Science and Engineering Award for Excellence in Biological Sciences (2012) and the Hynes Award from the Canadian Rivers Institute (2016). Professor Johnston won the 2015 Eureka Prize for Promoting Understanding of Australian Science Research. She is a regular media commentator and has helped take Australian marine science to an international audience. Professor Johnston advocates for increasing the participation of women in research, contributes expert opinion to government agencies, and consults with industry through the development and implementation of environmental monitoring programs.

Understanding and managing invasive marine species

When we transport a species to a location outside its native range, multiple factors influence its establishment and spread. Abiotic factors such as disturbance and environmental conditions determine the suitability of the new environment for an invader, and influence resource availability and ecological succession. Biotic processes such as competition, facilitation, predation and disease can either limit or promote invasion, as can emergent community-level traits such as species diversity. The invasion success of non-indigenous marine species may be influenced by human activities, such as coastal urbanisation and industrialisation. Professor Johnston will review the major human activities that affect the success of marine invaders and present management actions to reduce their success. Actions include managing contamination, redesigning artificial structures, minimising risks of transporting invaders, and protecting habitats and species diversity. Further research is vital to the development of management plans for reducing the impacts of invasive species.

Dr Aaron Dodd

Dr Aaron Dodd is a biosecurity policy analyst with a particular interest in the development of quantitative decision support tools. Following undergraduate training in botany, Dr Dodd spent the early years of his career in the field, delivering eradication programs on behalf of the Victorian Government. An advocate for practical, evidence-based public policy, Dr Dodd completed his PhD in 2016 at the University of Melbourne, developing several novel approaches to defining, estimating and managing biosecurity 'risk'. Since

2012, Dr Dodd has been responsible for making recommendations to government about the design of surveillance and eradication programs aimed at reducing the impacts of invasive species. He works across the management spectrum from on-ground managers through to applied researchers and policy-makers, capturing the unique insights that each discipline brings to biosecurity.

Plant invasions in Australia and decision-theoretic approaches to their management

The human-mediated exchange of species is an important economic, social and environmental issue costing Australians more than $4 billion annually. Despite considerable investment in pre-border biosecurity measures such as import regulations tied to weed risk assessment, alien plant species richness continues to increase in all regions across the globe. Prevention and eradication have become popular management strategies because of their high cost-efficiency when programs are successful. However, relatively little research has been conducted into the factors relevant to the design of multi-species surveillance and eradication programs, and the current global success rates for these programs remain low. Dr Dodd will explore the patterns of alien plant species in Australia and discuss how decision theory can be used to improve the success rates of programs designed to manage them. He will demonstrate how the benefits ultimately realised by a portfolio of eradication programs are limited by decisions made much earlier in the management continuum.

Associate Professor Phil Cassey

PHOTO: CHRIS WONG

Associate Professor Phil Cassey is an invasion ecologist and biosecurity researcher. He is head of the Invasion Ecology Lab at the University of Adelaide, and has diverse research interests in vertebrate ecology, biogeography, pest management and wildlife trade. He completed his PhD in Quantitative Ecology at Griffith University (2001), and worked as a postdoctoral researcher in France, the UK and the US before obtaining a United Kingdom Research Council Fellowship at the University of Birmingham (2007). In 2010 Associate Professor Cassey moved to Adelaide as an Australian Research Council Future Fellow. He has published extensively on the establishment and impacts of introduced species, and is currently leading research on novel approaches for combatting the illegal trade and transnational trafficking of wildlife species.

The ecological and conservation implications of biological invasions

Biological invasions constitute a major driver of anthropogenic environmental change. Invasive alien species (IAS) have profound impacts on all habitats, and produce major global economic and social costs. IAS are pervasive contributors to the ongoing global biodiversity crisis, and are one of the most common threats associated with species that have gone completely extinct from a wide range of taxa. Management of IAS is complicated by tensions between apportioning resources to previously established pests, and the surveillance and containment of new and emerging pests. Increased globalisation of transnational trade and tourism continues to drive growth in the number of IAS, and forecasts predict that new IAS will be responsible for even greater global environmental costs. Professor Cassey will discuss approaches for successfully combating the threats and costs of IAS, including the intelligent use of existing resources and identification of better management targets.

Event information

Colour coding

- New Fellows
- Fellows
- EMCRs/Lindau participants
- Awardees
- Symposium speakers

Photo sessions

Please meet in the foyer where you will be directed.

Tuesday

MORNING TEA

EMCRs group photo, EMCR awardee and Lindau participants group photos

LUNCH

New Fellows group and individual photos

AFTERNOON TEA

New Fellows individual photos continued

Wednesday

MORNING TEA

Honorific Awardees (early morning session) individual photos

LUNCH

Awardee group and individual photos

Thursday

LUNCH

Symposium speakers and chairs group photo

Registration desk

The main foyer registration desk will be staffed at all times for your assistance.

Luggage

A luggage cabinet is available at the registration desk.

Academy shop

Academy merchandise is available at the shop in the small foyer adjacent to the Jaeger Room.

Wi-fi

Network: **SHINEDOME**
Password: **5hinedome**

Please disable personal mobile hotspots as this slows down the network for all delegates.

Taxi

Canberra Elite **13 22 27**
Quote **Taxi Spot 59** as pick-up location

Bus routes

These routes drop off within walking distance of the Dome: 3, 4, 5, 7.
www.action.act.gov.au/timetables_and_maps

Parking

Limited free car parking is available in the Academy's Gordon St carpark.

The forecourt area of the Shine Dome is 'set down and pick up' only.

Additional pay parking areas are marked on the Academy map on the inside front cover of this program.

Disabled access

Two disabled parking spaces are available within the Academy car park. Wheelchair access is available please see the registration desk for help.

First aid

In case of emergencies or first aid please see an Academy staff member.

Quiet space

A quiet space is available in the Fenner Room and Basser Library on level 1 of the Shine Dome.

Social media

Follow us on twitter
@Science_Academy
#ShineDome17
@ShineDome

www.facebook.com/AustralianAcademyofScience

www.linkedin.com/company/the-australian-academy-of-science

Hearing Loop

The Ian Wark Theatre is equipped with a hearing loop. Please look for seats in the lower area of the theatre with a gold plaque indicating a hearing loop. An IR hearing loop is available for the first floor. Please see reception staff to obtain a device.

Coach timetable

Thursday airport shuttle

3.45 pm From the Shine Dome to the airport

Contacts

The following Academy staff will be available to assist you. Please don't hesitate to call them.

General enquiries

Lisa Crocker	0488 044 186
Ray Kellett	0411 156 801

Lindau delegates

Meaghan Dzundza	0438 458 637

Early- and mid-career researchers

Sandra Gardam	0406 754 600

New Fellows

Karen Holt	02 6201 9406

Awardees

Dominic Burton	0404 845 190

Media

Dan Wheelahan	0435 930 465

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Twice each year, we will keep you up-to-date with how philanthropic support—your support—is working and making an impact. We welcome your thoughts and ideas as we work together to support future generations. Thank you for putting your trust in the Academy to achieve its vision. Your gift is valued.

For further information, please do not hesitate to contact our Development and Stewardship Manager, Ms Isobel Griffin MFIA at the Australian Academy of Science.

Email **isobel.griffin@science.org.au** Tel **02 6201 9471** **www.science.org.au/donate**

SAGE

SCIENCE IN AUSTRALIA GENDER EQUITY

SAGE The Science in Australia Gender Equity (SAGE) Initiative is a partnership between the Australian Academy of Science (AAS) and the Australian Academy of Technology and Engineering (ATSE). Sage aims to improve participation, retention, and success of women, gender minorities and diverse groups working in Science, Technology, Engineering, Mathematics and Medicine (STEMM) in higher education and research. SAGE builds on the success of the Athena SWAN Charter and its 10 principles of equality and inclusion established and operated by the Equality Challenge Unit (UK). It does so by adapting the accreditation framework of the UK Athena SWAN Charter, which identifies and addresses gender inequality in higher education and research institutions.

Our mission is to empower member institutions to make systematic changes within their organisations; evaluate their success through the provision of accreditation services; and engage with our members to support them during the evaluation process.

More information, including a list of our members, can be found on our website **www.sciencegenderequity.org.au**

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JEIR STATION

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