The Royal Society OF VICTORIA
Promoting science since 1854

PATRON: The Hon Linda Dessau AC
Governor of Victoria

PRESIDENT: Mr David Zerman

October Events:

10th October: *What are Fungi Doing for our Bushlands?*

*With **Dr Sapphire McMullan-Fisher***

24th October: *Nanoparticles: Exploiting Colour and Light*

The 2019 Phillip Law Postdoctoral Award Lecture

*With **Dr Rajesh Ramanathan***

November Advance Notice:

14th November: *Art and Life in Earth's Chemical Reactor*

*With **Professor Uta Wille and Dr Caroline Kyi***

28th November: *Epilepsy, Algorithms and AI: Personalised Seizure Forecasting*

*With **Professor David Grayden***

October 2019 Newsletter

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The Royal Society of Victoria
Inc.
8 La Trobe Street,
Melbourne Victoria 3000
Tel. (03) 9663 5259

What are Fungi Doing for our Bushlands?

Thursday, 10th October at 7:00pm

Image: Cyptotrama asprata (Berk.) Redhead & Ginn by Christian Ferrer is licensed under CC BY-SA 3.0

Speaker:

Dr Sapphire McMullan-Fisher

Mycologist, the Royal Botanic Gardens Victoria

Did you notice fungi popping up in mulch or lawns after the winter rains? Did you wonder what it might be named? Fungal Ecologist Dr Sapphire McMullan-Fisher thinks a more interesting question to ask is: what is that fungus ***doing?***

Fungi fruit bodies like mushrooms, puffballs, stinkhorns and so forth are a sign that the fungus is in there, working away hidden in the grass, soil and wood. Many fungi are nutrient recyclers, others are symbionts of plants, and a few are parasitic. Join us to find out more about the Wood Wide Web, fungal ecology and how fungi work to keep our bushland healthy.

About the speaker:

Sapphire is an ecologist who has special interest in the conservation of biodiversity, particularly the macrofungi and mosses. She completed her doctorate at the University of Tasmania on 'Surrogates for cryptogam conservation – associations between mosses, macrofungi, vascular plants and environmental variables.'

Sapphire has been actively involved with citizen science organisation Fungimap since 1999. She is the regional representative for Australasia for the International Society for Fungal Conservation [ISFC]. She is also active with Australian scientific groups like the Education Subcommittee of the Australasian Mycological Society, the Ecological Society of Australia, Australian Bryophyte Workshops and community groups including many field naturalist clubs and Landcare groups.

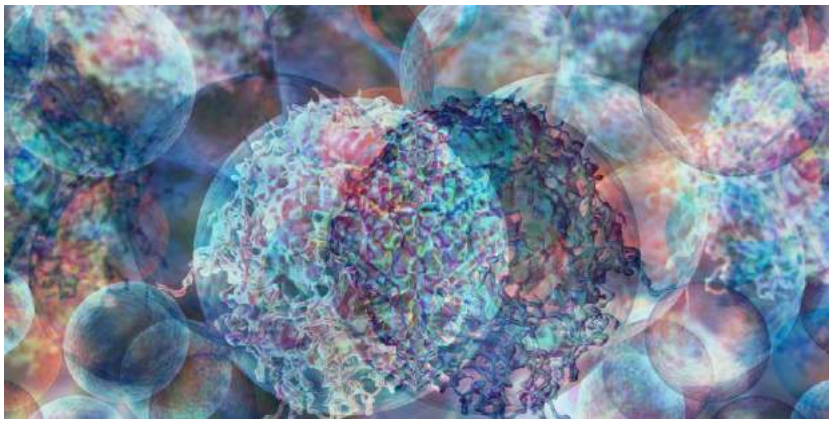
Having lived in four states and travelled across Australia's landscapes, she has been involved in many of the fungal community groups over the years. She has worked with many of these groups to raise the profile of local fungi and the important roles fungi play in our environment. She is involved in Greening Australia's Habitat Conservation and Management Course and the new Victorian Nature Stewards program. She particularly enjoys getting out into the bush to discover fungal treasures as often as she can.

Places limited, bookings essential! *Cocktail function from 6:00pm.* **Register online** now at https://rsv.org.au/events/fungi/, call or email the RSV office to secure your place: 9663 5259, rsv@rsv.org.au. Fully subscribed **RSV Members** can access discounted tickets by registering via their online profile, or entering their **promotional code** in the online ticketing window.

Nanoparticles: Exploiting Colour and Light

The 2019 Phillip Law Postdoctoral Award Lecture

Thursday, 24th October at 7:00pm



Speaker:

Dr Rajesh Ramanathan

Senior Lecturer and Co-lead, NanoBiotechnology Research Laboratory
School of Science, RMIT University

Nanoparticles, usually 500-100,000 times thinner than a human hair, have a fascinating range of properties due to their small size. **Dr Rajesh Ramanathan** and colleagues exploit these properties to create a range of new applications and technologies.

These include **sensors** that mimic our own senses of smell and taste in response to **colour**; light-active **antibacterials** that can kill bacteria by simply shining a **light**, and; biomedical **imaging** that can **visualise** biological processes in real-time. The underlying innovation in each case involves controlling the surface properties of exciting new nanomaterials.

Join the 2019 recipient of the Phillip Law Postdoctoral Award for the Physical Sciences to learn about the frontiers of nanobiotechnology being explored to create new materials, imaging applications and biomedical technologies.

About the speaker:

Dr Rajesh Ramanathan is a Senior Lecturer and co-lead of the NanoBiotechnology Research Laboratory (NBRL) at RMIT University's School of Science. First trained as a biologist, Rajesh combined his PhD work in materials science to consolidate expertise across chemical, physical and biological sciences, enabling him to develop and contribute to research projects across disciplinary boundaries.

The focus of his research interfaces nanotechnology and biology, including sensor processes and diagnostics, antimicrobial and wound management and imaging applications. Rajesh's work is based on understanding the fundamental properties of nanoparticles – particles a billion times smaller than a metre – and exploiting these properties to develop a range of next-generation biomedical technologies. The high prospect for commercial applications in the biomedical space has resulted in his work being shortlisted as one of the Top 50 life-changing innovative designs by INDEX: Design to Improve Life Denmark (2017). He is also a recipient of numerous awards and prizes.

Rajesh attained his Bachelor of Science from the University of Mumbai, India before moving to Australia to pursue a Master of Biotechnology from RMIT. Following a brief stint in industry after his Master's degree, Rajesh moved back to academia to complete his PhD in nanobiotechnology with RMIT and is now a Senior Lecturer within the School of Science. He is also the Treasurer for the Victorian Branch of the Royal Australian Chemical Institute (RACI).

Places limited, bookings essential! *Cocktail function from 6:00pm.* **Register online** now at https://rsv.org.au/events/nanoparticles/, call or email the RSV office to secure your place: 9663 5259, rsv@rsv.org.au. Fully subscribed **RSV Members** can access discounted tickets by registering via their online profile, or entering their **promotional code** in the online ticketing window.

Lessons from the Arctic

HOW ROALD AMUNDSEN WON THE RACE TO THE SOUTH POLE

In December 1911, Roald Amundsen planted the Norwegian flag at the South Pole, just weeks ahead of British polar explorer Robert Falcon Scott, who was approaching by another route. The tragic loss of the lives of Scott's team is well known—but how did Amundsen succeed?

This panel exhibition of images and personal accounts reveals how, exploring some of the lessons Amundsen learnt from earlier experience in both polar regions, Amundsen won the race to the South Pole. The rare images were taken by the expedition crew, hand-coloured by Amundsen and used in his 1912 lecture. See what the public saw in those heady days of icy exploration. Fascinating and fresh, this exhibition will surprise and delight.

Opening Sunday 6th Oct
4.30 – 6.30pm

MAGNET GALLERIES MELBOURNE

Exhibition 6th – 27th Oct

SC G19 Wharf St,
The District, Docklands
Melbourne 3008
(03) 8589 0371
michael@magnet.org.au
www.magnet.org.au

GALLERY HOURS
Tuesday - Friday 10am to 5pm
Saturday/Sunday 11am to 4pm

Sponsored by Royal Norwegian Embassy, Canberra
In association with the Norwegian Honorary Consulate General, Wellington
Victoria University of Wellington and the New Zealand Antarctic Society

A FRAM MUSEUM EXHIBITION

Norwegian Embassy

NEW ZEALAND ANTARCTIC SOCIETY

TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI VICTORIA UNIVERSITY OF WELLINGTON

Art and Life in Earth's Chemical Reactor

Thursday, 14th November at 7:00pm

Speakers:

Professor Uta Wille

Head, Wille Group, Bio21 Molecular Science & Biotechnology Institute

Dr Caroline Kyi

Art Conservator

Image: Detail of "Keith Haring en Pisa" by jandresg is licensed under CC BY-NC-SA 2.0

The Earth's environment is a gigantic chemical reactor – chemistry occurs constantly around all of us, fuelled by the sun during the day. Over the past century air pollution, including increasing amounts of greenhouse gas emissions, have become a major concern to society, impacting on humans, other animals, plants - and artwork.

The issues surrounding the conservation of cultural heritage in built environments are complex in their significance, and in their mechanisms. Unfortunately, unlike the conservation of cultural heritage that occupies the vast halls of galleries and museums, the discussion of ways to investigate and address these complexities are rarely held regarding public artworks, most of which are displayed outdoors and in the elements.

Join **Uta Wille** for a brief overview of fundamental principles of atmospheric chemistry and to receive results from recent work on the oxidative damage of biological molecules by environmental pollutants nitrogen dioxide and ozone. Using the conservation of the Keith Haring Mural in Collingwood Melbourne as a case study, **Caroline Kyi** will then examine how an appreciation of the cultural, social and art historical significance of the Mural and an understanding of the free radical-driven mechanisms of paint degradation are expected to combine in responding to the informed, long-term conservation of both the materiality and significance of a public art work.

About the speakers:

Professor Uta Wille graduated with her Ph.D. in Chemistry at the University of Kiel, Germany, which was followed by a Habilitation in Organic Chemistry at the same institution in 1999 and a postdoc in Basel, Switzerland, from 1997-1998. In the same year, she was appointed as Privatdozent at the University of Kiel and was invited in 2000 as a Visiting Fellow in the School of Chemistry at The University of Melbourne. In January 2003, Uta Wille moved permanently to Australia, where she was appointed as a Lecturer in the School of Chemistry at The University of Melbourne. In 2006, she was promoted to Senior Lecturer, in 2011 to Associate Professor and Reader and in 2019 to Professor (the second female Professor in the School of Chemistry at Melbourne University). Her research program targets the chemistry of reactive intermediates by merging radicals of atmospheric importance with organic and bio-organic chemistry.

Dr Caroline Kyi is a specialist wall paintings conservator with over 20 years of local and international experience as a conservator and conservation scientist. Caroline has worked in the higher education, cultural and commercial sectors on moveable and immoveable cultural heritage. She trained as a conservator in London and has a PhD in chemistry (the application of free radical chemistry in the control of biodeterioration of cultural heritage). Her practical and technical skills in project management, materials analysis and research and development of conservation interventions have seen her working on wide range of significant local and international sites and objects, including Keith Haring Mural in Collingwood for Creative Victoria and Collingwood Arts Precinct - recently award a Living Heritage grant for

conservation works. Specific research interests include the bio-deterioration of cultural materials, the testing of materials for conservation applications and monitoring of cultural heritage as a measure in preventive conservation.

Places limited, bookings essential! *Cocktail function from 6:00pm.* **Register online** now at https://rsv.org.au/events/free-radicals/, call or email the RSV office to secure your place: 9663 5259, rsv@rsv.org.au. Fully subscribed **RSV Members** can access discounted tickets by registering via their online profile, or entering their **promotional code** in the online ticketing window.

Epilepsy, Algorithms and AI: Personalised Seizure Forecasting

Thursday, 28th November at 7:00pm

Speaker:
Professor David Grayden
Clifford Chair of Neural Engineering,
Department of Engineering
The University of Melbourne

Image: Frank Dicksee, The crisis, 1891, oil on canvas, 122.4 × 158.1 cm, National Gallery of Victoria, Melbourne

Epilepsy is a common and serious neurological disorder, characterised by recurrent seizures, affecting over 60 million people worldwide.

Between 30-40% of sufferers' seizures are not adequately controlled with current therapies. The inherent unpredictability of seizures is a significant factor contributing to the risk of injury, psychosocial disability, and mortality. In these cases, the quality of life impairment compares unfavourably with other chronic illnesses such as hypertension, diabetes or heart disease, and the uncertainty of seizure occurrence is a major component of this impairment. New methods for epilepsy treatments, therapy titration and seizure forecasting are desperately needed.

Join biomedical engineer Professor David Grayden, who will explore how Artificial Intelligence technologies offer opportunities to automatically detect and even forecast epileptic seizures, which may allow new management strategies and pre-emptive therapies for seizure control to increase patient safety and quality of life.

About the speaker:

Professor David Grayden is the Clifford Chair of Neural Engineering in the Department of Biomedical Engineering and the Graeme Clark Institute for Biomedical Engineering at The University of Melbourne.

Professor Grayden's main research interests are in understanding how the brain processes information, how best to present information to the brain using medical bionics, such as the bionic ear and bionic eye, and how to record information from the brain, such as for brain-computer interfaces. He is also conducting research in epileptic seizure prediction and electrical stimulation to prevent or stop epileptic seizures, and in electrical stimulation of the vagus nerve to control inflammatory bowel disease.

Professor Grayden teaches BioDesign Innovation, an exciting hands-on program that has led to many start-up MedTech companies.

Places limited, bookings essential! *Cocktail function from 6:00pm.* **Register online** now at https://rsv.org.au/events/seizure-forecasting/, call or email the RSV office to secure your place: 9663 5259, rsv@rsv.org.au. Fully subscribed **RSV Members** can access discounted tickets by registering via their online profile, or entering their **promotional code** in the online ticketing window.

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Nominations for RSV Membership

Nominations for membership of the Society have been received on behalf of:

Professor Rodney **KEENAN**, Professor of Forest Science, The University of Melbourne
Dr Douglas **BRUMLEY**, Lecturer in Applied Mathematics, The University of Melbourne
Miss Serena **GALLOZZI**, PhD Student, Monash University
Mr Tim **O'HARE**, Student, The University of Melbourne

Unless Members request a ballot, these will be considered for election by Council and if elected, will be announced at the Ordinary Meeting of the Royal Society of Victoria to be held on 14th November 2019. Recently elected members who have not yet signed the Society's membership book are warmly invited to attend the 10th October meeting to be formally welcomed as members. **Please inform the office if you plan to attend, so we can prepare your membership certificate and welcome pack for collection.**

Valete

The Council of the Royal Society of Victoria marks with sadness the recent passing of the following members:

Professor Penny Whetton, 1958 -2019

A distinguished climatologist and a Lead Author to the 4th Assessment Report of the IPCC, for which the group was awarded a Nobel Peace Prize in 2007. A member since 2018.

Mrs Kay Thorne, 1940 – 2019

A pioneer of information technology in Australia and an accomplished proponent of cross-sector collaboration. A member since 2009.

Professor Emeritus Harold Clifford, 1927 - 2019

A distinguished Professor of Botany, pursuing a lifelong fascination with plant genetics following a 180 square kilometre assay of the eucalypts of the Dandenong Ranges in the 1950s. A member since 1949.

We extend our condolences to family, loved ones and all who grieve the loss of a valued friend and colleague. We take great pride in their lives' work and accomplishments.

Memorial service for Owen White
November 11 at 2pm, Fawkner Cemetery

Owen White MRSV passed away in Toronto, Canada on 23 June, 2018, aged 92. He was President of the International Association for Engineering Geology and the Environment from 1986 to 1990, and made a point of attending RSV events during his frequent visits to his home town of Melbourne.

Although Owen lived in Toronto for 60 years he always made it clear that, after his death, he wanted his ashes to be taken back to Melbourne for burial. To follow his wishes, the family will be having a Committal Service at Fawkner Cemetery on November 11 at 2 p.m., with a reception to follow in the Fawkner Tea Rooms. If you recall Owen and would like to honour his legacy, Elizabeth and family would welcome your attendance at the Service.

The cemetery has forwarded the following directions to the burial site: "*Enter the Fawkner Cemetery at 1187 Sydney Road, Fawkner, drive through the main gates and go straight ahead past the gatehouse and drive over the railway lines. Go around the roundabout passing Second Avenue, Fourth Avenue and Sixth Avenue until you get to Seventh Avenue and turn left. Keep driving down Seventh Avenue to the first street on the left (First Crescent), turn left and park the car. Walk to the first path on the right and walk past the first double row of graves, go to the second double row and you will find the grave at the very end, where you stand.*

RSV Policy and Advocacy: *Member Consultation*

State of the Environment Report 2018

Proposed Response by the Royal Society of Victoria

Members of the RSV were presented with an overview of the report's many findings and recommendations at a meeting in May 2019.

Of all the recommendations made by the Commissioner for the Environment, the RSV has opted to strongly support one of the recommendations made under the topic of Biodiversity. The Society particularly notes the report's following conclusion:

Most biodiversity indicators are poor and trending downwards. There are 23 main indicators, but several are divided into sub-indicators, giving a total of 33 indicators. More than 20 are poor, 7 are fair and none are good. 18 indicators show deterioration, 7 are stable, and only one (private land conservation) is trending up.

The report makes the following observations:

- The available data and science are inadequate to answer many of the critical questions about biodiversity condition and extent in Victoria.
- Different and inconsistent data sources and terminology make for problematic reporting on biodiversity.
- A lack of coordination and strategic approach to research investment is hindering decision making.

Recommendation: That DELWP improve biodiversity outcomes on public land by **streamlining and coordinating governance arrangements** for investment in environmental management, monitoring and data gathering across all government biodiversity programs.

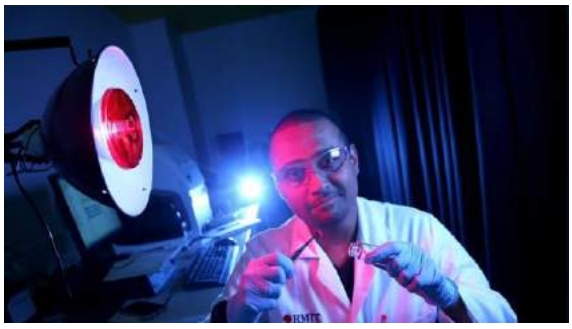
Further, that DELWP **establish the position of Chief Biodiversity Scientist** to oversee this combined effort and provide appropriate and timely counsel to the Secretary and to the Environment Minister.

In addition to this recommendation, the RSV strongly advocates that DELWP provides more resourcing for practical 'on the ground' programs that can reverse the parlous decline in the State's biodiversity. Merely monitoring and reporting on continuously deteriorating trends is unsatisfactory and demoralising. Enhanced partnerships with dedicated private landowners, traditional owners and philanthropic organisations is one way to improve outcomes.

* * *

*Members are asked to provide feedback on this position statement to **Dr Peter Baines**, Chair of the RSV Policy and Advocacy Committee, by no later than 30 October 2019, to inform the final position to be approved by the RSV Council. Peter can be reached at p.baines@unimelb.edu.au .*

Self-Cleaning Clothes, Wound-Healing Textiles and Real-Time Biological Imaging – the 2019 Phillip Law Postdoctoral Award



Successful commercialisation is a coveted indicator of impact for research institutions and Commonwealth funding schemes alike; it's so much easier to demonstrate a return on investment from our research sector when our scientists produce knowledge products that influence markets and improve our quality of living. Yet too few outside the research trenches appreciate that breakthroughs with high market potential stand on the shoulders of many decades of

investment in inquiry-led, or "pure" research. The work of thousands of skilled scientists in chemistry, physics, mathematics, engineering and biology has built a body of knowledge that now fuels our contemporary revolution in materials science. The incredible innovations being produced in both medical and domestic settings are the outputs of an accumulated wisdom and blurring of disciplinary boundaries between fields of scientific inquiry.

Yet it falls to the current generation to interpret, interrogate and extend this vast and impossibly complex body of knowledge, recognising the relationships and patterns within to see the opportunities for new applications, waiting to be explored and activated.

With **Dr Rajesh Ramanathan**, we encounter a special example of a scholar exploring the knowledge base from traditionally separate fields of scientific inquiry. First trained as a biologist, Rajesh combined his PhD work in materials science to consolidate expertise across the chemical, physical and biological sciences, enabling him to develop and contribute to research projects across disciplinary boundaries. Rajesh's interdisciplinary work is based on understanding the fundamental properties of **nanoparticles** – particles a billion times smaller than a metre – and exploiting these properties to develop a range of next-generation biomedical technologies. The focus of his research interfaces **nanotechnology** and **biology**, including sensor processes and diagnostics, antimicrobial and wound management and imaging applications to create a remarkable diversity of new applications and products with high commercial potential.

As always, our assessors worked diligently through a pile of applications that grows, year on year, commensurate with the growth in Victoria's remarkable pool of talent in a vibrant field. In a typically competitive field, Dr Rajesh Ramanathan has emerged as the lead applicant and will be awarded the Phillip Law Postdoctoral Award for the Physical Sciences on the evening of **Thursday, 24th October**, where Rajesh will present us with an insight to his exciting work.

Join us for Nanoparticles: Exploiting Colour and Light and help us to celebrate the accomplishments of this high-achieving, Victorian early career researcher. Details, including registrations, are included earlier in this newsletter.

About Dr Rajesh Ramanathan

Rajesh is a Senior Lecturer and co-lead of the **NanoBiotechnology Research Laboratory** (NBRL) at **RMIT University's School of Science**. His research in the area of bio-electrochemistry has led to the use of different bacteria as 'nano-factories' to achieve eco-friendly synthesis of nanoparticles. Dr Ramanathan employs electrochemistry to understand bio-geochemical processes within individual bacterial cells leading to the discovery of new enzymes involved in biogeochemical processes and gaining new insights into microbial biogeochemical pathways.

In addition to collaborations with CSIRO and other national research institutions, Dr Ramanathan has developed an extensive international network of collaborators at institutions such as University of Waterloo (Canada), Pacific Northwest National Laboratory (PNNL) (USA), University of Massachusetts (USA) and Martin Luther University (Germany). The high prospect for commercial applications in the biomedical space has resulted in his work being shortlisted as one of the Top 50 life-changing innovative designs by INDEX: Design to Improve Life Denmark (2017). He is also a recipient of numerous awards and prizes.

Rajesh attained his Bachelor of Science from the University of Mumbai, India before moving to Australia to pursue a Master of Biotechnology from RMIT. Following a brief stint in industry after his Master's degree, Rajesh moved back to academia to complete his PhD in **nanobiotechnology** with RMIT and is now a Senior Lecturer within the School of Science. He is also the Treasurer for the Victorian Branch of the **Royal Australian Chemical Institute** (RACI).

Victoria's Environment: Adapting to the New Normal

The Governor's Environmental Science Public Lecture

by Kate Bongiovanni

*This article follows a presentation to guests of the Governor of Victoria on 11 September 2019, featuring Dr **Pandora Hope** from the Bureau of Meteorology, Professor **Roslyn Gleadow** and Professor **Nigel Tapper** from Monash University, and Professor **Richard Eckard** and Associate Professor **Anthony Boxshall** from the University of Melbourne.*

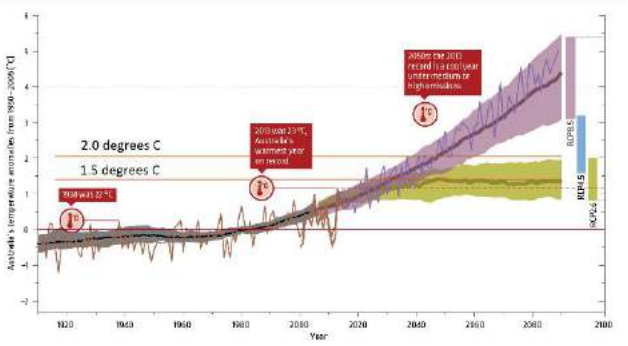
Set in the exquisite ballroom of Government House, around 500 guests were awestruck from the moment they arrived. The ballroom has had varied uses over the years - hosting 19th century balls for 2000 people, providing a temporary classroom for the early days of Mac.Robertson Girls' High School, and more recently the acrobatic performances of Circus Oz. On the evening of 11 September, the magnificent ballroom played host to a discussion on contemporary environmental science, featuring a globally-significant panel of Victorian scientists.

Official proceedings began with an introductory speech from Her Excellency the Governor, Linda Dessau. The Governor framed how we had come together under the banner of science to share methodologies and contemporary innovations, emphasising the need to learn more about science, how it shapes our environment and the important role of scientists in informing decisions about our future. The theme for the evening was how scientists can help us all adapt to Victoria's "new normal" - a warmer, drier climate.

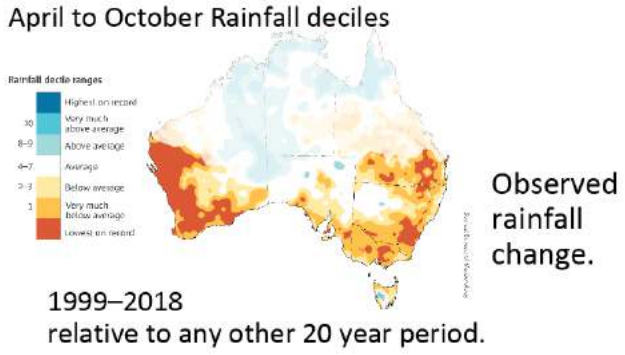
Our MC was Associate Professor **Anthony Boxshall** MRSV, an Enterprise Fellow at the University of Melbourne and the Principal of Science into Action. Anthony set the context: our climate is already changing. Under the Paris Agreement, Australia and the world's great nations have committed to reducing global temperatures to a 1.5-2°C rise over pre-industrial levels. Should this exercise prove successful, a 2°C rise will still have far-reaching climate effects, with major implications for the State of Victoria. He explained how the dramatic changes in climate we are currently experiencing have sparked research on how we can adapt and adjust to an emerging, new climate "normal." The senior scientists gathered from different institutions and sectors were briefed on helping us to understand how we could approach this challenge from a variety of angles.

The panel aimed to showcase some of the work in climate adaptation produced by Victorian scientists and, most importantly, share actions we could all take in our personal and professional lives.

Climatologist Dr **Pandora Hope** is a Principal Research Scientist with the Bureau of Meteorology. She set the scene by showing the shift in global temperature averages from 1910 to today, and also modelled projections of future temperatures until 2100.



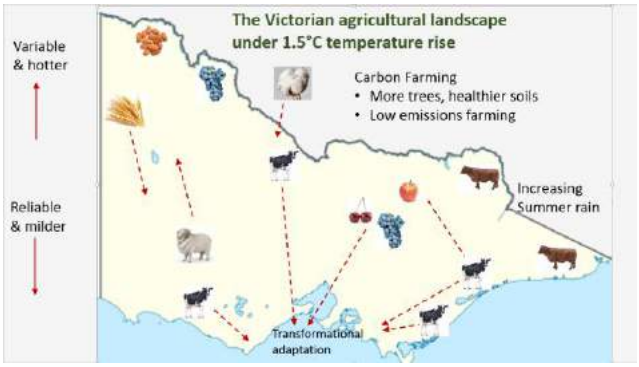
Pandora presented a graph which displayed the long term zero-line average temperature. She explained that since the 2000s our climate has been almost always above the zero-line, although there are still some isolated cold periods. In this time, we have experienced the warmest year on record, 2013. However, 2019 could be set to change this picture, as 2018-2019 was a record-breaking summer.



Pandora noted that temperature is not the only variable which responds to climate change. Rainfall changes are also becoming the new climate norm. We are experiencing new extremes such as more frequent droughts, which have significant effects on plants and animals. Additionally, there are seasonal changes characterised by reduced rainfall in winter and spring, and a slight rise in storm intensity in summer. Industry and city planners are already responding to these changes.

Agricultural scientist Professor **Richard Eckhart** followed on from Pandora, shedding light on how these climatic changes are affecting the agricultural industry. As the Director of the University of Melbourne's Primary Industries Climate Challenges Centre, he is uniquely placed to explain how some sectors are having to relocate further south because of climatic changes. Inland areas in central and northern Victoria are experiencing increased temperatures during extreme events and high variability in rainfall. Several industries, such as grain, cotton, dairy, wine and fruit, are challenged by these climatic changes. The southern coast of Victoria, moderated by the ocean, has milder temperatures and more reliable rainfall, offering more suitable conditions for these industries to make a transition.

In order to adapt to warmer climate, the dairy industry has introduced innovations in irrigation systems and the introduction of livestock insulation to protect cattle from the harsher elements. Hotter weather is pushing the dairy industry southward to places such as Gippsland and Tasmania.



The wine industry is also undergoing transformations. Some major pinot noir vineyards have already made the move south to Tasmania, while others have changed the varieties of grapes grown in Victorian vineyards. Researchers are looking into replacing wines traditionally grown in Victoria with grape varieties from Southern Italy that are acclimatised for Mediterranean conditions.

The Goulburn Valley Fruit industry may soon need to relocate south, due to a lack of a

sufficient cold period in winter. The growth of winter fruits, such as apples and pears, is reliant on a sustained chill from winter lows. If these lows are no longer reached, the winter fruit industry will need to relocate.

To minimise disruption to our agricultural sector, we need to move towards low emission carbon farming. Carbon farming involves growing more trees, promoting healthier soils and avoiding greenhouse gas emissions from the cultivation of crops and raising of animals. Sequestering carbon in plants and soils while minimising carbon emissions is a desirable function from agriculture, returning benefits to the whole planet – it is anticipated this will become an industry in its own right as we come to terms with what is required to manage the global climate.

Professor **Ros Gleadow** MRSV is a biologist at Monash University, specialising in plant physiology. Ros elaborated on Richard's points with a focus on plant adaptions to climate change.

The Earth has some ancient forests with trees that are hundreds of years old. These trees were produced under a different climate and their seedlings will no longer be suitable for our warmer climate. To overcome this obstacle in a natural way, parks need to incorporate different climatic zones; for example, both high and low elevation areas. In this way, seeds can be moved naturally (by wind and animals) to different elevations where they might demonstrate more success and adaptation across generations. To find out what kinds of plants are suitable for different environments and a new climate, Ros recommends consulting websites like "*Which Plant Where?"*.

Higher carbon dioxide concentrations in our atmosphere means plants are more efficient at photosynthesis (converting sunlight, carbon dioxide and water into sugar and oxygen). However, this high efficiency comes at the cost of a lower production of protein. The consequence of this reduction in leaf protein is that animals, such as koalas, need to either eat more leaves or change the type of leaves they eat in order to meet their nutritional needs. This problem needs to be addressed quickly, as some leaf varieties could return a third less protein in the next fifty years.

There are implications for human diets as well. For example, the same process will affect protein in wheat grains and, consequently the quality of the flour produced and its baking performance. Research is being conducted to create varieties of wheat that are most resilient to carbon dioxide. This process can take up to 15 years.

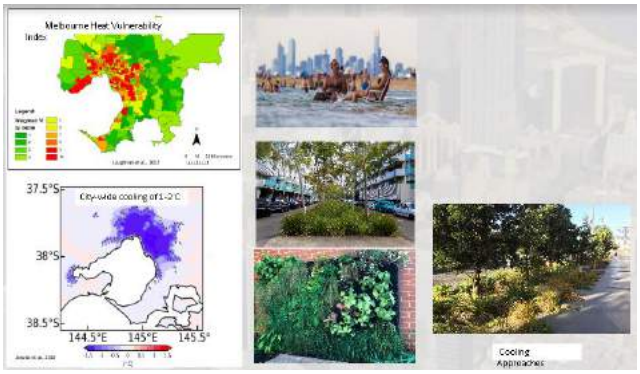
Another key human staple affected by climate change is the cassava plant, native to South America. Cassava is a carbohydrate-rich root vegetable that produces small amounts of cyanide, dependent on environmental conditions. Intensified drought results in higher cyanide concentrations, thus more toxicity. However, Ros emphasised there are steps we can take to adapt and make cassava safe. For instance, adding a bit of water to the crop just before harvesting reduces toxicity. Yet this can be difficult in many communities dependent on cassava with limited access to water. An alternative is to crush up the cassava and mix in a small amount of water before consuming, which

allows the cyanide to safely dissipate. New organisations are working to provide important education to locals to prevent risks from climate-driven physiological changes to cassava plants.

More people die of extreme heat than any other natural hazard, including fires and cyclones. Heat related deaths occur mostly in urban centres. When average daily temperatures surpass 30°C, there is a 17% spike in heat related deaths. There is a high possibility of increasing the death toll with more extreme summers.

Professor **Nigel Tapper** uncovered human health impacts and adaptions in the urban environment. Nigel is a Professor of Environmental Science at Monash University, leading a research group on Urban Climates that seeks to reduce heat wave mortality rates. Factors such as age, health, ethnicity, socio-economic status as well as tree cover in a given postcode affect the probability of heat mortality. The group aims to improve public heat health warnings and ensure the emergency services are better prepared.

Urban heat maps are used to identify and then target areas for cooling interventions and better heatwave preparedness. Through working with municipal agencies and the state government, this approach has resulted in a 50% drop in heat mortality in Melbourne in the last ten years.



Reducing heat in cities is not only necessary for human health but also to help protect infrastructure like roads, train lines, powerlines and communications. It is possible to create a cooling of 2°C on days of peak temperatures. In the built environment, simple steps such as changing the colour of roof tiles from dark (low reflectivity) to light colours (high reflectivity) enhances the Earth's natural albedo effect (reflecting solar radiation back into space) and has a big impact on urban cooling.

Increasing tree cover is another way to reduce heat in urban centres. Trees evapotranspire, which means they return water to the atmosphere and cool the air, much like how an evaporative cooling system works in your home. This means leaf temperatures are rarely above 28°C, making trees much more effective than a shade cloth on hot days. City councils are working on which trees are more suitable for different areas, depending on the anticipated conditions under a new climate regime. Most large cities around the world are increasing their tree cover. This process takes years to decades to establish, and must begin without delay to secure the desired outcomes for Victoria's urban areas.

Further innovation involves harvesting stormwater to support green infrastructure (green walls, green roofs, nature strips and swales), which further cools the urban environment, mitigates flooding from heavier rainfall and assists with cleaning the air of particulate pollution.

The Panellists, from left: Professor Nigel Tapper, Professor Richard Eckard, Dr Pandora Hope, Associate Professor Anthony Boxshall, Professor Roslyn Gleadow.

To end the night's conversation, the panellists each left us with one tip that would assist with adaptation to the new normal.

Nigel urged people to look out for our neighbours, especially the elderly, during the extreme heat waves we're anticipating. Adaptation is being led at the local government level, so we should aim to encourage our municipalities to embrace the strategies, developed in collaboration with our scientists.

Pandora urged people to ensure we stay informed by checking forecasts from the Bureau of Meteorology, including the Bureau's new heatwave service, and then responding appropriately. She also encouraged people to check on neighbours and stay cool during warm weather events.

Ros unashamedly advocated for investment in plant adaptation science and urged us all to plant a tree – the right tree, suitable for a changing Victorian climate.

Richard's tip was to support local farmers by purchasing local Victorian produce, as they will be bearing the brunt of economic disruption from Victoria's changing climate, and will be making large transitions in the coming decades.

On close, guests were left to ponder and discuss the evening's ideas with fellow guests and the panellists while enjoying the hospitality of the Governor and exploring the beautiful rooms of Government House.

Stories from the Cosmos

by Catriona Nguyen-Robertson MRSV

"The only way we're going to move forward is with modern science and ancient knowledge" – Uncle Dave Wandin of Wurundjeri Country.

To celebrate National Science Week, the Royal Society of Victoria hosted an edition of the Melbourne School of Psychology's "Psychtalks" program on the evening of **14th August, 2019**. The expert panel convened under the title "Stories from the Cosmos: What Indigenous storytelling can teach us about memory."

For 65,000 years, the night sky has been a map for Indigenous Australians. They have created complex knowledge systems using features of the sky and land that have been passed down across generations, being among the most complete and intact oral traditions known worldwide.

Ms Kat Clarke is a learner and listener from Wotjobaluk Country, near Horsham. Growing up, she would often sit and have yarns with the Elders, listening to their stories with great interest. Kat shared her father, Thomas Clarke's, artwork with us, telling the story of

Ngindal, the dark emu, as told by community Elders around a campfire:

"Ngindal terrorised Wotjobaluk Country. In an attempt to end her reign of terror, one of the Bram Bram Brothers tracked her down but was attacked in the process. The two remaining Bram Bram Brothers came looking for their missing Brother and also decided to hunt Ngindal. Ngindal chased them across the country; through the mountains, smashing open rocks as she did so, and that formed the jagged paths that we see in the Grampians today. The Bram Bram Brothers waited to ambush her in a crevice and speared her. She fell and her blood flowed into the Wimmera River. In the sky, there is a dark spot in the Southern Cross formation. That is Ngindal's prison. The smaller star to the right is her eye, still looking for a way to escape, and the Bram Bram Brothers are the stars on either side, guarding her."

These stories and lessons are what Kat holds most dear. Art, songs and stories are how lessons are remembered and passed down generation after generation.

Associate Professor Duane Hamacher works to bring the two worlds of Indigenous knowledge, culture and modern science together. The stories and teachings of Aboriginal and Torres Strait Islander people were about figuring out how the world works – "that is science at its roots". As Duane learned more about their many stories, he "started to see all the layers of science behind them". Modern science endeavours to find universal truths and Indigenous Australian knowledge is similar, yet more dependent on location – it is tied to the land, and the stories in the stars of the sky encodes the management systems and cycles that have assisted Indigenous custodians in caring for and producing livelihood from the land over many thousands of years.

Duane was told by an Elder "if you know how to read the stars, then you know how to predict everything you need to know". For example, fuzzy, blue, twinkling stars in the sky signal an imminent storm. As an astrophysicist, Duane realised that modern science also supports this. The stars twinkle due to wind, appearing fuzzy due to the dense atmosphere, and lastly, cold, atmospheric water is poor at absorbing blue light and so reflects it, causing the stars to appear blue. It's a robust system for prediction.

Dr Simon Cropper, Melbourne School of Psychology, loves gazing at stars in the sky. Originally from the Northern Hemisphere, he remembers lying on his back outside the Melbourne city haze for the first time and being awestruck at the night sky – with very familiar features to what he was used to, only upside down. He is interested in what inspires us to group stars together as shapes. Someone at one point must have connected dots to see an image, and then shared the star configuration they saw so that it became widespread knowledge today. The fact that the night sky looked similar on either side of the world shows how reliable it is as a map. We change our land, but it's harder to alter the sky, "so we rely on it to ground us". Because it is easiest to remember a story or song lyrics than a set of words, lessons have been imbedded in stories and songs to become the lasting teachings across thousands of years.

From rear left: Uncle Dave Wandin, Ms Kat Clarke, A/Prof Duane Hamacher. From front left: Dr Lynne Kelly, Dr Meredith McKague (MC), Dr Simon Cropper.

Traditional Indigenous knowledge systems enable people to remember vast amounts of information – all that knowledge, built up over millennia. Author of "Memory Craft" and more recently "The Memory Code," **Dr Lynne Kelly** made it her mission to learn how they do it. She found that repetition makes for good recall, so songs, dances, stories and places are used to deeply embed associated

knowledge in the collective memory. Indigenous cultures all over the world also use hand-held devices as memory aids; for example, wood covered in coloured stones, shells or patterns that encode masses of associated information, or cylinders carved with glyphs. At the same time, not all knowledge is shared; Lynne spoke of the concept of restricted and specialised knowledge, noting that if you talk too much about a high concept without suitable rules and structures in place to guide interpretation and retention, then its meaning may become corrupted. This is how Indigenous knowledge is protected and preserved, and Lynne has put the practice to good use in her own life and geographical context in Castlemaine.

We should be learning more from Indigenous Australians. They are knowledgeable and have many lessons to teach about our country. Duane has partnered with elders and communities to develop materials to bring Aboriginal culture into the Australian curriculum, and Lynne has already shown that traditional memory systems work very well with teaching the very young. Simon and Kat believe that Aboriginal culture and a connection with the land can help us feel more coherent in our own lives, particularly when we are feeling lost or alone.

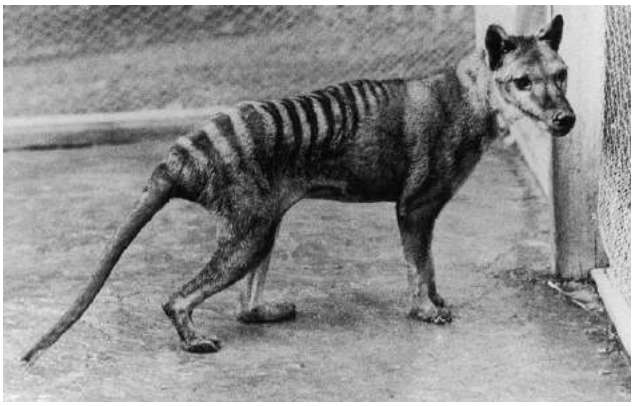
Indigenous cultures have a deep emotional investment and attachment to the landscape that acts as both a textbook and encyclopaedia. It's amazing that different cultures separated by vast oceans and continents have independently perceived the patterns in constellations in strikingly similar ways, despite being geographically and temporally separated. Stories from the cosmos give both guidance and spiritual comfort, and this way of telling stories and reading the stars is a constant across generations.

Thanks to all our speakers and colleagues from the Melbourne School of Psychological Sciences for a fascinating evening! Livestream footage of proceedings is available to view online from the RSV's Facebook page at https://www.facebook.com/royalsocietyvictoria/videos/vl.2282388202000129/2288490491240125/

The Thylacine – Once Threatened, Now Extinct

by Priya Mohandoss MRSV

Restoring the health of our native flora and fauna is of vital importance to all who share our planet's ecosphere. Each year, September 7th is **National Threatened Species Day**, with a focus on ensuring that we, as citizens, can be made aware of those species that are threatened with extinction and preserve our national heritage through sound decisions.



September 7th marks the day when the last Tasmanian tiger, known as 'Benjamin', passed away in Hobart Zoo in 1936, marking the end of the thylacine species. In appearance, the Tasmanian tiger was light yellowish-brown to grey, with defined dark stripes along its body and a wolf-like tail. It was diurnal, however mainly hunted on kangaroos, other marsupials and birds at night. Although ithis species could be primarily found throughout Australia, in the past few millennia it was only to be found on the northern and eastern coastline and midland areas of Tasmania.

The thylacine's extinction is thought to have come about due to the introduction of dogs, a rival apex predator, and European settlers culling the species' numbers over competition for sheep. On the sixtieth anniversary of its extinction, National Threatened Species Day was established and is now considered a day to not only think about this unique creature but also to dwell on the vast number of Australian plant and animal species that may soon face the same fate.

While in Australia we are fortunate to have a great diversity of species, supported by our

similarly diverse ecosystems, there are still a number of factors that can impact on population health. These include the introduction of competing, feral species like rabbits, the introduction of feral predators like cats and foxes, and the loss of native habitat due to human disruption. Human activities contribute to the erosion of fragile soils, and the destruction of plant communities through the incursion of agriculture, development and invasive weeds, as well as air, land and water pollution.

So while National Threatened Species Day reminds us of those species we have lost, it is also an opportunity to explore actions we can take to save those currently facing further decline and extinction.

Our Valuable Waste

by Catriona Nguyen-Robertson MRSV

This article follows a presentation to the Society on 17 August titled "The Alchemist: Turning Waste into Wealth" by ARC Laureate Professor Veena Sahajwalla, Founding Director of the Centre for Sustainable Materials Research and Technology at the University of New South Wales.

"We all contribute to the waste problem, but much of it is really a resource that's waiting for its next life" – Veena Sahajwalla, UNSW.

Professor Veena Sahajwalla decided to become an engineer after breaking a ceramic sink when trying to crack open a coconut. She discovered that she liked pulling things apart. After growing up in Mumbai, she studied in Canada, the US, and then moved to Australia – where a major waste crisis is now unfolding.

To this day she still tears things apart – but is now exploring how she can repurpose the resulting materials. She is pioneering the establishment of micro-factories in Australia to transform waste materials into something of value.

Much of the waste generated in Australia is currently shipped offshore, to be dealt with by other countries, often in less than satisfactory conditions for human health and wellbeing. Veena argues that "if we want a better planet, we should be wanting a better planet for everyone." Stockpiling waste, whether in Australia or elsewhere, can cause harm to communities and the environment in the form of pollution and fire hazards.

Australia, along with many other countries, shipped its recyclable plastic waste to China for many years, which came to an end in 2018. Following China's ban on receiving recycled waste, Indonesia, Malaysia and Thailand have become dumping grounds, but even they have started to send some of our waste back. Australia does not have strong recycling infrastructure as we have never been impelled to develop it – accordingly, our only solution to the situation has been to send what was originally intended for recycling to landfill. Due to the global shift in waste markets, the pressure is mounting on countries like Australia to start dealing with their own waste onshore. We need innovative methods of processing recyclable waste, and we need them fast.

Professor Veena Sahajwalla with a selection of materials and consumables produced with her prototype microfactory at UNSW.

Instead of shipping waste offshore, we could be harvesting the high value materials in our waste. Each year, 50 million tonnes of e-waste is produced globally. In Australia alone, and fewer than 1.5% of the 4 million computers sold a year are recycled. The total value of the resources embedded in them approximates $70 billion. At the micro-level, computers contain complex arrays of metals, plastic polymers, and glass fibres. Plastics in computer monitors can be used to produce plastic filaments for 3D-printing. The copper in circuit boards is 10 times more concentrated than what is mined in copper ore – looking at a photo of computers piled up in landfill, Veena says "here is a mine sitting above ground yet we let it go to waste." With the Victorian government now banning the disposal of e-waste in landfill, the pressure is on to turn this dilemma into an opportunity.

Computers are not the only objects that contain valuable resource we let go to waste. Batteries contain many rare Earth metals, and packaging contains aluminium that can be recycled into a high grade resource through chemical methods rather than energy-hungry smelting. Veena wants to put all these raw materials all back into the supply chain to "close the loop" of the economy, as close as possible to the point of consumption to mitigate carbon emissions from transportation. The idea is that waste management organisations will harvest materials in waste and either on-sell them to manufacturing companies to make new products, or manufacture products directly on site – and the cycle repeats. In a collaboration between researchers, the government, manufacturers and retailers, materials can be extracted from our waste and reformed into new products. We talk about three R's: reduce, reuse, and recycle. Veena offers a fourth: **reform.**

Veena's SMaRT Centre is currently establishing microfactories in New South Wales. Everyone can be part of the change: the owners of waste materials, designers and manufacturers, and the end users. It would be fantastic to see the initiative, and the opportunities for wealth and jobs creation, gain ground here in Victoria.

Veena is committed to deliver new science, processes and technologies that will drive the redirection of waste from landfills back into production. This will simultaneously reduce production costs and alleviate pressures on the environment from pollution and mining to source new materials. She sees waste as an opportunity rather than a problem – "a positive for our planet and people".

* * *

Our thanks to Veena for generously sharing her Centre's work with us for National Science Week! Video footage of her presentation is available from the Society's Facebook page at https://www.facebook.com/royalsocietyvictoria/videos/vl.2282388202000129/653880178452057/ .

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