The Royal Society of Victoria
Promoting science since 1854

SCIENCE VICTORIA

NEWS FROM THE ROYAL SOCIETY OF VICTORIA

OCTOBER 2021

THE OFFICIAL NEWSLETTER OF RSV

In this issue

ISSUE 11

News and notices

New RSV Members

Mrs Andrea Zanin
RETIRED

Adjunct Associate Professor Owen Richards
ENGINEER - MCGREGOR COXALL

Associate Professor Kim Dowling
GEOLOGIST - FEDERATION UNIVERSITY AUSTRALIA

Unless Members request a ballot, these will be considered by Council and, if elected, will be confirmed at the next Ordinary Meeting of the Royal Society of Victoria.

Restoring Ecosystems & Recovering Resources – The Royal Society Of Victoria's 2021 Research Medallist

Announcing the Royal Society of Victoria's 2021 Research Medallist, Distinguished Professor Andrew Ball

The Royal Society of Victoria (RSV) is delighted to announce the 2021 recipient of the RSV's prestigious Medal for Excellence in Scientific Research – **Distinguished Professor Andrew Ball**, Director of the ARC Training Centre for the Transformation of Australia's Biosolids Resource at **RMIT University.**

With deep expertise in environmental microbiology and biotechnology, Professor Ball was, until recently, the Director of the Centre for Environmental Sustainability and Remediation (EnSuRe) at RMIT. His research focuses on developing clean, sustainable technologies to remediate environmental contamination, looking for ways of removing contaminants – particularly petroleum hydro-carbons (oil), but also other organic pollutants – from soils, groundwater and water bodies. The process of using naturally occurring microorganisms in both drawing out contaminants and restoring an ecosystem's original microbiome is called bioremediation.

Andy and his team have contributed to cleaning up contaminated sites all around our highly industrialised world. As no local ecosystem is quite like another when it comes to microbiological communities, new and innovative approaches are always required when approaching each contaminated site. The work begins in the laboratory, then is scaled up for impactful and commercially successful applications in the field. While this has resulted in millions of dollars in cost savings to industry and the far greater value of a cleaner environment, the constant process of translating discovery into application has contributed a wealth of research and teaching experience to the State of Victoria in the fields of algal biotechnology, bioremediation, organic (biosolid) waste treatment

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and environmental microbiology.

According to RSV assessment panel member **Professor Richard Reina** (left), "Professor Ball's highly applied work has had significant impact on local and international bioremediation projects; the technology is scalable and focused on real-world problems."

> "Andy has an excellent record of leadership and training of many academic and industry partners."

"I have heard story after story of him going out of his way to help people out," explains **Professor Oliver Jones**, the Associate Dean of Biosciences and Food Technology at RMIT's School of Science (left).

> "He is not only an exceptional scientist, but also an outstanding role model in science and in general. He takes an active interest in his PhD students and postdocs and other staff and helps them to be the best they can be and inspires others to act in the same way, and this is perhaps the greatest impact of all."

Professor Andy Ball (second from left) with the Environmental Biotechnology Group. Source: RMIT University

This year's assessment panel members had a "tough choice" according to the Royal Society of Victoria's President, **Rob Gell AM** (left). "Victoria has a truly remarkable community of researchers in the biological sciences, all working across diverse fields and sectors – it's really hard to weigh and compare their many achievements relative to each other. But Professor Ball's impressive impact across many disciplines certainly portrays a researcher at the top of the game, and I'm delighted by the panel's final recommendation."

> "I really hope we'll see the other nominees back in the assessment pool the next time this category comes around in 2025. They are universally high achievers and it's certainly a testament to the standard of Andy's work that he's come out ahead of such a competitive field."

The Royal Society of Victoria congratulates Distinguished Professor Andrew Ball, the 2021 recipient of the RSV Medal for Excellence in Scientific Research. Andy will be presenting his work to the Society at a public lecture on the evening of 9th December, 2021, where he will be presented with the 2021 Medal by the Society's Patron, the Governor of Victoria.

About the Medal

Inaugurated in 1959, this year the RSV Research Medal was awarded in Category I – the Biological Sciences. The Medal for Excellence in Scientific Research recognises peak research career achievements and outstanding leadership in research by Australian scientists, particularly those conducting work within (or about) the State of Victoria.

About the Medallist

Professor Andrew Ball began his career as a Research Fellow at Liverpool University, UK, then as a Reader at the University of Essex, UK. In April 2005, Andy was appointed Chair of Environmental Biotechnology at Flinders University, Australia.

He has performed a number of key institutional roles for each university at which he was based over the past 30 years. At the University of Essex UK, Andy was Director of the Centre for Environment and Society. At Flinders University, he was appointed Director and Chair of Flinders Bioremediation.

Andy was appointed Professor in Environmental Microbiology at RMIT University in 2012, and Distinguished Professor in 2016. There, he established and served as

Director of a new Research Centre for Environment, Sustainability and Remediation (EnSuRe) and now serves as Director of the ARC Training Centre for the Transformation of Australia's Biosolids Resource.

Andy has generated internationally acclaimed research outputs since 1985. He has over 300 peer reviewed publications cited 11,000 times in total, with an annual citation average above 1200 over the past 3 years with an h-index of 54 (Google) and 42 (Scopus). In addition, Andy has published 6 books (3 as author and 3 as editor) and written 42 book chapters. He currently has three provisional and three full international patents.

Andy has consistently received Category 1 funding from sources including the Australian Research Council, Australia-India Strategic Research Fund, and the Department of Agriculture, amounting to over $25M in grant funding. He has developed the support of several, key partner industries, including: Environmental and Earth Sciences International (2008-present, bioremediation of Kuwait sands), Coffey International (2012-present, bioremediation of chlorinated hydrocarbons), Thales (2015-2017, bioremediation of munition waste), Victorian EPA (2014-2016, application of molecular biological techniques to commercial bioremediation), CRC CARE (2007-2010, the potential for natural attenuation to clean up oil contamination), COMET Resources (2006-2010, National solution to tank bottom) and Shell (2003-2006, natural attenuation of a contaminated sandstone aquifer). At Flinders University, Andy was Technical Director of a wholly university-owned spinoff company, Flinders Bioremediation (2005-2010), subsequently leading the company as Chair (2010-2012).

Andy has headed the Environmental Biotechnology Group, now at RMIT University (previously based at Essex University and Flinders University), since 1995. Andy has brought a wealth of research and teaching expertise to RMIT University at an international level, particularly in the fields of bioremediation, organic waste treatment, and environmental fate of organic pollutants. He has supervised 30 postgraduate research students in the past 10 years.

Opening Biomolecular Pathways: The 2021 Phillip Law Postdoctoral Award

"Dr Draper-Joyce is already making significant advances in our understanding of the molecular mechanisms involved in drug binding and action on membrane receptors; this is a vital area of research."

– Professor Sandra Rees FRSV, assessor

The Royal Society of Victoria is delighted to congratulate Dr Christopher Draper-Joyce, the 2021 recipient of the Phillip Law Postdoctoral Award, and the first to be awarded in the new category of Biomedical and Health Sciences.

Assessment panel member **Professor David Walker** MRSV remarked that "of all the candidates, Dr Draper-Joyce probably shows the most independent ability to drive his work forward in a targeted manner."

Christopher attained his PhD from Monash University in 2017, working with the Monash Institute of Pharmaceutical Sciences (MIPS) under the supervision of Dr J Robert Lane and Dr David Thal to characterise the biomolecular actions of the dopamine D2 receptor using pharmacological assays, molecular biology and biochemistry techniques. He continued on with MIPS as a Postdoctoral Fellow, extending his analytical and molecular pharmacology skillset into the field of structural biology, with a particular focus on "solving" – revealing – the structures of a family of cell surface receptors, the G Protein-Coupled Receptor (GPCR) G protein complexes with new methodologies, opening the door to new opportunities for therapeutic drug discoveries. Christopher commends the training and mentorship he received from GPCR research leaders Professor Arthur Christopoulos, Professor Patrick Sexton and Dr Alisa Glukhova at MIPS, who have "a long and successful track record or mentoring early career research fellows."

Now based at the Florey Institute of Neuroscience and Mental Health as an ARC DECRA Fellow, Dr Draper-Joyce has joined a multi-disciplinary team under the mentorship of Professor Ross Bathgate and Associate Professor Daniel Scott, who combine expertise in protein engineering and peptide pharmacology at their laboratory within the Florey's Discovery Sciences division. Christopher is currently working with A/Professor Scott on several protein engineering projects, including developing lead proteins that bind to the S glycoprotein (Spike) of SARS-CoV-2 and may have the ability to act as novel antiviral agents.

Further, they have begun a collaboration with Professor Claus Løland at the University of Copenhagen to use protein engineering efforts to aid in the molecular characterisation of the human dopamine transporter, an important target for Attention Deficit Hyperactivity Disorder, Bipolar Disorder, clinical depression and substance use disorders. Concurrently, Christopher is working with Professor Bathgate's and Professor Paul Gooley's team to help solve GPCR structures concerned with the peptide relaxin to enable further structure-based drug design.

Dr Draper-Joyce has received multiple awards, prizes, scholarships and selections across his research career to date, including the Asia-Pacific Protein Association Young Scientist Award in 2020, and has made excellent progress in securing substantial grant funding towards his continuing research, including an ARC DECRA funding and an NHMRC Ideas Grant, with support from the Florey Innovation Fund and Perpetual's 2021 IMPACT Philanthropy Application Program. He is clearly focused on contributing to the further development of the research sector, with placements in a number of specialised training programs in both academic leadership and the commercialisation and translation of biomedical research.

Most significantly, the Award recognises Christopher's contribution to developing the skills and careers of more junior scientists, which is "very high with regard to research supervision of PhDs, Masters, Honours and undergraduates," according to assessment panel member Dr Jane Canestra MRSV.

Please join us in congratulating Christopher. We also convey our gratitude to our assessment panellists for their challenging work in weighing the merits of a very competitive field of entries this year:

Dr Gavin Smith MRSV, **Dr Jane Canestra MRSV**, **Professor David Walker MRSV** and **Professor Sandra Rees FRSV.** Our thanks to you all.

Dr Draper-Joyce will be presenting a public lecture on his work to the Royal Society of Victoria on Thursday, 25 November at 6:30pm titled "Improving Drug Discovery: A Molecular Understanding of Cell Surface Receptors," where he will be presented with the 2021 Phillip Law Postdoctoral Award and a prize of $3,000.

About Dr Christopher Draper-Joyce

Dr Christopher Draper-Joyce is an ARC DECRA Fellow with the Florey Institute of Neuroscience and Mental Health and a Lecturer on Drug Discovery with the University of Melbourne's Faculty of Medicine, Dentistry and Health Sciences. He was previously a Postdoctoral Fellow at the Monash Institute of Pharmaceutical Sciences, where he earlier completed his PhD on the biomolecular actions of the dopamine D2 receptor using pharmacological assays, molecular biology and biochemistry techniques.

Christopher's postdoctoral work has extended his analytical and molecular pharmacology skillset into the field of structural biology, with a particular focus on solving and stabilising the GPCR-G protein complexes, to shed new light on the molecular mechanisms of drug-receptor action. He has contributed to the collective pandemic effort with colleagues at the Florey, bringing the Institute's collective skillset in protein engineering to bear on SARS-CoV-2, developing novel lead proteins that can bind to the S glycoprotein (Spike) of the virus, and may be useful as antiviral agents.

Dr Draper-Joyce's efforts have been recognised with an ARC Discovery Early Career Researcher Award and the Asia-Pacific Protein Association Young Scientist Award in 2020 and, in 2021, he is the recipient of the Royal Society of Victoria's Phillip Law Postdoctoral Award in Category II: Biomedical and Health Sciences.

About the Phillip Law Postdoctoral Award

This Award was made possible from the generous bequest to the Society from the estate of the late Dr Phillip Garth Law AC (1912-2010), a leader of the Australian National Antarctic Research Expeditions that established our nation's bases in the southernmost continent, and a former President of the Royal Society of Victoria. The award is for excellence in scientific research by an early career researcher within seven years of attaining a PhD from a Victorian research institution. Allowances are made for career interruptions due to parenting obligations.

DAAD – VIC Research Funding Scheme

The Victoria-Germany Bilateral Academic Exchange Program, delivered by veski and the German Academic Exchange Service (DAAD), is designed to improve international relations and encourage bilateral research cooperation with German universities.

Who can apply?

Applications are invited from academics and scientists who have completed a doctoral degree and work at a university in Victoria. The program is open to applicants across all fields.

What can be funded?

Funding can support onsite research, from 14 days to three months, at state or state-recognised institutions of higher education or non-university research institutes in Germany. Funding cannot be used to fund lecture tours or visits to congresses.

Academics from Victoria must be working at a Victorian university on a genuinely collaborative research project with German partners, not furthering their individual research in Germany (or vice versa).

The length of the grant is determined by the selection committee and depends on the project in question and the applicant's work schedule. The grant is non-renewable.

How is the selection made?

An independent selection committee reviews applications based on academic achievements and the research project.

Application Process:

STEP 1: Victorian applicants must submit an initial registration via *veskidelivered.awardsplatform.com*

STEP 2: Following your registration, you will receive an email containing the link to complete the full application via the DAAD portal.

Applications are due by 15 October 2021.

For more information on the program, download the *DAAD- VIC Research Funding Scheme Guide* and read the program *FAQs*.

veski delivered... DAAD Deutscher Akademischer Austauschdienst German Academic Exchange Service

Indigenous STEM Awards – Invitation to apply and nominate

NOMINATIONS OPEN NOW AND CLOSE WEDNESDAY 3 NOVEMBER 2021

Hi,

You're invited to help us celebrate and showcase the achievements of Aboriginal and Torres Strait Islander people studying and working in Science, Technology, Engineering and Mathematics (STEM) fields, as well as the integral role of teachers, schools and mentors play in the lives of Aboriginal and Torres Strait Islander students pursuing STEM education and careers.

THERE ARE 7 CATEGORIES OF AWARDS

The Aboriginal and Torres Strait Islander STEM Professional Awards School Award	School Award	STEM Champion Award	Teacher Award
The Aboriginal and Torres Strait Islander Student STEM	The Aboriginal and Torres Strait Islander Student Maths	The Aboriginal and Torres Strait Islander Student Science	

To reach and encourage more Aboriginal and Torres Strait Islander students and STEM professionals to

apply as well as teachers, mentors and schools supporting these students we need your help to:

SHARE – ENCOURAGE – NOMINATE

If not you, then who? With your help we can reach, celebrate, and inspire.

NOMINATIONS CLOSE:
Wednesday 3 November 2021.

For APPLICATION FORMS and to find out more please visit www.csiro.au/en/education/Programs/Indigenous-STEM-Education-Project/Indigenous-STEM-Awards or contact our Awards team on 03 6232 5315 or indigenousstemawards@csiro.au.

The Indigenous STEM Awards are funded by the BHP Foundation and delivered by CSIRO.

CSIRO

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Land Management Strategy

Parks Victoria has developed a draft Land Management Strategy that sets out a clear vision and long-term strategies and priorities for the protection, management and use of Parks Victoria managed land for the next decade. This is the first time Parks Victoria has embarked on preparing a state-wide land management strategy. Once finalised, the Land Management Strategy will provide us with an overarching and consistent state-wide guide for the management of our parks across the state.

The draft Land Management Strategy has been informed by early stakeholder and community engagement undertaken in 2019, which focussed on the draft aspiration and guiding principles for the Land Management Strategy. Drafting of the strategy and the public consultation to inform its development is legislated under the Parks Victoria Act (2018). It will be revisited at least every 10 years and is supported by an Outcomes Reporting Framework to track its implementation.

The draft strategy is open for consultation from 16 September to 1 November 2021.

Consultation on the draft Land Management Strategy

As visitors and supporters of Victoria's parks and reserves, your understanding and experience of the parks estate is critical to the finalisation of the Land Management Strategy.

You can participate by:

- downloading the draft Land Management Strategy and draft Outcomes Reporting Framework (here >>)
- joining an online community information session (here >>)
- completing the the survey, or uploading a submission (here >>).

Melbourne's Future Planning Framework

Have your say on the 30-year vision for each metropolitan region of Melbourne.

Overview

Plan Melbourne 2017-2050 is the high-level plan developed by the Victorian Government to guide growth and change across our city. It is a blueprint guiding the actions of planners, local councils, landowners, and developers – ensuring Melbourne grows more sustainable, productive and liveable. Find out more about information about Plan Melbourne 2017-2050 *www.planmelbourne.vic.gov.au.*

Plan Melbourne 2017-2050 recognises that more detailed planning is needed for Metropolitan Melbourne to manage growth across the city. Plan Melbourne identifies the need for six plans to be developed, providing detailed guidance at a regional

Melbourne's Future Planning Framework introduces six Land Use Framework Plans for six regions of Metropolitan Melbourne.

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level and setting a 30-year vision for each area. To achieve this, the Department of Environment, Land, Water and Planning has developed Melbourne's Future Planning Framework which is now available for you to review and provide your feedback.

Melbourne's Future Planning Framework comprises of six Land Use Framework Plans to guide strategic land-use and infrastructure development for the next 30 years. The plans will provide a means of aligning state and local planning strategies and working collaboratively across government to implement Plan Melbourne.

The purpose of the LUFPs is to guide the application of Plan Melbourne's nine guiding principles, 7 outcomes, 32 directions and 90 policies at a regional and local level.

These plans mark a new era in the planning of Melbourne, building on the efforts of generations of Victorians to shape the way land is used around Port Phillip Bay. They aim to set long-term plans for investment that protect and enhance local areas and communities while ensuring Melbourne's inner city grows more prosperous, liveable, affordable and sustainable.

The plans identify urban renewal and growth areas, flag future transport opportunities, prepare for community, health, education, recreation, sporting and cultural facilities, and continue our work in protecting and identifying open space and greening initiatives.

These plans are all about keeping Melbourne marvellous – from the inner city laneways to the parks, rivers and beaches, plus the innovative industries and dynamic culture.

The six Land Use Framework Plans have been developed for each of the six metropolitan regions identified in Plan Melbourne:

- Inner (Melbourne, Port Phillip and Yarra Local Government Areas or LGAs)
- Inner South East (Bayside, Boroondara, Glen Eira and Stonnington LGAs)
- Eastern (Knox, Manningham, Maroondah, Monash, Whitehorse and Yarra Ranges LGAs)
- Southern (Cardinia, Casey, Frankston, Greater Dandenong, Kingston and Mornington Peninsula LGAs)
- Western (Brimbank, Hobsons Bay, Maribyrnong, Melton, Moonee Valley and Wyndham LGAs)
- Northern (Banyule, Darebin, Hume, Mitchell, Moreland, Nillumbik and Whittlesea LGAs)

Click the link below to watch a video that provides an introduction to Melbourne's Future Planning Framework and the Land Use Framework Plans: *Melbourne's Future Planning Framework*

How to Participate

Your feedback is now being sought on the six draft Land Use Framework Plans that collectively form Melbourne's Future Planning Framework. Hearing from you will help shape the 30-year vision and priorities for your area.

Head to *https://engage.vic.gov.au/mfpf* to review the information for your area and provide feedback before **11:59pm, 24 October 2021.**

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Goulburn Murray Irrigation District Drainage Management Strategy

We want to hear what you think about the draft Goulburn Murray Irrigation District Drainage Management Strategy

Overview

Effective, fit for purpose surface and subsurface drainage is essential for sustainable irrigated agriculture.

Goulburn Broken Catchment Management Authority and North Central Catchment Management Authority have a lead role in identifying irrigation drainage and salinity mitigation needs across the Goulburn Murray Irrigation District through the development of Regional Catchment Strategies and Land and Water Management plans. The collaborative, partnership approach to drainage issues, and a positive approach to working with regulatory agencies has proven to be an effective way to manage drainage needs.

Recently there has been a range of significant changes to irrigated agriculture in the Goulburn Murray Irrigation District and the external environment within which irrigation drainage service providers operate.

The draft Goulburn Murray Irrigation District Drainage Management Strategy (the draft Strategy) has been developed to provide a clear direction for the future management of irrigation drainage.

Importantly the draft Strategy recognises that the future is uncertain, and it has been developed using resilience principles. These principles aim to enable a more flexible approach to the way surface and subsurface drainage services are provided; as well as supporting a structured, continuous review, improvement, and adaption process into irrigation drainage management.

The Goulburn Murray Irrigation District Drainage Management Strategy is intended to be an adaptive ongoing strategy. It is expected that the strategy will be reviewed and updated every four years unless it is identified that there has been significant change in the Goulburn Murray Irrigation District which requires the reviews to be brought forward.

How to participate

Before finalising the Goulburn Murray Irrigation District Drainage Management Strategy, we want to hear from you to make sure we haven't missed anything. To participate, please:

- Read the draft Goulburn Murray Irrigation District Drainage Management Strategy (*here*).
- Complete the survey *here*.

Next Steps

All feedback will be assessed and where appropriate included in the final strategy. Once the partner organisations commit to the strategy, the strategy will provide guidance and direction to Goulburn-Murray Water and North Central Catchment Management Authority as the service providers with support from their customer committees and the other catchment management authorities.

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Mental Health and Wellbeing Workforce Strategy Forum Summary

The Department of Health is seeking feedback from Victoria's mental health sector and community to develop the Mental Health and Wellbeing Workforce Strategy.

Overview

Building our mental health workforce

The range of mental health and wellbeing services is expanding in Victoria. These services need a diverse, skilled and multidisciplinary workforce. The Royal Commission recommended a range of structural workforce reforms. These reforms aim to attract, train and transition the staff needed for Victoria's mental health services. These include non-government organisations, community services, and Local, Area and Statewide Mental Health and Wellbeing Services.

Recommendation 57 proposed development of a Mental Health and Wellbeing Workforce Strategy to be released by the end of 2021. The Strategy will help build the workforce we need for sustainable delivery of mental health reforms. It will focus on strategies to address key challenges over the immediate, medium and longer term. This includes workforce supply, wellbeing and capability, as well as developing the regional and rural workforce. The Strategy will be revised every two years to support ongoing reform.

The Strategy builds on the 2021-22 Victorian State Budget's $206 million investment to grow the mental health workforce. This means more mental health nurses, doctors, allied health professionals, lived experience workers and support staff and sits within the broader program of sector reforms. This work includes the significant progress already underway to implement existing strategies for the consumer mental health workforce, the family carer mental health workforce, and the alcohol and other drug (AOD) peer workforce in Victoria.

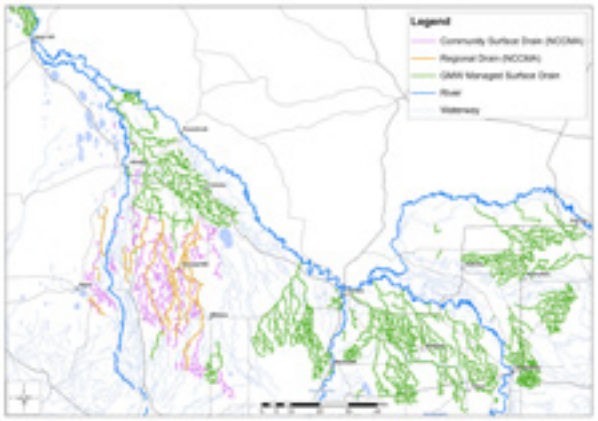
Consultation activities to date

This consultation process for the Strategy has built on previous and ongoing engagement with a wide range of mental health stakeholders. This includes the extensive consultation that informed the Royal Commission's final report and the Department of Health acknowledges the valued contributions of experts and stakeholders including people with lived experience.

On 30th July 2021 a Mental Health Workforce Forum was held with over 130 stakeholders from across the mental health system to discuss four key focus areas for inclusion in the Mental Health and Wellbeing Workforce Strategy – workforce supply, wellbeing, capability and rural and regional workforce development. The opportunities for development and potential solutions across these focus areas can be found in the attached 'Mental Health Workforce Forum Detailed outcomes' document.

To build on the Forum, a series of workshops that cover the areas of workforce supply, capability, wellbeing and rural and regional workforces are being held across August-October. Sector representatives and those with lived experience have been carefully selected to participate in this process to ensure cross-cutting representation and to enable meaningful engagement in a small group setting.

A separate workforce census survey has recently been undertaken to gather data about the workforce that will inform the Strategy. In October personnel working across the mental health sector will be invited to participate in a survey that provides insights into mental health workforce



Major irrigation drainage systems in the Goulburn Murray Irrigation District.

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including worker wellbeing and the Capability Framework.

While the Strategy will set some important priorities, the department will continue to work closely with our stakeholders and the community in the implementation of the Strategy following its release.

How to participate

The Department of Health wants to provide further opportunity for input, in addition to the Royal Commission consultations, recent Forum, workshops and workforce surveys. Considering the input summarised in the Forum Summary we are seeking your views on:

What additional opportunities are there to address workforce challenges within the priority themes of:

- Workforce wellbeing
- Workforce supply
- Workforce capability
- Rural and regional workforce issues

Next steps

Responses will inform the continued development of the Strategy prior to its release in December 2021. Implementation of the Strategy will also be informed through your responses to this and other engagement processes.

Provide your feedback here >>

The Department of Health would like your feedback on the outcomes report following the Mental Health and Wellbeing Workforce Forum.

PARLIAMENT OF VICTORIA

ENVIRONMENT AND PLANNING STANDING COMMITTEE – LEGISLATIVE COUNCIL

MEDIA RELEASE

Community input invited on renewable energy in Victoria

The Legislative Council's Environment and Planning Committee is seeking submissions to its inquiry on renewable energy in Victoria.

"We want to take a snapshot of what steps Victoria needs to take to prepare for a clean energy future," said Committee Chair Sonja Terpstra.

"We're seeking to explore what resources will be needed to transition to 100 per cent renewable energy, as well as the economic benefits and job creation opportunities," she said.

The inquiry is seeking input from the community particularly on:

- measures to enable Victoria to transition to renewable energy
- jobs and economic benefits and implications of the transition
- investment required to achieve 100 per cent renewable energy generation
- further opportunities for Victoria to reduce emissions
- government action that would be needed to support workers in impacted industries
- the economic risks of not urgently reducing emissions by transitioning to renewable energy.

Submissions are welcome by 26 November 2021.

The Committee prefers short submissions (up to 20 pages).

It will be holding limited public hearings in early 2022, before tabling its final report in the first half of 2022. For the full terms of reference and more information visit the Committee's *website* or email *renewableinquiry@parliament.vic.gov.au* or phone (03) 8682 2869.

ISSUED: 27 SEPTEMBER 2021

How does science impact public decision-making? The dark art explained.

Dr Anthony Boxshall MRSV, Principal, Science into Action

Science, engineering, and technically complex stuff are essential to good decision-making. At the very least, the COVID-19 pandemic has highlighted to us all how much the public sector (and related organisations) does rely on good science, done well and embedded into decision-making to deliver public value. People ask us at Science into Action how this process works. How does science get from the sciency bit into the decision-making part and then on to make a difference?

In this piece I will explore the process of making impact with science in the public sector and what happens when science impacts decision-making. To really understand this, it is helpfully to step back and look at some definitions first.

What is public value?

Like many things, the easiest way to understand public value is to talk about what it is and contrast it to what it is not.

There are many definitions. In his book, Prof. Mark Moore (1995) "Creating Public Value" gave the clearest statement about public value. Have a look at that if you want a formal definition. In an organisational sense, it is the value that the organization contributes to society. It is about things that are consumed collectively and are often considered by many less tangible albeit essential to the health and prosperity of the society, e.g. wellbeing; liveability; biodiversity; education; transport; clean air and water; cultural health – the list can go on.

These are the things that make a society function but are often not traded or sold per se. And often they are not measured and counted as clearly as commercial outputs. Aside from the social enterprise movement and B-Corps in the USA, public value is often the exclusive domain of Governments and organisations that support their objectives. There are often multiple and unclear, or unstandardised ways to measure these elements of public value and very rarely are there standard and broadly accepted measures of successfully impacting public value. Thankfully high-level international frameworks now exist – see UN Sustainable Development Goals. However there are no current standard frameworks or approaches that take a piece of science and turn it into public value.

In contrast private value is much easier to count and trade. It is private wealth generated. It is shareholder value. The outcomes of private value generation are consumed individually (via payment) and there are accepted ways for science to go from a discovery into commercial production. This is possible as there is a clear, standard single measure of impact –$. Taking science into private value leads to IP, commercialised outputs, patents, and sales.

Note that in our system of Government there is a fundamental yin and yang relationship between generating public and private value. Often Governments seed markets for both public and private outcomes. And we can all think of commercial products that exist to improve a public value.

Why does this all matter for science and decision-making?

For us here at *Science into Action*, where the dichotomy becomes important is when people are trying to get science to have an impact. Whether it is a decision-maker looking for science for decisions, or a scientist looking to have some science influence a decision... knowing how to translate the science into public value is essential. Even though the process of using science in a commercial sense is complex (and it can be), there are at least many accepted pathways with quite mature frameworks and approaches (e.g. accelerators, start-ups, innovation hubs, IP exchanges, Venture Capital investment, patents etc etc). However, the pathways for getting science used to impact public value decision-making is like a dark art!

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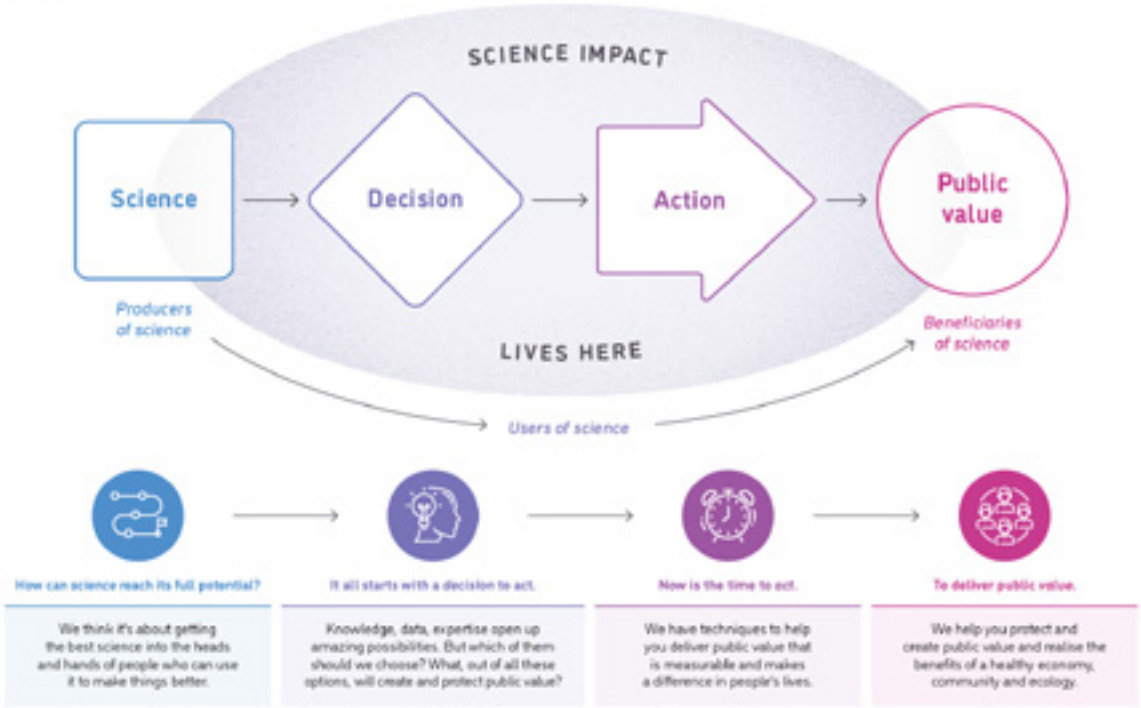
scienceintoaction.com.au



Codifying the dark art of science impact...

To do something easier/better/smarter we need to understand how it works and at Science into Action we break down the process of getting science to influence public value into 4 crucial parts.

This all originates by wondering how the **science** can reach its full potential. We think it is about getting the best science into the heads and hands of people who can use it to make things better – who can have impact. This is often about working with the people who produce the science and giving them the skills, knowledge, and tools to get that science used.

The process continues with a **decision** to act by those who are using the science. They will know *what* needs to be done and often need to sharpen their understanding of how and when (and sometimes who needs to be involved). Knowledge, data, and expertise open amazing possibilities. But which of them to choose? What are the options? How do we get the most from the science?

Action is so simple to say and sometimes in the public sector it is hard to make happen. There are ways of doing things that work, and ways that don't. Science is one of many uncontested inputs into public sector decision-making. How do decision-makers drive action with science? How do we know the actions taken will make a measurable difference, be appropriate and improve public value?

Ultimately, this is about protecting and **creating public value** so that we all realise the benefits of a healthy economy, community, and ecology. In our science impact framework, public value is the beneficiary of science used to support good decision-making in the public sector. This explains why we do what we do at Science into Action. It is also where we are most skilled.

So, what is science impact?

While the impact is seen as a benefit to public value, the process of science impact happens in the exchange between the producers and users of science. It happens when science is used in decisions to drive action to make change.

Science impact lives in that overlap between science, decision and action. At Science into Action we work with you to be better at science impact. We help make that dark art clearer. We have practical techniques, approaches and even some tools to enable science to be used for decisions that lead to action.

SCIENCE INTO ACTION

scienceintoaction.com

Events for the month

UPCOMING LECTURES:

Electronic Skin: Sensing the world around and within us

Thu, 11 Nov 2021

6:30 PM - 8:00 PM

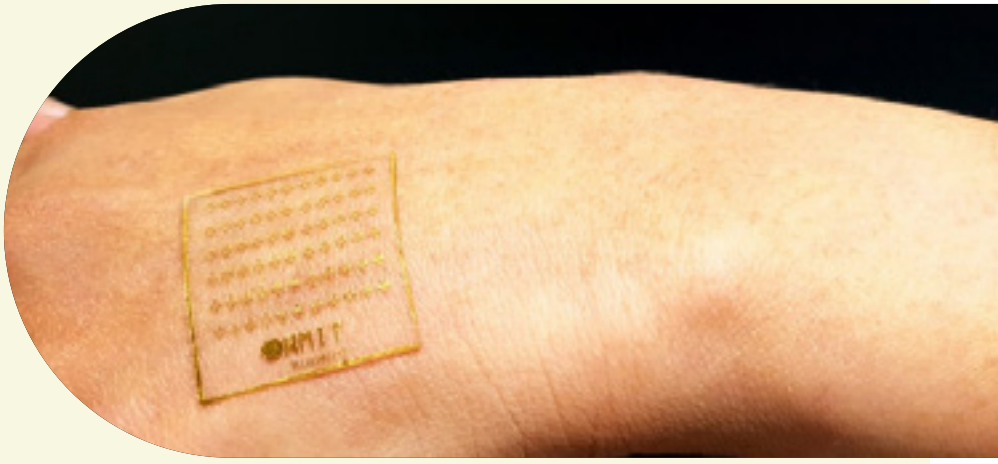
General Registration

A$6.36

incl. A$1.36 Fee & Tax

SALES END ON 11 NOV 2021
GENERAL ADMISSION FOR NON-MEMBERS

Stretchable and wearable electronics represent a new wave in devices which can bend, flex, and stretch with the human body. Researchers from Melbourne's RMIT University have developed a prototype to mimic real human skin, with the aim to create a viable alternative to invasive skin grafts and conventional prosthetics.



Join **Professor Madhu Bhaskaran**, who leads the team working to transform conventional, hard electronics into soft, unbreakable products, thin enough to create "electronic skin." These ground-breaking, electronic, prosthetic patches can adhere to the skin to mimic, measure and diagnose body functionality, and monitor the environment around, on, and within us. Their potential extends beyond improving the lives of people with prosthetic limbs and skin grafts to offer new tools for surgeons, astronauts and other professions requiring a precise "feel" without direct contact.

About the Speaker

Professor Madhu Bhaskaran is a multi-award winning electronics engineer and innovator. She was the 2014 recipient of the RSV's Phillip Law Postdoctoral Award, and has since been recognised for her outstanding achievements with a slew of awards, including the 2018 Batterham Medal from the Australian Academy of Technology and Engineering and the 2020 Frederick White Medal from the Australian Academy of Science.

Professor Bhaskaran co-leads the Functional Materials and Microsystems Research Group at RMIT University, which she established at the outset of an ARC postdoctoral fellowship in 2010, and acts as Node Director and Chief Investigator for the ARC Centre of Excellence for Transformative Meta-Optical Systems. Her work on electronic skin and wearable sensors has been patented, and her group now works collaboratively with multiple industry and design partners to commercialise the technology for healthcare and aged care.

Madhu attained her Bachelor of Engineering at the PSG College of Technology in Coimbatore, India, before completing first her Master of Engineering then Doctor of Philosophy at RMIT University, Melbourne.

Tickets are available *here* to participate in the webinar via Zoom and/or Eventbrite. RSV Members are prompted to enter their promotional code to access a member's ticket. Alternatively, you can watch along via *Facebook Live* at the appointed time without buying a ticket.

Inspiring AUSTRALIA Victoria

Streamed online as part of the Inspiring Victoria initiative in 2021

Bio-remediation: Restoring contaminated Ecosystems, naturally

Thu, 9 Dec 2021

6:30 PM - 8:00 PM

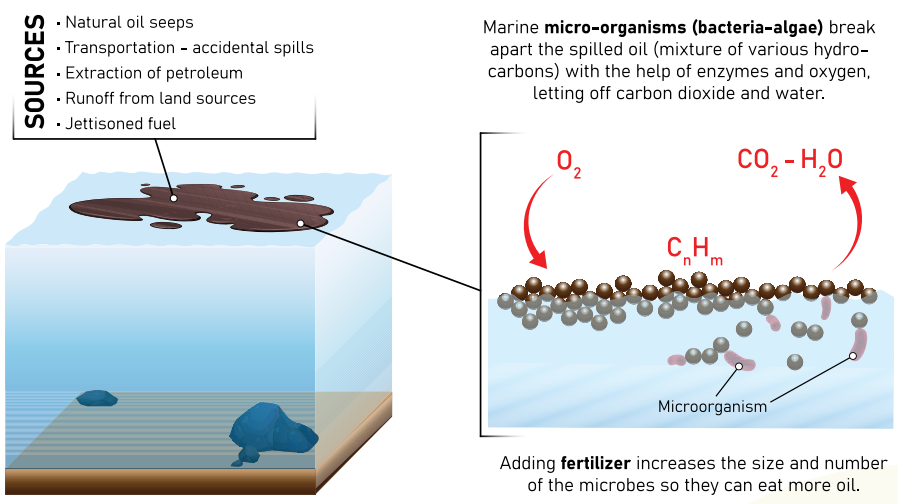
1 x General Registration
A$6.36 incl. A$1.36 Fee & Tax

SALES END ON 9 DEC 2021 GENERAL ADMISSION FOR NON-MEMBERS

Nature-harnessing technologies are key to effectively and sustainably restoring contaminated ecosystems, using naturally occurring microorganisms to clean up contamination from oil and other organic pollutants in soils, groundwater and water bodies. The bioremediation process both destroys contaminants and restores an ecosystem's microbiome.

But every local ecosystem is unique when it comes to microbiological communities, so new and innovative approaches are required for each contaminated site.

Understanding the factors that determine the stability and resilience of contaminated ecosystems, and the critical role of that system's natural microbial community, remains one of the frontiers of environmental science. Join Professor Andy Ball to explore how environmental microbiology can be scaled up for impactful and commercially successful applications to contaminated sites all over our highly industrialised world.

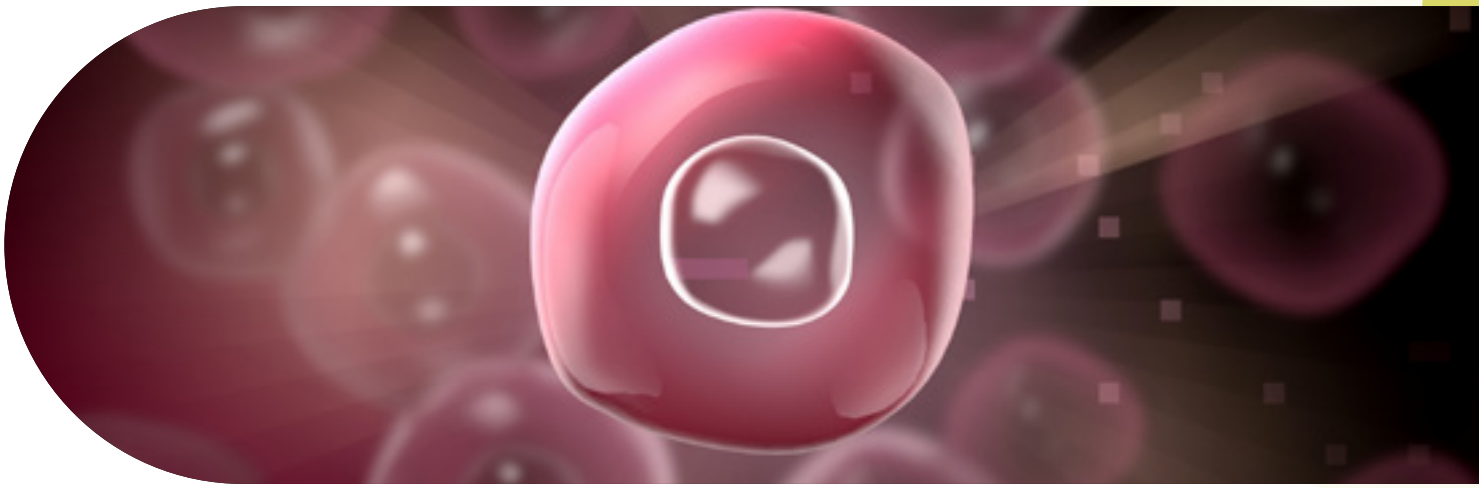


About the Speaker

Professor Andrew Ball is the Director of the ARC Training Centre for the Transformation of Australia's Biosolids Resource at RMIT University. With deep expertise in environmental microbiology and biotechnology, Professor Ball was, until recently, the Director of the Centre for Environmental Sustainability and Remediation (EnSuRe) at RMIT.

Andy has headed the Environmental Biotechnology Group, now based at RMIT University (previously based at Essex University and Flinders University), since 1995. He has brought a wealth of research and teaching expertise to Victoria at an international level, particularly in the fields of bioremediation, organic waste treatment, and the environmental fate of organic pollutants. His contributions to his field and to the research community in Victoria were recognised this year with the award of the Royal Society of Victoria's Medal for Excellence in Scientific Research in Category I: Biological Sciences.

Tickets are available *here* to participate in the webinar via Zoom and/or Eventbrite. RSV Members are prompted to enter their promotional code to access a member's ticket. Alternatively, you can watch along via *Facebook Live* at the appointed time without buying a ticket.



Improving Drug Discovery: A Molecular Understanding of Cell Surface Receptors

Thu, 25 Nov 2021

6:30 PM - 8:00 PM

1 x General Registration
A$6.36 incl. A$1.36 Fee & Tax
SALES END ON 25 NOV 2021
GENERAL ADMISSION FOR NON-MEMBERS

The human animal is multicellular – an organism comprised of trillions of smaller organisms. As with any complex organisation, each individual cell in our body must communicate with and respond effectively to the collective to keep our systems working. Our cells send and receive signals through the use of special proteins on their surfaces – **receptors** - that interact with the "extracellular matrix," a network of specialised molecules that perform structural, biochemical and signalling functions between our bodies' cells and systems.

The largest family of these cell-surface receptor proteins are called G Protein-Coupled Receptors, or GPCRs. GPCRs respond to extracellular stimuli such as hormones, neurotransmitters, peptides, metabolites and odours, while controlling a variety of physiological functions. Importantly, they have been found to have an excellent response as drug targets and are thus very useful in developing effective medicines to combat serious disease. Currently, GPCR targets are implicated in around 25% of all medicines approved by the USA's Food and Drug Administration.

However, many hurdles remain to improving GPCR drug discovery, requiring an expanded, interdisciplinary approach to open the door to new therapies. Join **Dr Christopher Draper-Joyce** to explore new, proof-of-concept approaches that promise the development of safer and much improved options for GPCR therapeutics.

About the Speaker

Dr Christopher Draper-Joyce is an ARC DECRA Fellow with the Florey Institute of Neuroscience and Mental Health and a Lecturer on Drug Discovery with the University of Melbourne's Faculty of Medicine, Dentistry and Health Sciences. He was previously a Postdoctoral Fellow at the Monash Institute of Pharmaceutical Sciences, where he earlier completed his PhD on the biomolecular actions of the dopamine D2 receptor using pharmacological assays, molecular biology and biochemistry techniques.

Christopher's postdoctoral work has extended his analytical and molecular pharmacology skillset into the field of structural biology, with a particular focus on solving and stabilising the GPCR-G protein complexes, to shed new light on molecular mechanisms of drug-receptor action. He has contributed to the pandemic effort with colleagues at the Florey, bringing the Institute's collective skillset in protein engineering to bear on SARS-CoV-2, developing novel lead proteins that can bind to the S glycoprotein (Spike) of the virus, and may be useful as antiviral agents.

Dr Draper-Joyce's efforts have been recognised with an ARC Discovery Early Career Researcher Award and the Asia-Pacific Protein Association Young Scientist Award in 2020 and, in 2021, he is the recipient of the Royal Society of Victoria's Phillip Law Postdoctoral Award in Category II: Biomedical and Health Sciences.

Tickets are available *here* to participate in the webinar via Zoom and/or Eventbrite. RSV Members are prompted to enter their promotional code to access a member's ticket. Alternatively, you can watch along via *Facebook Live* at the appointed time without buying a ticket.

Inspiring Victoria

SCIENCE WEEK SEED GRANTS

National Science Week Victoria again offers a *Seed Grant* scheme of amounts up to $1000 excluding GST to assist Libraries and individuals who would like to present a public event during National Science Week, August 2022. Applications will open 1 December 2021 and close on Friday 11 February 2022 5.00pm AEST. Get your ideas ready!

NATIONAL SCIENCE WEEK 2022

The grant round for **National Science Week 2022** is open for applications until 5.00pm AEDT Thursday 21 October 2021. Get in quickly as this national opportunity is closing soon.

Grants between $2000 – $20,000 will be awarded and can support in-person events as well as online activities if they include two-way participation or involvement. There is a total grant pool of $500,000 available.

https://www.scienceweek.net.au/grants-available-for-national-science-week-events-in-2022/

Looking Back on National Science Week in Victoria

Ms Rena Singh, Manager Inspiring Victoria

In a fresh beginning, 2021 has been a year of opportunity, collaboration and new partnerships for Inspiring Victoria and National Science Week in our state. Building upon our regional engagement through broadcast and online content in 2021, we moved to a new model of partnership programming with our state's most loved and trusted cultural institutions and reputable organisations. These partners each have proven community engagement outcomes and unique audience following while sharing the values of National Science Week.

Our program partnership model was flexible to meet the exemplary creative talents of producers within our partner organisations and for them to keep independence and agency in delivering high quality content to their audiences while inviting new audiences though co-broadcasting and collaboration around our collective theme. **ACCLIMATISE – the science of sustainability and adaptation**, was chosen as the Victorian theme to meet the strong desire in the community for important scientific literacy and knowledge sharing on this topic and was a fantastic success. This collective effort culminated in a diverse program of free events, activities, conversations and workshops exploring the science of sustainability and adaptation, all pivoted to virtual broadcast.

2021 also saw Inspiring Victoria again deliver a significant community grants program for science week with a **small grant funding to 10 libraries and independent organisations, 37 schools and for the first time welcomed 20 Neighbourhood Houses** to participate in self organising events and activities for their local communities. Overwhelmingly our State-wide survey feedback told us that the digital and online delivery of programming and events this year enabled a significantly greater audience diversity to

join in Science Week activities. The online platforms levelled access for rural, regional and metropolitan audiences, and we saw a far greater participation by regional and interstate audiences in particular; just one of the welcome results of trying something different out of sheer necessity in another unique year. In future years we will continue to be advocating for an accessible digital and online delivery model to accompany our physical events for Science Week to keep broadening opportunities for diverse audience participation.

I would like to thank our team here at the Royal Society of Victoria and our many volunteer Councillors and Committees, particularly the Victorian National Science Week Committee and Inspiring Victoria Board, for a fantastic effort to govern this year's National Science Week. I wish to thank each of the cultural institutions and organisations who made the main event program possible - **Museums Victoria, Royal Botanical Gardens Victoria, Zoos Victoria, Public Libraries Victoria, Parliament of Victoria, State Library of Victoria, Philip Island Nature Reserve, Neighbourhood Houses Victoria and Royal Society of Victoria** and the many volunteers and community groups who deliver their unique community focused events, activities and workshops across regional Victoria.

Our aim is to continue playing a catalyst role to build upon these partnerships, facilitate new connections and opportunities for them through the annual Inspiring Victoria program and support the building of a science literacy and engagement eco-system through strategic collaboration, ensuring we keep our commitment that 'Science is for everyone'. Take a look at some of the images of this year's Science Week in Victoria.

Our report on National Science Week 2021 in Victoria will be released in November and distributed via Science Victoria.

Transactions

The Queers in Science Lecture Series

Australia's Response to the COVID-19 Pandemic

THIS ARTICLE FOLLOWS A PRESENTATION ON 21ST APRIL 2021 AS PART OF THE MIDSUMMA FESTIVAL *QUEERS IN SCIENCE LECTURE SERIES* DELIVERED BY **PROFESSOR MICHAEL TOOLE AM** (BURNET INSTITUTE) AND **PROFESSOR DEBORAH WILLIAMSON** (THE PETER DOHERTY INSTITUTE FOR INFECTION AND IMMUNITY). THIS SERIES WAS SUPPORTED BY QUEERS IN SCIENCE, MUSEUMS VICTORIA, THE ROYAL SOCIETY OF VICTORIA AND THE INSPIRING VICTORIA PROGRAM.

Professors Deborah (Deb) Williamson and Michael Toole were overseas when they first news of the novel coronavirus in Wuhan – in both cases, via the New York Times. Deb was concerned that it was on the front page rather than further in, but returned her attentions to her holiday with her daughter in Los Angeles. Michael was in Egypt celebrating Coptic Christmas with his partner and also felt a sense of dread but filed it away.

By the time Michael stopped at Beirut Airport en route back to Melbourne and checked the news again at the end of January, the WHO had declared a global public health emergency. From 54 cases in Wuhan to 10,000 worldwide, he knew it would be bad.

They were both in for a crazy, hectic year.

Professor Deborah Williamson

Michael cut short his long-service leave. Having been working since he graduated from Monash Medical School for exactly 50 years, he had been ready for retirement mid-2020, but his boss suggested that he might postpone to September – of an unspecified year.

Michael completed his Medical Residency in Chiang Mai, Thailand, then was appointed Director of the Ban Nam Yao Refugee Health Program in Thailand, where he saw 200 patients a day and had to learn three languages on top of English and Thai to provide adequate care. His next assignments were as Senior Health Adviser for a Somailan Refugee Health Unit, then Oxfam. He coordinated public health responses as a Medical Epidemiologist in the International Health Unit of the US Centres for Disease Control and Prevention (CDC), before returning to Australia as Head of Burnet Institute's Centre for International Health. With extensive experience in international health, Michael was no stranger to dealing with pandemics.

After returning to Melbourne in early 2020, Michael was assigned as Technical Advisor to the newly established Knowledge Hub for COVID-19 (Know-C19 Hub) at Burnet Institute. One of his tasks was to produce a biweekly global update report incorporating public health responses, current scientific understanding, data and models, and a global analysis. He was particularly interested in assessing how other countries were going about easing restrictions and learning from what they were doing right.

When the second wave rippled through Victoria, Michael

strongly advocated for mask wearing, decentralised testing hubs and hotel quarantine. South Korea was an exemplar country for digital contract tracing efforts – they had a decentralised system whereby local governments conducting drive-in testing and pioneered the use of QR codes at retail land hospitality venues. Michael was involved in a pilot program with Yarra Council to demonstrate the effectiveness of decentralised community-based responses, and also advocated for better contact tracing – and now we can't imagine not scanning into places with a QR code.

As he reflects on the global response to the pandemic, Michael believes that it was a failure in most high and upper middle income countries (and even lower income countries, such as Brazil, Mexico, Indonesia and India). In many of these cases, governments ignored public health advice to their country's detriment, and in others, there were blind spots (e.g. migrant workers being ignored in Singapore, leading to the highest infection rates per capita in Asia). The rare success stories are mostly in the Indo-Pacific region, including Australia and New Zealand – coincidentally, both countries where Deborah has worked.

Deb Williamson was appointed the Director of Microbiology at the Royal Melbourne Hospital in 2019. She had grand plans for the year ahead, but they were thrown out the window. Deb's passion for microbiology and infectious disease was ignited during her medical and science degrees at the University of Glasgow. She then moved to London for physician's training at St Mary's Hospital, where she constantly walked past the room in which Alexander Fleming discovered penicillin. She undertook clinical microbiology training in Auckland and then was recruited as the Deputy Director of the Public Health Lab at the Doherty Institute for Infection and Immunity. After being promoted to Director of Microbiology, her year turned into a fluctuation between scraggy hair, fighting for toilet paper, and a rollercoaster of successes and challenges in the lab.

Professor Michael Toole AM

Early in the pandemic, it became very clear that testing would be a fundamental part of the response. Deb turned to her pathology training to navigate the many challenges with laboratory testing: swab and reagent shortages, timely reporting, regulatory frameworks, etc. Deb's group was one of the first to consider using saliva testing for COVID-19. Compared to the (uncomfortable) nasopharyngeal swabs, saliva testing was not as sensitive, but has now become an integral part of hotel quarantine testing. (Out in the community, however, we still have to deal with jabs up the nose.)

Deb also helped develop a *lateral flow antibody* (serological) test, which uses blood from a finger prick to assess whether a person has antibodies against the SARS-CoV-2 virus. Antibodies are proteins produced by the immune system that are specifically shaped to target certain viruses, and their presence indicates exposure or immunity. Towards the end of the second COVID-19 wave in Victoria, they also tested *rapid antigen* tests, which detect viral protein from patient samples and could show results within 15 minutes. While standard testing remained the best way to track infection, this work offered hope during a time we needed it.

Being on the front lines, not only did Michael and Deb have to navigate the changing situation and constant influx of information, but also the media. Michael was not prepared for the media storm – since April 2020, he has had 520 media engagements with news outlets around the world. Similarly, every study on COVID testing published by Deb's team has been picked up by the media and she sometimes felt ambushed.

Deb and Michael were both grateful to be doing meaningful work every day. For Michael, daily walks along the beach across the road with his puppy got him through lockdown. But he hasn't seen partner since he returned to Melbourne in January 2020, as he stayed to work in Cairo. Deb, thankfully, has been surrounded by family – her children and partner – who helped keep her sane, well-fed, and entertained with memes.

These two incredible individuals were at the forefront, solving many of the challenges thrown at us by the pandemic. It has been a tough 1.5 years, but we are thankful for their efforts and for sharing their experiences.

The Queers in Science Lecture Series

Ecology Now

THIS ARTICLE FOLLOWS A PRESENTATION ON 5TH MAY 2021 AS PART OF THE MIDSUMMA FESTIVAL *QUEERS IN SCIENCE LECTURE SERIES* DELIVERED BY **GUY RITANI** (PERMAQUEER) AND **PROFESSOR BOB WONG** (MONASH UNIVERSITY). THIS SERIES WAS SUPPORTED BY QUEERS IN SCIENCE, MUSEUMS VICTORIA, THE ROYAL SOCIETY OF VICTORIA AND THE INSPIRING VICTORIA PROGRAM.

Think about the air you breathe in as you read this. If you are in Naarm (Melbourne), the air you breath in comes from Wurundjeri or Boonwurrung ecology.

Guy Ritani, Director of PermaQueer, is interested in exploring how culture relates to the environment and people around them. They strive for the harmonious integration of landscapes with people through permaculture and promoting natural flourishing ecosystems.

Core to ecology is patterns. According to Guy, only a handful of forms exist and we can learn to recognise these repeating patterns. Once we can recognise and identify these patterns, we have an ability to predict how ecosystems change, respond, and thrive. One is example is the "true to type" pattern: that an organism replicates its role in an ecosystem over time, providing stability and consistent environmental provisions for others (e.g. vegetation that grows consistently year after year, providing food for animals).

Another pattern is "ecological succession", which is how an ecosystem is born and grows. Starting from nothing, wind brings in airborne seeds to grow small grass species. As they grow and die, they contribute biomass to the soil, bringing in microorganisms and water, and nutrients start to cycle through. With more plants, insects and birds come from neighbouring ecosystems, carrying more seeds. As succession occurs, the ecosystem builds and grows more complex with greater diversity and more, larger organisms.

Over time, ecosystems grow and become more complex, both above and below the ground

As a custodian species of these ecosystems, Guy believes that we have become disconnected from what our responsibilities are.

'There was a time where we were able to live in harmony with the environment, but for whatever reason, we've pushed over the threshold,' says Guy.

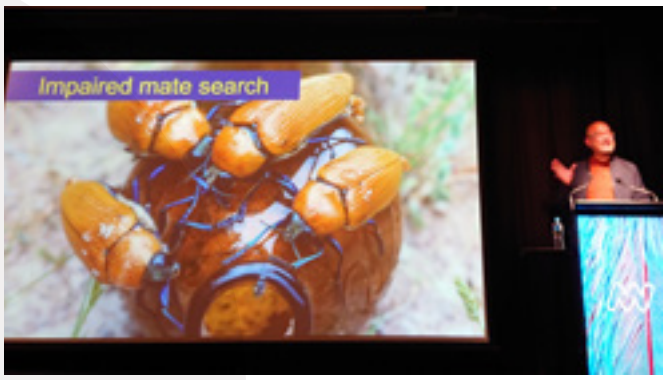
Traditional ecological knowledge is not simply one thing, given that we all come from diverse backgrounds. Yet some cultural conventions are ecologically coded forms of relating with each other and nature: for example, the breath Guy shares with others as part of a Māori greeting, smoking and cleansing ceremonies, and cultural adornments made from things in nature. Even analogue watches that many people wear contain crystal quartz as the oscillator, using 'memory locked into the stone to tick time'.

Guy encourages us to consider what our ancestral lines are. How did they live in harmony and how can we bring that into our lives now?

They don't ever feel alone because they are 'pushed forwards by the winds of [their] ancestors and pulled on the tides of [their] descendants'. 'No one and nothing can take that away from me,' they say.

As we reflect on our role to play within the ecosystem, Associate Professor Bob Wong asks us to pay more attention to our waste that feeds into it: especially pharmacological waste. Waste from prescription drugs is literally medicating our waterways as most slips through the wastewater treatment process...and this is impacting the reproductive success of other animals.

Human waste impacting the reproductive success of other animals has occurred for years. Last decade, ecologists on a field trip in WA found golden brown beer bottles strewn across the ground – with which Australian jewel beetles males were attempting to mate. The similarity of these "empties" to the female Australia jewel beetle is striking in both colour and texture. Because they are larger, they were a 'supernormal, sexy stimuli' for the males. Not only did this mean that males were confused and not successfully mating as they were being thrown off by bottles, but they were also more vulnerable to predators in the time that they desperately clung on to bottles.



Male Australian jewel beetles cling onto empty beer bottles in an attempt to mate

While this story has a happy ending with Australian breweries changing their bottle design, the emerging concern of pharmacological waste is having a widespread impact. It is now ubiquitous in the environment and many drugs have long half-lives, persisting even in the most remote places on the planet including Antarctica.

A large issue with pharmaceuticals is that the receptors on our cells that drugs are designed to target tend to be evolutionarily conserved among different animal groups. Medicines that are developed for humans therefore can also have the same or a similar effect on other non-target species. However, only a fraction of the dose used for humans results in an effect in smaller animals.

Bob's research into this area began 15 years ago when he saw declining biodiversity in the streams of Mexico. He observed female sawtail fish that were struggling to seek males of their own species and instead mating with the wrong species. This sparked his interest in endocrine disrupters, chemicals that perturb the delicate balance of sex hormones. The contraceptive pill is a permeating example that has been found to cause sex changes or feminisation of males in fish, turtle, alligators and frog species, and has also altered the songs and brain structure of some birds.

One particularly pervasive drug is the powerful steroid trenbolone. It used by body builders and is fed to Australian cattle as a growth promoter with 50 times the potency of testosterone. Due to its extensive use for livestock, it enters the environment where it lingers with a half-life of 270 days. Bob studies its impact on guppy fish, which reproduce either by females choosing a mate (usually based on their spots that are reflective of superior genetic quality), or by sneak copulation by males that bypasses female choice. Exposure of guppy fish to trenbolone for 3-4 weeks made males bulk up and become more aggressive, increasing sneak copulation over courting, while females because less interested and discerning in their choice. The result for the species is a deviation from typical evolutionary processes and a likely reduction in their genetic diversity

But it is not all bad news. As an example of where our waste isn't entirely negative, in Mexico, some birds are incorporating cigarette butt fibres into their nests which aids fledgling success as the chemicals inhibit the growth of nest parasites.

'No species exists as a vacuum,' says Bob. Reproduction is essential for the survival of animals and maintenance of biodiversity, yet it is easily disturbed by humans. Our actions, especially our discarded waste, have large ecological consequences. Think about how you treat (or don't "treat") our waterways.

THE STEM AND SOCIETY OF ONLINE PRESENTATIONS EXPLORES THE SCIENCE AND STORIES BEHIND THE GAME-CHANGING WORK UNDERTAKEN BY VICTORIA'S SCIENTIFIC COMMUNITY. LEADING EXPERTS SPOKE ABOUT THE WORK THEY ARE DOING TO ENGAGE THE COMMUNITY AND BRING ABOUT MEANINGFUL CHANGE IN THEIR FIELD OF STUDY AND IN OUR EVERYDAY LIVES. THIS SERIES WAS PRESENTED BY THE VICTORIAN PARLIAMENT, WITH THE ROYAL SOCIETY OF VICTORIA AND VICTORIAN PARLIAMENTARIANS FOR STEM.

Parliament presents

STEM and Society

With the Royal Society of Victoria and Victorian Parliamentarians for STEM

SealSpotter

THIS ARTICLE FOLLOWS A PANEL DISCUSSION ON 12TH MAY 2021 WITH DR REBECCA MCINTOSH AND ROSS HOLMBERG FROM PHILLIP ISLAND NATURE PARKS.

Can you spot a seal? Books like *I Spy* and *Where's Wally* are quite nostalgic. While not quite a picture book, SealSpotter is a citizen science project run by Phillip Island Nature Parks. Marine scientists call on everyone to search for seals in photos to monitor and protect the seal population at Seal Rocks.

Citizen scientists from every continent participate in the annual SealSpotter Challenge. Footage of drones flying over Seal Rocks is shared for people to count the number of pups. This count enables scientists like Dr Rebecca McIntosh and Ross Holmberg to analyse seal population data faster and more accurately so that they can see how the population is fairing over time.

Seals were harvested heavily in south-eastern Australia in the 1800's, reducing thriving colonies of five seal species to a single species. The Australian fur seal is thought to have survived because they bred in caves, hidden from hunters. Since seals in Australian waters became officially protected in 1975, the population has somewhat bounced back, but in the last decade, pup numbers have been declining again.

Because seals sit at the top of the food chain, they are vulnerable to ecosystem changes. As water temperatures rise, the location and abundance of fish populations, their main food source, also change. But also because of this, they constantly sample the ocean and bring valuable information back to land as part of their diet. Monitoring seals' diet, abundance and population trends can inform us of the entire ecosystem's health.

However, while out and about in the ocean, seals can become entangled in marine pollutants such as present ribbon, fishing nets and plastic bags. Seals play with plastic debris, and if they get stuck, the plastic cuts into them. This is particularly bad for young seals who keep growing and the plastic cuts into them more and more. Rebecca and members of her team release entangled seals that they can find, but they unfortunately cannot catch them all – not even half of those they see. Ironically, it can be unsafe for the team to approach an entangled seal if other seals are around and there is potential for a stampede.

To reduce net debris from commercial fishing boats, the team produced bins that sit on boats to catch all the waste. They worked in partnership with scientists

from RMIT and fishing boats to ensure that the bins were best suited for maximum debris recovery and ease of use. You can also play a role in protecting seals from entanglement by minimising waste: plastic bags, disposable keep cups and gift ribbon – anything that can form a ring or trap.

Phillip Island Nature Parks also calls on you to be SealSpotter. As part of the program, drones fly over Seal Rocks to collect footage that is converted to images that are assessed by you – citizen scientists. You can help by counting the number of seals in each picture and identifying entangled seals.

The results collected from hundreds of people around the world have so far provided reproducible, reliable data and trends. In the beginning, Rebecca and Ross had to problem solve and troubleshoot; for example, they found the best way of stitching all the overlapping images together so that seals wouldn't be counted more than once and the best height to fly drones so that they would be close enough without disturbing seals or sea birds. After testing out SealSpotter on a small audience and ironing out the kinks, it was good to go and has been up and running for the past several years.

The team specifically assesses the pups as an index sample of the entire seal population as they all remain on the rocks at one time. It is difficult to accurately count adults as there will always be some in the water foraging. The scat of pups contains information about their diet: the variation of fish and squid they consume from year to year based on mean sea surface temperature changes. It also has revealed exposure to chemical pollutants such as PFAS. The group of fire-resistant chemicals, PFAS, have been widely used by multiple industries and are now ubiquitous and persistent in the environment. They act as carcinogens and/or endocrine disrupters (impacting the delicate balance of sex hormones vital for reproduction), thereby influencing the reproduction capacity of seals and their food source.

Around this time of year, all the seals are on hunt for food. Pups are starting to spend time in the water, learning to forage in preparation for their independence. Females are leaving the colony to find food for their young and are anticipating the next lot of pups due in December. Meanwhile, males are bulking up to be ready to fight for females in the coming breeding season.

It has taken a long time for seals to bounce back from when they were overhunted, and they have, yet new threats are emerging. Seal Rocks is home to an estimated 20,000 seals, one quarter of the entire Australian fur seal population. How many seals will you find as a SealSpotter?

Parliament presents

STEM and Society

With the Royal Society of Victoria and Victorian Parliamentarians for STEM

The Anthropocene

Where on Earth are we going?

THIS ARTICLE FOLLOWS A PANEL DISCUSSION AT PARLIAMENT OF VICTORIA ON 16TH JUNE 2021 WITH PROFESSOR BRENDAN WINTLE AND PROFESSOR WILL STEFFEN FROM THE THREATENED SPECIES RECOVERY HUB AND AUSTRALIAN NATIONAL UNIVERSITY RESPECTIVELY.

We are living in a new epoch of geological time – one of our own making. Human activity warps the chemistry of the atmosphere, oceans, and environment rapidly and drastically. Human pressures on the planet have now become so great that scientists have proposed that we have left the Holocene, the geologic epoch of the last 11,700 years. We have entered a new period of Earth's history: the Anthropocene.

The current rates of carbon dioxide and temperature change are unprecedented in the entire 4.5-billion-year history of the planet. Professor Will Steffen tracked Earth system trends over centuries and found that there has been a *Great Acceleration* of change from a relatively stable baseline; greenhouse gases, ozone depletion, global temperature rise, ocean acidification, deforestation, etc. These jumps coincide with a concurrent acceleration of the human enterprise since the mid-20th century: population and economic growth, use of resources, urbanisation, and other factors. The only time Earth systems changed so drastically before was when an asteroid hit 66 million years ago. All evidence points thus points to humans for these changes.

As we push nature to its limits, we have also brought about the sixth great mass extinction. Nature is declining faster than ever before, and Professor Brendan Wintle, Director of the Threatened Species Recovery Hub, is deeply concerned. Around 2% of species have been lost globally since the 1700's, which is up to 100-fold greater than the extinction rate expected over time as part of natural processes. Australia alone has the second highest extinction rate in the world. Since European invasion, there have been 110 extinctions recorded (likely an underestimate) and the accelerating extinction rate shows no signs of slowing.

'The web of life on Earth is getting smaller and increasingly frayed,' says Will.

Will and Brendan paint a grim, catastrophic picture. Great biodiversity underpins our existence. Flourishing ecosystems provide a carbon sink, medicines, pollinators for our food, clean water, and filtered air. But will they continue?

The Anthropocene describes a new point in the Earth's history in which humans have started to significantly impact the planet's climate and ecosystems. We have reached two tipping points: the burning of 95% of eastern Australian forests and the death of coral reefs – both since temperatures have risen and will continue to rise for decades.

Can we turn it around or at least slow down the Great Acceleration?

Reviewing elements of the human enterprise, Will has found that wealth, production, and consumption are major drivers of climate change. While an increasing global population is often blamed for increasing pressures on Earth systems, only 19% of the population account for most of the change – the proportion of the population with the most wealth. Will encourages us to reflect on our choices.

'We don't really have an excuse, we just have to get with the program and do what's needed,' says Brendan.

Redirecting our money could help protect the one million species threatened with extinction. According to Brendan, Australia's current investment in species protection is only one twentieth of what we need it to be to mention it. As evidence of the benefits of greater investment, the US budget for species protection under the Endangered Species Act is greater than Australia's, and their program has been extraordinarily successful in recovering *85% of threatened bird populations*. Australians spend *$13 billion* annually on their pets, and we even used the GST from that alone, it might be enough.

We can also create bottom-up change. Will hopes that we are building enough social pressure to see action for reduced consumption, emission reduction, and ecosystem restoration. He refers to "social tipping points" – social values and norms – that change under the radar but very rapidly (e.g. the pressure for change around marriage equality and gender equity). He is hopeful that the younger generation wants to make things different for the environment.

There is already amazing climate adaption work being undertaken around Melbourne and regional Victoria. Farm owners are protecting threatened animal species behind predator-proof fences and land holders are growing trees more tolerant of hotter, drier conditions in preparation for the inevitable changes. Brendan hopes that if we can slow the big drivers of climate change, then what we do on a local level can make a difference to 'help keep species and ecosystems in the game.'

While it is unlikely that lost ecosystems will ever return to what they once were, we can help them recover as much as possible. The burned Australian landscape is bouncing back, but the soil has changed, and the climate is different to when the forests first grew. Will and Brendan encourage us to become stewards of Earth systems to secure our future prosperity (and existence) and conserve our natural and cultural heritage.

Parliament presents

STEM and Society

With the Royal Society of Victoria and Victorian Parliamentarians for STEM

A hard-won theory

Tectonic plates in Victoria

THIS ARTICLE FOLLOWS A PANEL DISCUSSION AT PARLIAMENT OF VICTORIA ON 14TH JULY 2021 WITH FOUR EMINENT VICTORIAN GEOLOGISTS: PROFESSOR PETER BETTS, DR WILLIAM BIRCH AM, PROFESSOR ANDY GLEADOW, AND ASSOCIATE PROFESSOR SANDRA MCLAREN.

Amongst a midst of misinformation and personal opinions that are presented as facts with unwavering certainty, how do we distinguish scientific truths? It can be especially confusing when we hear from scientists, who are reluctant to speak in absolutes but rather discuss 'degrees of certainty'. In the world of science, a 'theory' is the closest we may ever come to 'the truth'.

To understand the process of how modern scientists arrive at an accepted theory, Parliament of Victoria takes us through one of the major revelations of the past century: tectonic plate theory.

Plate tectonics describes fragments of the Earth's outer shell (the lithosphere) that move against, over, and under one another at their boundaries. The dynamic movement of these fragments and interaction at their boundaries slowly changes the shape and location of our continents and oceans. The theory revolutionised Earth sciences by providing a context to understand how mountains are built, volcanoes erupt, and earthquakes are triggered.

While the theory is a given now, it wasn't always.

The idea of continental drift was first proposed in 1915 but has since been universally denied. Geophysicist and meteorologist, Alfred Wegener, hypothesised that the continents were once joined together, broke up, and drifted away. Fossils of similar species across land masses, continuing glaciers and complementary coastlines that fit together like a jigsaw puzzle hold clues to their distant past. Antarctica's mountains are an extension of the Andes Mountains. Africa and South America fit perfectly together. Some fossil remains of an individual species have been found strewed across all continents in the Southern Hemisphere, indicating that they were once connected.

Highlighting the importance of scientific evidence, part of the opposition to this theory was that Wegener had no good model to explain how the continents moved apart. Most of Wegener's observations about fossils and rocks were indeed correct, he just wrong on several key points and had no mechanism to back his theory.

It wasn't until there was data on the ocean floors that the theory started coming together. Over two thirds of the planet is covered water, but there was very little understanding of it.

In the 1950's, scientists on ships used magnetic

instruments *(magnetometers)* to detect submarines, but they also detected odd magnetic variations across the ocean floor. There appeared to be stripes of rock with opposing polarity: either aligned with the Earth's present magnetic field or the reversed polarity. Fred Vine, a PhD student under Drummond Matthews, published a Nature paper in 1963 to explain the intriguing magnetic striping on the ocean floor. When magma from the Earth's mantle rises through mid-ocean ridges and cools. But because the Earth's magnetic field switches direction over time, the new oceanic crust being deposited reflects whether Earth's magnetic orientation was either normal or reversed at the time.

Canadian geologist Lawrence Morley independently arrived at the same idea but faced resistance. He struggled to publish a paper as the reviewers were hostile to such a revolutionary idea. Once the Vine-Matthews-Morley hypothesis was accepted, it became crucial in the theory of Plate Tectonics. Within three years, the entire ocean floor had been dated.

Then Marie Tharp, a geologist and oceanographer, created maps that changed the way people view the oceans. Most scientists assumed that the seabed was featureless, but her maps detailed the mountains, valleys and trenches at the ocean floor. While Wegener had noticed how the coastlines of modern continents such as Africa and South America fit together but couldn't explain how they drifted apart, Tharp identified mountains and a rift valley in the centre of the Atlantic Ocean where the two continents had been ripped apart.

Tharp's work was dismissed by her research partner as "girl talk". But when a research assistant plotted locations of earthquake epicentres and they fell within Tharp's rift valley, everything changed. 'It wasn't until we understood the oceans that we could make that step forward,' says Professor Peter Betts.

As evidence accumulated, scientists could not argue against the theory as much. There was a paradigm shift in thinking, but it did take a while to trickle down into schools. When Peter Betts, William Birch, Andy Gleadow, and Sandra McLaren were young geologists, plate tectonics were still not a given. It certainly was not taught in schools and even some lecturers at university were resistant to teaching it or were uninformed of the new ideas.

Scientists were more siloed at the time within individual fields, but the people driving the evolution of plate tectonic theory thought across boundaries. Interdisciplinary teams of scientists now come together to solve problems. While Vine and Matthew's 1963 paper had the duo as sole authors, most papers nowadays have at least ten researchers working toward the same goal bringing in slightly different angles.

One of the most important outcomes of plate tectonic theory is that we can better predict when earthquakes and tsunamis occur or when volcanoes will erupt. It is important to acknowledge that scientists can be mistaken in their hypotheses (like Wegener was), but when several scientists work together or independently produce data that supports each other, we can be more confident in evolving scientific information.

Collecting Insights

Environmental adaptation in Victoria

THIS ARTICLE FOLLOWS A PANEL DISCUSSION ON 22ND AUGUST 2021 WITH DR SALLY SHERWEN (ZOOS VICTORIA), PROFESSOR TIM ENTWISLE (ROYAL BOTANIC GARDENS VICTORIA) AND DR KEN WALKER (MUSEUMS VICTORIA). THIS WAS THE FINAL EVENT AS PART OF THE ACCLIMATISE PROGRAM AND STEM AND SOCIETY SERIES.

Museum collections reveal our place in the past, present and future. To know where we are headed and whether the planet can adapt to a changing climate fast enough, we first need to look back.

Visiting Melbourne Museum, Melbourne Zoo or the Royal Botanical Gardens is a fun day out, yet many don't realise that, behind the scenes, they are also important research hubs. Dr Ken Walker, Dr Sally Sherwen and Professor Tim Entwisle discussed what their respective organisations are doing to protect Victorian flora and fauna in the face of climate change.

> 'Natural history museums are libraries of life...we need to preserve the past to see into the future,' says Ken.

The collections entomologist Ken works with are incredibly valuable troves of information. Australia does not have a single national collection but has 120 public biodiversity collections that hold over 70 million specimens worth around $8 billion.

While Ken works in an 'insect morgue', the Royal Botanic Gardens are teeming with life. Across two gardens and a nursery, they are a living collection with 9,000 different plant species. Led by Tim, teams at the gardens research adaptation, maintain an enormous seed bank and seedling nursery, and help cultivate plants and gardens that will survive and thrive over the next 100+ years as it gets hotter and drier.

> 'No species on Earth is immune to the impacts of climate change,' says Sally.

Everything within an ecosystem is interconnected. Plants are a source of food and shelter for animals and animals aid in seed pollination and distribution. Animals

rely on other animals and food sources being available at certain times of the year. If one goes out of whack, they all do.

At Zoos Victoria, Sally and her team are working hard to save threatened species. They are committed to fighting wildlife extinction by running captive breeding and recovery programs, as well as launching campaigns around animal welfare. Animals have ways to adapt to changing climates, but evolution does not work fast enough. They cannot respond as ecosystem changes accelerate.

The 2019-2020 bushfires pushed many species over the edge and all three organisations responded rapidly. Many animals and insects died immediately or in the aftermath, and many plants were reduced to char.

The Royal Botanic Gardens surveyed the destroyed habitat. What did animals have to go back to after the fires? Very little. The team took cuttings of plants to grow them in the nursey, and quickly replanted trees to restore animal habitats.

With loss of shelter, food, and increased risk of predation, animals became incredibly vulnerable. Zoos Victoria set up a rapid conservation breeding program, bringing animals to safety so that populations could bounce back in a sanctuary. For example, there is only one population of the Eastern Bristlebird in Victoria near Mallacoota and an expert team extracted birds by helicopter to ensure their continued survival. Young critically endangered Spotted Tree Frogs were also saved from their home to be the founders of future generations.

Ken and other etymologists monitored insect populations in the affected areas. Very few insects remained. While they had previously observed 46 different species across five locations, after the fires, the insects were only to be found in one place. The genetic diversity and spread across the landscape were gone. Unlike the animals rescued by Sally's team, invertebrates are difficult to relocate. Insects instead rely on the seedlings planted by Royal Botanic Gardens and others – and we have to hope that's enough.

While the bushfires were catastrophic and the impacts were sobering, it is heartening to hear how people are driving recovery and ensuring that we have a future rich in biodiversity. The three speakers are also hopeful for the future of science to help address the climate crisis.

Taxonomy provides a way to communicate information about species and a context in nature. Australia is estimated to be home to 600,000 species of flora and fauna, yet 70% remain unnamed. If we continue at the current rate, it will take 400 years to name them all and many will have gone extinct in that time (while new ones may emerge). To speed things up, Taxonomy Australia launched a 25-year mission to name them all. Increasingly advancing technologies such as genetic sequencing, artificial intelligence and supercomputing might make it possible to give us a good handle the diversity of life on our planet

Weas individuals can play a part too. We can drive social change, be conscious about how our actions can influence the environment (both positively and negatively) and be citizen scientists. People can help gather data on which species are found where and changes over time. A great advocate of citizen science projects, Ken often says, 'tell me what's in your back yard, because I can't get there.'

While climate change is a great cause for concern, there are many organisations here in Victoria working tirelessly to protect the environment. An estimated one million species are on the brink of extinction, but we can change their trajectory by working together. Combining the skills of our current and future scientists with the whole community, we can help our plants and animals adapt to Victoria's warming, drying climate.

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