The Royal Society of Victoria
Promoting science since 1854

SCIENCE VICTORIA

NEWS FROM THE ROYAL SOCIETY OF VICTORIA | *RSV.ORG.AU* | MAY 2022

Saving the Platypus 20

THE OFFICIAL NEWSLETTER OF RSV

In this issue

ISSUE 17

In this issue

ON THE COVER:

A platypus, *Ornithorhynchus anatinus*, in the wild, swimming with fish. Photo: Inge Blessas

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FROM THE PRESIDENT

Trust in Science

I was most interested to see the recent update by the Monash Climate Change Communications Research Hub (MCCCRH). I had the pleasure of assisting Director, Associate Professor David Holmes understand a little about how television newsrooms work in the early days of the MCCCRH[1]. A cornerstone of the program was to assist television weather presenters explain climate issues by providing them with useful graphical information.

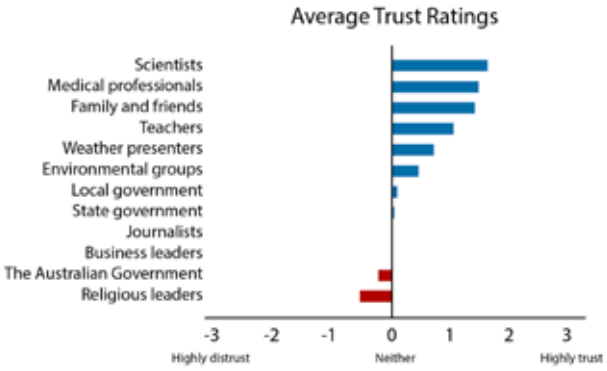
It was understood that weather is not climate, however, the need to present readily absorbable information about climate information within news broadcasts was important. The daily weather presentation seemed an ideal opportunity and the MCCCRH has successfully developed a positive relationship with a number of news services.

I'm both delighted and amazed to know that 7 News weather actually presented a MCCCRH version of Ed Hawkins 'warming stripes' on 'Show your stripes day' last year[2]. Climatologist Professor Edward Hawkins MBE3 is a professor of climate science at the University of Reading and has received a number of prestigious awards for his brilliant graphical visualisations of long-term trends in annual temperature anomalies. He was awarded the Royal Meteorological Society's Climate Science Communication Prize in 2017.

The MCCCRH has recently completed a national survey of Australian's attitude to climate change. Dr Lucy Richardson a Post-Doctoral Research Fellow in Climate Change Communications with MCCCRH and has presented to summary of that survey in this edition of Science Victoria.

The graphic that drew my attention was the survey's results on average trust ratings. It found that scientists are the most trusted people for information on climate change (trusted by 81%). Perhaps this is not surprising? The 2022 Edelman Trust Barometer4 has described a 'vicious cycle of distrust' that is thwarting progress on climate change, global pandemic management, racism and mounting tensions between China and the USA. The four identified forces are:

- Government-media distrust spiral
- Excessive reliance on business
- Mass-class divide
- Failure of leadership



1 *https://www.monash.edu/mcccrh/home*
2 *https://drive.google.com/file/d/1j-vniNIH6HXgN99186urpo3oMAYmQ2za/view*
3 *https://en.wikipedia.org/wiki/Ed_Hawkins_(climatologist)*
4 *https://www.edelman.com/trust/2022-trust-barometer/breaking-vicious-cycle-distrust*

Edelman suggests that this is a particular problem in Germany, Australia and the United States.

Recent research by the Pew Research Centre suggests that after an initial increase the global pandemic has caused a significant fall in public confidence in medical scientists and scientists[5], however, large majorities of Americans have 'a fair amount of confidence' in scientists (77%) to act in the public interest placing them at the top of the list of nine groups and institutions included in the survey.

My view is that in challenging times and for a number of reasons the RSV should capitalise on 'trust in science', take a lead position and facilitate an opportunity for science-focussed groups in Victoria need to 'speak with one voice'. Our CEO Mike Flattley drew attention to our new initiative for the RSV to affiliate with like-minded organisations in the last edition of Science Victoria. We have identified a number of organisations who wish to work with us to establish arrangements affiliation agreements that would provide access to RSV facilities and develop positive communication channels in pursuit of our common goals. This should be a primary role for the RSV as a convenor of the scientific community.

RECOMMENDED READING

May I offer some articles that I have found particularly valuable recently?

I am a regular listener to the Energy Insiders podcast published by RenewEconomy. A recent episode featured our 2019 Research Medal recipient **Professor Andy Pitman,** currently Director of the ARC Centre of Excellence for Climate Extremes, hosted by UNSW. The episode **2°C? It's already nearly too late** is an excellent, up-to-date summary of climate science as it pertains to the Australian continent.

Biodiversity loss and the collapse of nature is an equally important issue. The Taskforce on Nature Related Climate Disclosures is the finance sector's primary global effort to reverse nature-negative outcomes from global financial flows. This is something our RSV Natural Capital Finance Working Group will focus on; see the related news item on Saving the Platypus in this edition of *Science Victoria*. They have recently developed an interactive online platform which seems to be a serious attempt to address this issue.

As usual, I invite members and other readers to comment on ideas put forward in *Science Victoria*. Please contact me at president@rsv.org.au . We would like to publish your letters and thoughts on any issues raised in future editions of this newsletter. Please respond to any of the letters and articles published, as we seek to generate positive conversations and new ideas.

Rob Gell AM MRSV
President

5 *https://www.pewresearch.org/science/2022/02/15/americans-trust-in-scientists-other-groups-declines/*

FROM THE CEO

A Temple Run

When dealing with the intersection of science and society, a contested and messy space the Royal Society of Victoria has occupied for over 160 years, I find myself cleaving to this truism more and more frequently:

*T*ransmitting scientific knowledge to non-scientists represents extremely well-informed and considered advice, not a decision or directive. Deliberation is a function of our social order and is most effective when well informed.

When scientific evidence is bypassed or overlooked in a deliberative process, we may justifiably be dismayed; not because science is the last word, but because it means the decisions are either made in ignorance, or compromised by conflicting and potentially unethical agendas, or both. Certainly, a decision that flies in the face of excellent scientific advice is unlikely to be the best decision, and motivations should be examined closely.

However, when we consider that scientists are themselves flawed human beings with unconscious biases, embedded ideologies, hubristic personalities and unreliable memories on board, we appreciate all the better how utterly reliant the research endeavour is on principles and processes of ethical conduct, critical oversight, and intellectual rigour to guard against the failings of individuals in a collegial enterprise. This is how scientists tend to relate to one another; always on guard, always second guessing, anticipating the finding of fault, recalibrating and refining work that is never truly definitive. Reputations are hard won and easily lost in this endlessly critical and contested space, and well may we call fields of research endeavour "disciplines" as a result.

THE DEATH OF SOCRATES, by Jacques Louis David, 1787
The Western conception of the sciences commenced as branches of Western philosophy, including political science. The relentlessly critical Socrates was sentenced to death ("*hand me the damn hemlock, Phaedo, cheers everyone, oh stop blubbing Apollodorus*") as a proponent of dangerous, anti-democratic views whose adherents had turned Athenian society on its head more than once. But his friends and students loved and mourned a unique mind who had inspired a new system of thought.

The Critical Friend

Wei Zheng (580 – 543 CE) a Taoist and fearlessly critical chancellor to the Tang Dynasty during the reign of Emperor Taizong, provides the celebrated origin of the term 'zhengyou', famously recoined in 2008 by then Australian Prime Minister Kevin Rudd in a landmark (and critical) speech to Chinese intellectuals and officials at Peking University. An enormously valuable and successful advisor to decision makers, Wei Zheng famously justified his openly adverse advice to leadership as a function of loyalty, quoting the directive of a legendary ancient Chinese ruler, Emperor Shun: "Do not obey me in my presence and make secret speeches against what I do."

Photo: Fanghong - Own work, CC BY 2.5, *https://commons.wikimedia.org/w/index.php?curid=844416*

> *Ultimately, it comes down to this: if you work in research and find the typically critical exchange between peers distressing, then you're probably in the wrong profession. Socratic questioning and "productive discomfort" can be both intensely frustrating and personally confronting, which is not for everyone, at least not on a regular basis.*

I hasten to qualify that abuse, intimidation and exclusionary behaviours are not functions of a respectful critical discourse – no workplace should tolerate a culture of personal attack, intellectual diminishment, exclusion and harassment. Most of us commit our brief lives to earning money from labour, so it's only reasonable that working cultures provide access to fellowship, a sense of belonging and higher purpose, and due acknowledgement for our achievements. So, let's not put each other to death, nor self-righteously quaff hemlock, and agree to be 'critical friends.' Concord and progress, colleagues.

When we come to the public communication of science, scientists are suddenly required to shift gear, put their heads above the institutional parapet and become an "expert," a public authority on their subject. Scientific knowledge is already complex and difficult to distil into sound bites. Add to this that the best advice is always subject to change as more information comes to hand, meaning scientists can only truly convey degrees of certainty, not hard truths. As I did myself in the previous paragraph, every point must be qualified, which frequently frustrates the interests of, say, a short-form journalist hoping to engage their readership with a brief, attention-grabbing article that unambiguously tells us how to think, feel or behave.

It also means that the rules of critical discourse – addressing flaws in process, analysis and argument, while not belittling or abusing the human being conducting the work – are pretty much out the window. Scientists set sail on the seas of social media many years ago, and mainstream media many years before that, and as valuable as the opportunity to engage directly with audiences can be, it is all too often a platform for an unmoderated exchange of invective and abuse, particularly when scholarly work collides with the unfiltered range of biases, ideologies, intellectual hubris, outright misanthropy and all the other human failings that the research endeavour generally works hard to constrain (with varying results).

You might be a science-literate communicator or a communication-literate scientist; either way, you are accountable for the advice you are providing to people, who are making decisions based on that advice. Simply being a human being with an opinion can have disproportionate effects if you are a recognised holder or proponent of expertise, however unrelated to the subject matter at hand your expertise may be.

Personally, the science communication endeavour often makes me feel like I'm Indiana Jones hurtling through a perilous temple maze of hidden, catastrophic traps. What if I get it *really* wrong in the heat of the moment?

We see civic agencies such as the Australian Electoral Commission charting a very similar terrain and doing it spectacularly well in the midst of the current Federal election campaigns; safeguarding our democratic process through a critical exchange with citizens is another form of knowledge leadership, providing intersectoral lessons to trade with science communicators. The media environment is often fluid, dynamic and fraught with reputational peril, and you must rely on your wits and self-discipline to maintain consistency and rigour. To sustain such an effort, the practice of science communication is, and must be, regarded as its own discipline, accountable to the critical gaze of peers in order to be held to account ethically and kept in line with best practice. But more than anything, it is important to be supportive of our colleagues displaying genuine courage in navigating this unmoderated space - fact checking for curious minds, inviting genuine discussion and, importantly, engaging in open, critical debate beyond the safety of the familiar.

It was a real pleasure to hear from seasoned science communicator **Dr Shane Huntington** for last month's RSV lecture. 30 years of public broadcasting on scientific work, conducting his own research and delivering strategic programs for research institutions revealed a scholar passionate about what he does, and an expert in his field.

> *Shane tells us "it's obvious in science that we can't always give absolute answers, we know this. That's the nature of science; science is also evolving, so those answers can change. But what do the public expect? When they're making choices based on risk, it is very challenging to communicate the information that they need so that they can make those choices in an informed way."*

So, there's a balancing act to strike here; yes, scientists must continue to observe academic discipline in the public eye and be clear on degrees of uncertainty, but there's also a civic responsibility that comes from being the holder of specialised knowledge within a society. That responsibility impels a scientist to convey clear and cogent advice when needed in order to return clear value to the society that invests in the research enterprise.

Dr Shane's presentation *Earthquakes, Pandemics and the Communication of Science* is available to watch now on the RSV's YouTube channel

Shane discusses the critical nature of responsible public communication in any career that utilises science, in particular the skills required to relate levels of risk to the general population, from cigarettes to earthquakes to pandemics. His presentation is online now, along with the rest of our recorded lectures, at *https://www.youtube.com/c/TheRoyalSocietyofVictoria*, and reflections on his key points are provided by Catriona Nguyen-Robertson in this edition of Science Victoria. My thanks to Shane for a great talk, which has provoked much further thought and reflection, and to anyone indulging me in the result of same!

Mike Flattley
CEO

LETTERS

Do Our Common Foods Contain Toxins?

Dr JA Edgar, PhD CSIRO Agriculture and Food, Prof David W Walker PhD, DSc Neurodevelopment in Health & Disease Research Program,School of Health & Biomedical Sciences

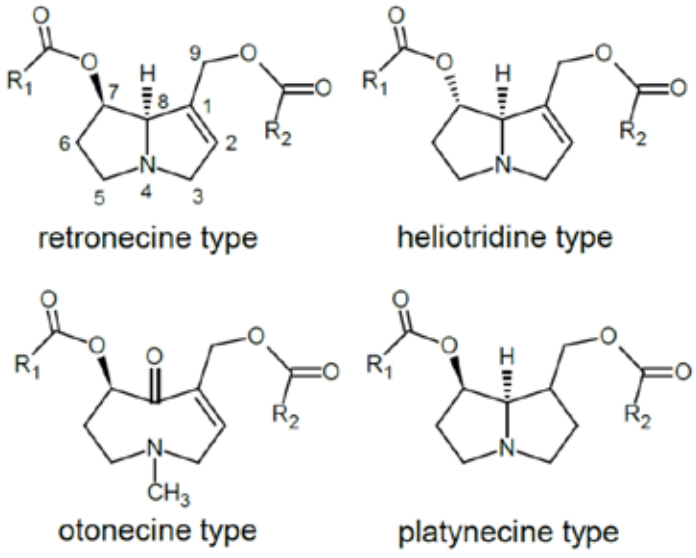
We are writing to you and the RSV membership to alert you to the presence of some very hazardous plant-produced toxins as contaminants in a range of foods we are consuming. We will, as an example, discuss common hazardous food contaminants called pyrrolizidine alkaloids (PAs) that all of us are currently exposed to in some of the foods we are eating. More than 500 different PAs are produced in an estimated 3% of flowering plants worldwide. They serve to protect the plants producing them from being eaten by herbivores but we, as food connoisseurs, also ingest them, sometimes in large amounts.

Many PA producing plants grow as weeds in agricultural systems worldwide and many of the PAs they produce have been found as contaminants in honeys, teas, grains, meat, eggs, dairy products and herbal medicines. In Australia, widespread agricultural weeds producing PAs include, for example, Salvation Jane/Paterson's curse (*Echium plantagineum*), Common heliotrope (*Heliotropium europaeum*), Groundsel (*Senecio vulgaris*), Fireweed (*Senecio madagascariensis*), comfrey (*Symphytum spp.*), and a variety of *Crotalaria spp* such as the 'Green Birdflower'.

> *PAs are not toxic per se, but they are converted by enzymes in many of our tissues to highly reactive metabolites that can damage DNA. Thus, PAs have been linked to causing a variety of cancers and potentially a range of other common genetic diseases.*

Regulations specifying "tolerable" levels of PAs in food have been determined by authorities worldwide, including the World Health Organisation. Food safety agencies in many countries, including Food Standards Australia New Zealand, are aware of this issue and are, to some degree, attempting to reduce dietary exposure of consumers to these hazardous substances.

Of particular concern however is the lack of regular monitoring of PAs in foods consumed in many countries, including Australia. The German Federal Institute for Risk Assessment (BfR) is one example of a government agency providing an excellent on-going and effective monitoring and risk assessment of PAs in German foods (see *https://www.bfr.bund.de/cm/349/updated-risk-assessment-on-levels-of-1-2-unsaturated-pyrrolizidine-alkaloids-pas-in-foods.pdf*). This recent BfR publication provides an excellent summary of the international PA food safety literature and, in particular, the risk assessment of dietary PAs in foods on sale in Germany. We suggest this represents an excellent model for Australian food safety authorities to consider implementing here.



Key Structures of Pyrrolizidine alkaloids (PAs). Adapted from "Updated risk assessment on levels of 1,2-unsaturated pyrrolizidine alkaloids (PAs) in foods (doi.org/10.17590/20200805-100055)

As gene-mutating, cancer-causing food contaminants, no "safe" threshold level of dietary exposure can be determined for PAs; the best that can be determined is a "tolerable" level of exposure. When people have been exposed to relatively high levels of PAs in food, their livers, lungs and brains can be irreversibly damaged,

and many hundreds of people have died as a result of dietary exposure in some countries. Such large-scale, acute poisoning has apparently not occurred in Australia, but a point we want to make is that the current 'acute toxicity standards' do not address the issue of toxicity arising from chronic, low-level exposure over months or even years.

One of us (JAE) has recently been involved in publishing a peer reviewed-journal article (*Chem. Res, Toxicol.* 2022, 35, 340-354, accessible at: *https://doi.org/10.1021/acs.chemrestox.1c00384*) on the potential for dietary PAs as a cause of sporadic neurodegenerative diseases such as amyotrophic lateral sclerosis (ALS) and motor neuron disease (MND). Genetic inheritance only explains a proportion of these age-related cases. Could the higher incidence be the result of dietary exposure to PAs? In addition, it must be considered that chronic exposure to these plant-derived toxins during pregnancy and in young children could also contribute to the emergence of early illnesses such as childhood cancers, and developmental behavioural conditions such as ADHD, autism, and epilepsy. Clearly, further targeted research is needed.

> *The reason for bringing this issue to the attention of the RSV members is not to be alarmist, but to raise awareness of the need to avoid high consumption of some of these hazardous foodstuffs (e.g., some honeys, herbal teas, infusions, etc), and to urge Food Safety authorities here in Australia and New Zealand, and worldwide, to continue to regularly monitor the presence of these plant-based toxins in the food chain so that everybody, from infants to the very elderly, can maintain life-long health and well-being.*

We need to know what we need to know.

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North Ryde, NSW 2113
Email: *john.a.edgar@hotmail.com*

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Neurodevelopment in Health &
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School of Health & Biomedical Sciences,
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RSV NEWS AND NOTICES

New RSV Members

Ms Kate Phillips
Senior Curator, Museums Victoria

Miss Caroline Cotton
Founder, BioBrain

Mr Roland Muller
Legal Practitioner, Parke Lawyers

Mrs Megan Kreutzer
Sustainability Manager, Coliban Water

Dr Nandini Doreswamy
Senior Manager, Pricewaterhouse Coopers

Ms Amelia Travers
Web Developer, Cogent

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.

Developing Science-Backed Investment Models to Save the Platypus

Victoria's science society is developing a series of implementable ideas to save the platypus, formally declared a vulnerable species by the Victorian Government on the recommendation of its Scientific Advisory Council in January 2021.

> *"The earliest fossil records of the modern platypus date back at least 100,000 years, and its monotreme ancestors were present on the supercontinent of Gondwana hundreds of millions of years ago," says RSV's CEO, Mike Flattley. "Yet the twin threats of anthropogenic climate change and ecological collapse means the platypus may not be living in the wild by the end of this century."*

RSV President Rob Gell laments that "we've already lost the platypus from the wild in South Australia, and it is entirely in our hands whether we make the necessary investments to protect and regenerate platypus habitats here in Victoria."

> *"The science is clear, and we know we need to act. We just need to establish the ways and means to do it."*

The Victorian Government's Scientific Advisory Council, which recommended the platypus be listed as vulnerable in *November 2020*, identified the primary threats to this declining species as the destruction of habitat, the reduction in surface water and flows due to drought, and altered flow regimes and water extraction for domestic, industrial and agricultural purposes. Predation by natural enemies like goannas and snakes has always been a feature of platypus life, but introduced species such as the red fox, cats and dogs have increased pressure on the iconic animal.

> According to the Council, the unreliability of surface flows and subsequent degradation of aquatic systems is predicted to increase under future climate change scenarios and the impacts of a growing human population.

Recognising the scarcity of public funding to drive recovery, the RSV is establishing a Natural Capital Financing Working Group to focus on the urgent need to stimulate private sector investments that protect, preserve and regenerate local biodiversity in the face of threats from climate change and habitat loss. The working group will consist of a broad cross section of stakeholders including scientists, local government, financial institutions and corporations.

Moonee Ponds Creek in West Brunswick

Ideas that will be explored by the working group include:

1. Developing models to fund necessary investments to protect, preserve and regenerate platypus habitat through the issuance of bonds that could colloquially be called Platypus Bonds.
2. Developing commercial market opportunities for recycled water that can support biodiversity outcomes by guaranteeing flow of water to our rivers and streams in the face of extreme weather events. Examples include:
   - upgrading Melbourne Water's Western Water Treatment Plant to Class A recycled water;
   - construction of a pipeline to transport reclaimed water to the source of the Lerderderg River to improve environmental flows;
   - mandating installation of distributed, smart water systems across urban catchments to support environmental flows to waterways at times of heat stress.

A *discussion paper* has been developed and released by the Society for consideration by Group members.

The platypus has deep links to the history of the Royal Society of Victoria. In the 19th century, the RSV brokered the scientific expertise to develop Melbourne's water supplies, storm water and sewerage systems, informing standards for the rollout of municipal infrastructure across the state which, ironically, has had a profound impact on the platypus' natural habitat.

> *"A world-class sewerage system and a reliable source of healthy drinking water remain a big win, but the transformation of Melbourne's natural waterways into underground and hard-surfaced drains to speed rainwater directly to Port Phillip Bay didn't consider the value of permeable creek beds and banks for charging our soils and water table," claims Mr Flattley. "It certainly didn't account for sustaining biodiversity within our urban waterways."*

> *"These natural systems can do so much for us; reed beds and aquatic plants can help sequester carbon, clean the water and mitigate erosion. Natural waterways charge adjoining soils with water to support plants and animals that, in turn, contribute to pollination, soil health and the control of pest species."*

Mr Gell says the plight of the platypus is of national and international concern. "The threat to its existence is not at some distant date in the future. It is today. It is possible that at any time in the next few years we can expect a spring flash flood followed by a string of 45°C+ days. In this environment, the platypus will not breed."

> *"The eyes of the world will be on Victoria in confronting the decline of an iconic Australian species. We are known internationally for our science. We must be known for using our science to protect our biodiversity."*

The Society's Natural Capital Financing Working Group will be led by *Mr Gordon Noble* MRSV, an experienced proponent of sustainable investment policies and related financial instrumentation. The Society anticipates sharing recommendations following an intersectoral members' *forum* on biodiversity conservation and recovery, scheduled for June

Notice of Annual General Meeting

5:00pm, Thursday, 25th May, 2022

RSV members are asked to register to attend the 2021 Annual General Meeting (not an error – held in 2022, reviewing our performance in 2021), noting a quorum of 50 will be required.

Meeting papers and the members' circulation draft of the 2021 Annual Report, comprising our Financial Reports and President's Report, will be circulated ahead of the meeting. We will also be voting on amendments to our Rules, which are proposed *here*.

Please register to attend now at *https://rsv.org.au/events/2021-annual-general-meeting/* .

If you cannot attend, please nominate your proxy on the online form provided by the RSV at *https://rsv.org.au/proxy-form-2021-agm/.*

This meeting will be conducted online as a Zoom conference (including voting on motions via live Zoom poll). Please test your software's compatibility ahead of proceedings – w e recommend installing the latest version of the Zoom application and registering with a free account.

Fully subscribed RSV members only at the AGM please*;* full members, student members and Fellows are all entitled to vote. If your membership subscription has lapsed, please ensure it is renewed before 5pm on Wednesday, 25th May to be eligible to attend.

Research Sector Pledges Sought for the 2022 Federal Election

R&D INVESTMENT KEY TO JOBS AND GROWTH

As a member of Science and Technology Australia, Victoria's Science Society supports the research sector's ten election pledges, seeking commitments from candidates for this year's Australian Federal Election. We list the pledges as follow:

STA election priority 1

Make Australia a global STEM superpower by **growing R&D investment to lift the country into the top 10 OECD countries**, relative to the size of the economy.
Read more at **sta.org.au**

Let's punch *at* our weight in research funding, at least. It's a matter of investing in our brainpower as a resource for other sectors to draw on and sustain tertiary education as one of the nation's major exports.

STA election priority 2

Legislate the new $2.2 billion research translation and commercialisation fund and train Australia's first generation of bench-to-boardroom scientists.

We argue research translation is about "bench to community" – and "industry" is a big part of this picture. Public funding has established a world class research sector in Australia, but the private sector is where we need to build the capacity to benefit from this amazing resource.

STA election priority 3

A comprehensive **plan across Government to coordinate R&D investment, policy, and roles** to seize competitive strategic advantage for Australia.

Demonstrating the return on investment in science and research is a complex exercise. In the policy arena, we need to "connect up the dots" so everyone in the value chain understands their contribution across government silos and the nation benefits from an efficient system that delivers.

STA election priority 4

Boost investment in major research grant agencies to **embolden discovery research.**

Invest in trial & error. Discovery research allows scientists to tackle the unknown, take risks and make mistakes. Failure is a valuable component of the scientific process, helping us understand how things (don't) work – the lessons learned make applied research projects more efficient and cost effective.

STA election priority 5

Tackle the broken system of insecure work tied to competitive research grants to **protect early career scientists – the future of the profession.**

We are failing the next generation of Australian scientists. The academic workforce is static, at capacity, and tenure for Early Career Researchers is practically non-existent, typically at an age when housing and primary caregiving become a feature of adulthood.

These are some of the most highly trained yet most insecure roles in the workforce. This complex structural crisis requires a cross-sector process to resolve; we claim we need STEM expertise, so we need to create well-articulated career structures to support those who stake their youth and future on that claim.

Consider this recent article by PhD graduand Miro Astore (University of Sydney), who will soon be leaving Australia in pursuit of postdoctoral work: *https://www.smh.com.au/education/australia-has-spent-a-million-dollars-training-me-and-now-i-m-leaving-20220419-p5aelz.html*

STA election priority 6

Commit to **keep funding the national science agencies** by at least current levels of investment indexed by CPI.

Steady as she goes! This is not the time for *less* science.

STA election priority 7

Develop a comprehensive plan to transition to a **net-zero economy and safeguard Australia's unique biodiversity.**

Science has made sense of a complex problem. Now we need a government that seriously invests in climate action and biodiversity conservation as a basic duty of care to its electorate, and a responsible commitment of the taxpayer's funds. Based on the wisdom of the ancients, we estimate that $62.50 of prevention is equivalent to $1,000 of cure.

STA election priority 8

Renew the investment in the nation's vital research infrastructure through the National Collaborative Research Infrastructure Strategy.

Cross-sector participation in research is resourced by cutting edge national infrastructure funded through the NCRIS program. Renewed Commonwealth investment in NCRIS will resource these future-focused collaborations to sustain (and grow) Australian excellence. *https://dese.gov.au/ncris*

9

Craft a plan to **tackle a decline in STEM achievement** of Australian school students and stop the brain drain of our children out of STEM.

We have a world-class research workforce with a diminishing pipeline of talent. Industry faces the same issue. Disengagement by Australian school students with STEM subjects is a long-neglected issue that requires serious government commitment; we cannot keep cynically leaning on skilled migration to address a systemic failure to engage our current youth with their future opportunities.

STA election priority 10

Make further commitment to programs to **boost diversity and inclusion in STEM** to ensure the nation draws on the widest possible pool of talent.

We need all brains on deck to tackle current and unfolding challenges; gender, ethnicity, socioeconomic status and other markers of relative privilege should not comprise barriers to participation in the STEM workforce. We must prioritise and enable inclusion.

This is the RSV's angle on election pledges developed by Science and Technology Australia. You can read the STA's position piece, drawn from leadership across the science & technology sector, at *https://scienceandtechnologyaustralia.org.au/election-2022-bold-rd-investment-key-to-jobs-and-growth/* .

Australia's science sector must come out of the pandemic strategic, focused and energised.

AUSTRALIAN SCIENCE NEEDS LONG-TERM INVESTMENT

What would an excellent 10-year investment strategy for Australian science look like?

- An investment strategy for science and research is essential to secure Australia's scientific capacity so fundamental to our future in an uncertain world, and to find solutions to our nation's challenges.
- A strong science sector relies on long-term, consistent and coherent government funding – the 'patient capital' – to support discovery and innovation.

Australia needs sustained investment in science

Science is fundamental to our capacity to address the major challenges faced by our nation. It has a pivotal role in developing the ideas, systems and processes needed to provide Australians with a secure, prosperous and fair society.

Our pandemic response, national security, capacity to mitigate and adapt to the destructive forces of climate change, and our recovery from extreme events such as floods and bushfires, depend on science. It is science that supplies the aggregate knowledge developed by many years of investment of 'patient capital' central to discovery: the rapid development of mRNA vaccines was founded on work that began around 40 years ago, not in 2020.

Investing in science capability protects Australia's national interests. There are uniquely Australian problems that only we will have the motivation to solve. Challenges such as the impacts of climate change on the Great Barrier Reef, securing our agricultural sector against changing climate and weather and protecting our unique biodiversity will not be addressed by researchers in other countries.

A long-term investment strategy for science

A 10-year, long-term investment strategy for science is essential to secure the scientific knowledge and discovery needed to underpin future technologies and commercial opportunities. It should include growth, focus and coherence.

Industry Innovation and Science Australia reports that in 2019–20 the Australian Government's innovation, science and research investment was split across 202 programs and 13 portfolios.

This fragmentation is indefensible, made worse because few programs, if any, fund the actual cost of research, so researchers have to secure multiple grants for the work that a single grant would cover in a fit-for-purpose system.

An excellent long-term investment strategy would feature:

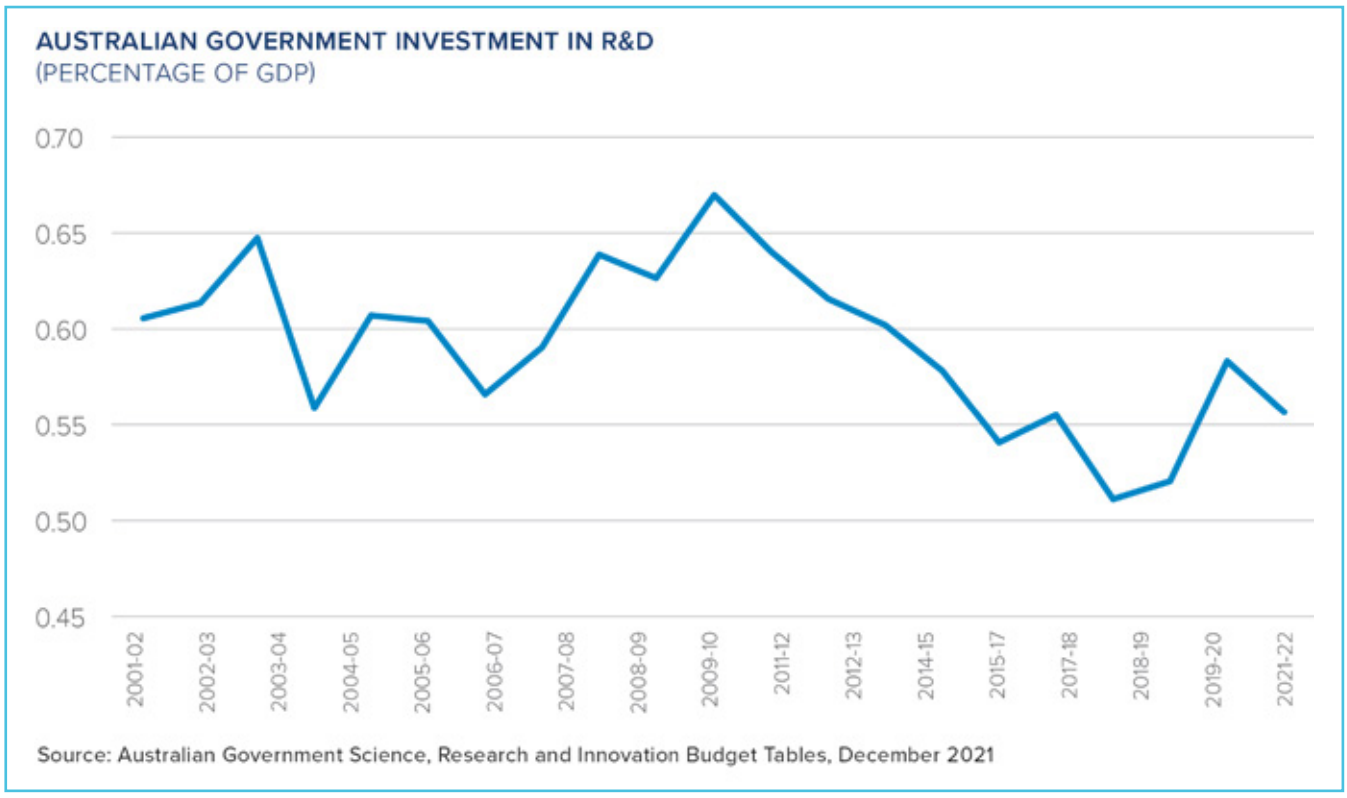
- adequate funding, with a proportion directed to building Australia's comparative and competitive advantage and balanced across fundamental research, applied research and experimental development
- a secure workforce pipeline, with PhD students remunerated at fair and reasonable levels, together with sustainable career options for early- and mid-career researchers
- continuity of investment for research infrastructure, maintained and relevant to contemporary research needs
- an international science engagement and diplomacy strategy to enhance international research collaboration
- an ambition to grow the quantum, the excellence and the impact of Australian science

Current state of investment in Australian R&D

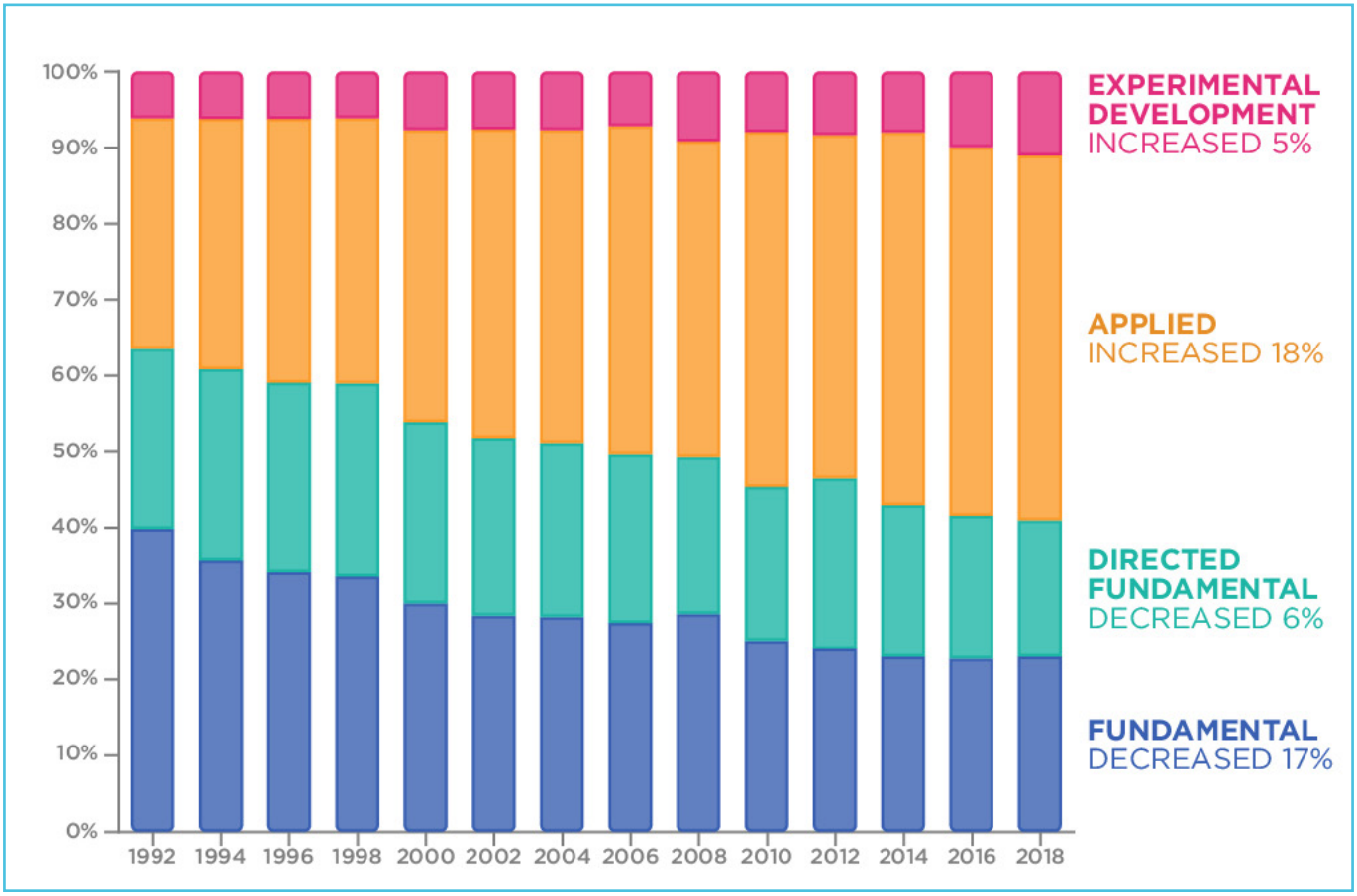
There has been a decline in support for fundamental research – the building block from which applications and innovations are derived. The drift to short-term project funding, reliance on unstable income streams such as revenue from international student fees, unnecessarily lengthy and burdensome application processes, and a demoralising decline in success rates, are all signs of a sector not fit-for-purpose.

Australia's investment in research and development (R&D) as a proportion of gross domestic product (GDP) has fallen over the past decade. In 2021 the Australian Government's investment was 0.56% of GDP, behind nations such as Germany, Japan, the United Kingdom, France and the United States. In 2019, R&D investment (Gross Domestic Expenditure on R&D) as a percentage of GDP was 1.79%, way below the OECD average of 2.5%.

Recent trends in government funding have focused on work with anticipated practical and commercial outcomes, but reducing support for fundamental research is like taking books from the library and never replacing them. Sooner or later, there are no books.



Australia's investment in research and development (R&D) as a proportion of gross domestic product (GDP) has fallen over the past decade.



The decreasing trend in higher education investment in pure basic research in Australia. Source: Australian Bureau of Statistics (ABS).

The pandemic dilemma – stronger or weaker?

The pandemic has cost Australian research. Our university sector's scientists, researchers and technicians comprise 45% of our national research workforce. From 2020 to 2021, the higher education sector reported a loss of 9,000 (7% decrease) full-time equivalent staff.

Australia's science sector will emerge from the pandemic weaker than it went in unless the value of investment in science and the research base is accepted and supported in Australia, as it is in our ambitious international comparators: strategic, focused, energised.

Questions for consideration:

- Where are the opportunities for change to improve Australia's research funding system?
- What key features should a long-term investment strategy for science include?
- How could the research community be involved in reviews of long-term research priorities?

The Royal Society of Victoria welcomes your thoughts and responses to these questions from the Academy. Please address letters to the President, care of *president@rsv.org.au* .

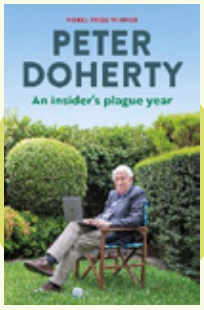
WHAT I'VE BEEN READING

Thoughts and reflections from Fellows of the Royal Society of Victoria.

Paying It Back

Laureate Professor Peter C Doherty AC FRS FMedSci FRSV

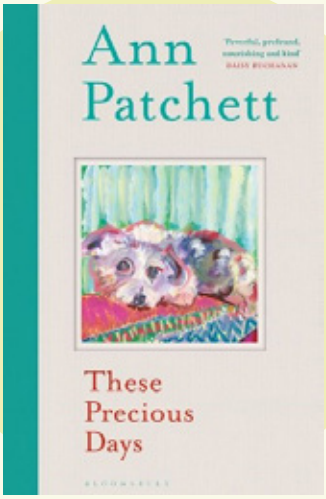
These Precious Days
Anne Patchett
Bloomsbury Publishing, 2021



I've been writing a lot over the last two years, mainly an 800-1,000 word weekly essay (mostly on COVID, just did #96) for our website and a book based on that (An Insider's Plague Year).

Things have quietened down, so I'm now getting back to reading more widely. Last night, I picked up These Precious Days, a book of essays by novelist Ann Patchett. So far, I've read only two, but they both resonated.

The first focused on her great fear of dying before completing a novel: not only would she be lost, but so would all those unique people that exist only in her head! I've had that same sense as a non-fiction writer. The unlikely connections I've made - which is what I think I contribute - would never see the light of day.



The second essay that hit home was the story of her three fathers – her mother was a serial monogamist. All gone now, they loved and supported AP and, in highlighting a little of their quirkiness, she in some way 'pays that back'.

I'm just finishing the edits on my first (of 8) non-science book (written in 2019, to be published this August) that's partly about WW2 and members of my mother's family. I've been obsessed with the sense that it must be finished! Telling some of their story is a partial compensation for all those words that can never be said, to pay back just a little of that unconditional love I received as a young child!

11 March, 2022

EVENTS

Sci Fight Debate: Pleasure is a False God

6:30pm, Thursday, 19th May

Howler, 7-11 Dawson Street, Brunswick

Sci Fight is a quarterly science comedy debate, with your definitely qualified host, Alanta Colley. [citation needed]

Sci Fight brings together science folk and comedy folk and makes them debate the big issues in a silly way.

This round we turn to pleasure. Finally! What is it? Where does it come from, and can I have some please? Pleasure is part of our biological make-up; evolution's way of prodding us to consume calories, procreate, and not freeze to death, so surely seeking pleasure is only natural? If nothing else, pleasure is a small compensation for all the suffering we endure simply by being trapped in these ridiculous meat vehicles, what with all their tooth decay, ear ache, period pain, and haemorrhoids. Can we not have a little dopamine as a treat? Why not steer our ship of purpose towards the Cape of Pleasure?

Or is pleasure a false god? Simply a smoke screen for more pain? Was it pleasure that led to the tooth decay in the first place? Is pleasure only ever a short term reward, where the deeper satisfactions born from hardship, suffering and sacrifice? One can't imagine Marie Curie bunking off early from the lab for a cheeky pint and a parma. Does the pursuit of pleasure prevent us achieving all that we are fully capable of as a species?

What ever happened to those kids in the marshmallow test? Are some of them still waiting?

Join us at the Howler for an evening of passionate and pleasurable discourse as scientists and comedians dissect our purpose, our passions and our pitfalls.

Tickets: ***https://moshtix.com.au/v2/event/sci-fight-science-comedy-debate-pleasure-is-a-false-god/138682***

RSV Members' Forum: Biodiversity Conservation and Recovery

Saturday, 4th June from 9:30am to 4:30pm

> Developing a consensus position, with recommendations for further work and effective investment towards the goals of Biodiversity 2037.

This is a one-day workshop, delivered as a hybrid event; a mixture of interactive online and in person participation, depending on your role in proceedings.

We will be hearing from subject matter leaders from four different sectors on how their domain of experience, expertise and responsibility is reflected in the task before us. We anticipate presentations of no longer than about 10-15 minutes from each RSV Fellow, spaced throughout the day according to the task at hand, followed by room and panel discussions.

There will be breaks throughout the day to conserve our energies and gather our thoughts.

This forum will feature deliberative components to help our team develop a draft position paper for the Royal Society of Victoria, with recommendations for further work across the industry, government, academic and community sectors and developing effective investment strategies to help Victorians meet the goals of Biodiversity 2037.

Featuring (below):

Ms Fern Hames FRSV, Director, Arthur Rylah Institute for Environmental Research (Department of Environment, Land, Water and Planning)

Mr Damein Bell FRSV, Atlantic Fellow and previously CEO, Gunditj Mirring Traditional Owners Aboriginal Corporation

Ms Judith Downes FRSV, FAICD, FCPA, FCA, Chair, Bank Australia and immediate past Chair of the Global Alliance for Banking on Values Governing Board Forum

Professor Brendan Wintle FRSV, Conservation Ecologist and previously Director, Threatened Species Recovery Hub

Please secure your place by registering online at *https://rsv.org.au/events/biodiversity-forum/*. As this is a member-only event, the option to register will only be available once your access code has been entered at the top of the ticketing window. Please contact *the Society* if you are unsure of your code. If you are not a member but would like to join the Society, please refer to our *membership page*.

STEM & Society: Biodiversity Conservation & Recovery in VIctoria

3:00PM AEST on Sunday, 5th June

A public presentation by the Parliament of Victoria with the Royal Society of Victoria and the Victorian Parliamentarians for STEM for World Environment Day.

There is nothing more important to humanity's continued existence than sustaining a healthy natural environment. Yet despite efforts in recent decades, many native plant and animal species remain under threat as Victoria's biodiversity continues to decline.

Governments are good at creating legislation, setting goals and formulating policies to achieve them – this is their core role. But with a problem as big as the survival of the natural world against the continued loss of habitat, species overexploitation, ecosystem pollution, spread of disease and invasive species, and the impacts of climate change, we will need all sectors of our society to prioritise and commit to protecting and recovering our biodiversity in partnership. Each of us have a role to play; we just need to define and align these to gain the best outcomes from available resources.

This World Environment Day, join leaders from across four sectors of Victorian society – government, industry, community and academia – who will provide their perspectives on protecting and recovering Victoria's biodiversity. We will explore:

- initiatives within the private sector to invest in and protect natural systems;
- opportunities for First Nations peoples to restore relationships with Country as a feature of cultural landscape management and the unfolding process of reconciliation and decolonisation;
- and, a range of tried and tested, science-based interventions and investment tools to guide and resource local people in restoring ecological health to Victorian regions.

WORLD ENVIRONMENT DAY | UN environment programme

Most importantly, we will discuss how these can all integrate to meet the goals set out in Biodiversity 2037, Victoria's ambitious plan to stop the decline of our biodiversity and ensure that our natural environment is healthy, valued and actively cared for by everyone.

SPEAKERS:

Ms Fern Hames FRSV, Director, Arthur Rylah Institute for Environmental Research (Department of Environment, Land, Water and Planning)

Mr Damein Bell FRSV, Atlantic Fellow and previously CEO, Gunditj Mirring Traditional Owners Aboriginal Corporation

Ms Judith Downes FRSV, Chair, Bank Australia, immediate past Chair of the Global Alliance for Banking on Values Governing Board Forum, and a Director for ImpediMed

Professor Brendan Wintle FRSV, Conservation Ecologist and previously Director, Threatened Species Recovery Hub, The University of Melbourne

Please note: this public discussion will be livestreamed via Facebook Live on the pages of the *Parliament of Victoria* and the *Royal Society of Victoria*; please tune in at **3:00PM AEST on Sunday, 5th June** to follow the broadcast and submit your questions for the panel.

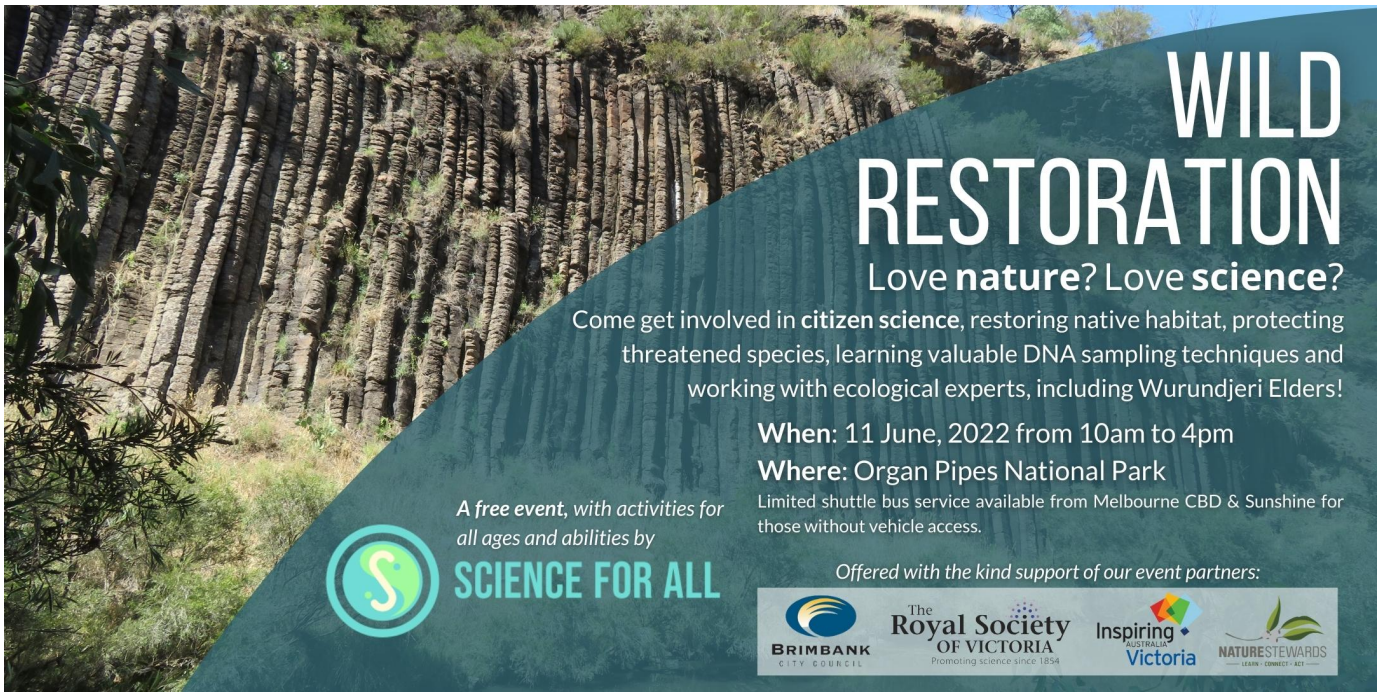
Members of the Royal Society of Victoria are also warmly invited to join the audience at Parliament House, in-person at Queens' Hall; **numbers are strictly limited, so please book early** using the registration page at *https://rsv.org.au/events/stem-society-biodiversity/* . The ticket option will only be available once your members' promo/access code has been entered. Please *contact the Society* if you are unsure of your code. If you are not a member, but would like to join the Society, please refer to our *membership page.*

Presented by the Parliament of Victoria and the Victorian Parliamentarians for STEM in partnership with the Royal Society of Victoria. A part of the *Inspiring Victoria* program.

Parliament of Victoria

The Royal Society OF VICTORIA Promoting science since 1854

Inspiring AUSTRALIA Victoria



Wild Restoration – Organ Pipes National Park

Saturday, 11th June 2022 (10am -4pm)

Organ Pipes National Park (Organ Pipes Rd, Keilor North VIC 3036)

Get involved in citizen science, restoring native habitat and recovering threatened species.

Come and learn how to get involved in restoring native habitat and recovering our local species while learning valuable citizen science skills at Organ Pipes National Park!

Hear from local experts and learn about the history of the Organ Pipes, using environmental DNA sampling to find local species, hear from Wurundjeri elders and get involved in restoring habitat and growing native plants.

Activities for all ages and abilities, with snacks and face painting provided!

We can bring a limited number of people with us by shuttle bus (pickup/drop-off at the Melbourne CBD or at Sunshine Station, Sunshine) or else you can get yourself there under your own steam.

For a detailed and up-to-date itinerary, please visit *https://ScienceForAll.World/Events* .

This event is run by Science for All with the support of the Royal Society of Victoria and the Nature Stewards program, jointly funded by a grant from Brimbank City Council, Inspiring Victoria and public donations. Our thanks to the Friends of the Organ Pipes National Park for their support of this event.

Please register to attend so we can manage numbers on the day: *https://rsv.org.au/events/wild-restoration/* .

Australian caves – diversity, wonder and risk

24th June at 6:30pm AEST

The Australian continent is not well-endowed with caves on a world scale, but Australian caves are notable for their diversity (greater than any other area of equivalent size on Earth), which reflects variety in carbonate rock types, climate, vegetation and geological history. Australian karst has something for everyone, from the razor-sharp towers of north Queensland to the cold, deep shafts of southwest Tasmania, the carbonate dunes of southwest Western Australia, the clear cenote lakes of southeastern South Australia and the ancient reefs of northwest Western Australia.

Australian caves are wonderful, both in terms of their visual impact and their scientific importance. They contain bat colonies that consume hundreds of kilograms of insects each night, a globally exceptional invertebrate fauna, vertebrate fossils that record animals and environments for at least the last 25 million years, and calcite speleothems that preserve detailed records of past climates.

> And Australian caves have risks. There are inherent dangers in exploring caves, including cold, heat, falls and getting stuck, but there are very few accidents in Australian caves because organised trips must have an experienced leader and appropriate equipment. Some caves themselves have been at risk from overuse and threats like limestone quarries.

Join Professor John Webb, who will cover all these aspects and give examples from his own experience.

ABOUT THE SPEAKER:

Professor John Webb is Professor of Environmental Geoscience at La Trobe University. His geomorphological interests centre on karst, and he is principal editor (with Susan White and Garry K. Smith) of *Australian Caves and Karst Systems*, in the book series *Cave and Karst Systems of the World*, soon to be published by Springer.

He also works on tectonic geomorphology and the interaction between landscape evolution and human settlement, and he has studied the geomorphology of archaeological sites in Australia, Jordan, China, Papua New Guinea and New Caledonia. In addition, he specialises in groundwater and contaminated site management, with on-going research projects on improving treatment procedures for acid mine drainage and on the influence of climate and land-use change on groundwater.

Tickets are available from *https://rsv.org.au/events/australian-caves/* to either attend in person or participate via Zoom. RSV and GSAV Members are prompted to **enter their "promo code" to access a member's ticket.** Alternatively, you can watch along via our *YouTube channel* at the appointed time without buying a ticket.

Streamed online as part of the *Inspiring Victoria* initiative in 2022.

Inspiring Australia Victoria

International Year of Caves and Karst 2021

Union Internationale de Spéléologie

Geological Society of Australia

AWARDS, PRIZES AND FELLOWSHIPS

Call for Nominations - Young Scientist Research Prizes 2022

The Young Scientist Research Prizes are open for 2022 nominations! Final year doctoral candidates at Victorian institutions can apply across four categories of science, with finalists presenting their work to the Society during National Science Week in August.

Applications for the 2022 competition opened on 1 March and will close at **5:00pm on 31 May, 2022.** Candidates should nominate themselves.

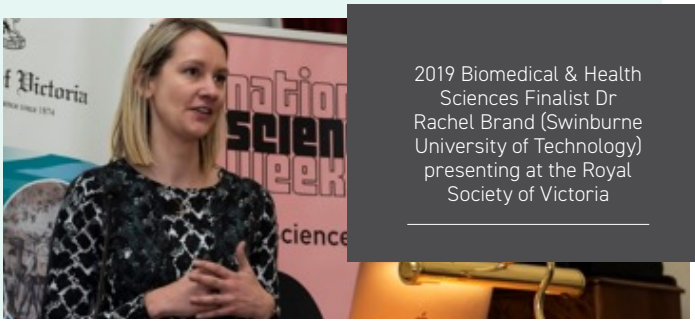
Your application for a prize should consist of an **application form**, incorporating your extended abstract - to be submitted electronically, then printed (from your confirmation email), co-signed by your Supervisor or Head of Department (to ratify your contribution to your doctoral research, particularly if it is a team research project) and submitted along with your **RSV Membership Form** (if required).

Your extended abstract presents a succinct summary of your research work. This is incorporated in the body of the application form to guide structure and length, and includes a title, rationale for the study, aims, methods, results, conclusions and significance, indicating why your research is important and of scientific interest. Our form will lead you through each element.

On the basis of the written abstracts, the judges will select a short list of two candidates in each of the four fields of Biomedical and Health, Biological (Non-human), Earth Sciences and Physical Sciences (eight finalists in total). We are planning to host a live event this year (on Thursday, 18th August), however should COVID-19 pandemic restrictions be imposed on gatherings, each of the short-listed candidates will be required to give a 10 minute oral presentation to camera at the Society's premises during July, followed by 5 minutes of discussion with a general audience of scientists and members at the Society at an online conference, to be livestreamed during National Science Week on the evening of **Thursday, 18th August, 2022** commencing from 6:30pm. Finalists who are unable to present or attend the 18th August event cannot be considered for an award.

First Prize winners will each receive a certificate and a prize of $1000. Second Prize winners each receive a certificate and a prize of $500. All finalists will also receive free student membership of the Royal Society of Victoria for a period of two years and the opportunity to participate in the Society's programs and access our professional networks for mentoring and collaboration as desired.

Forms and full guidelines on applications and eligibility are available from the Society's website at *https://rsv.org.au/awards-and-prizes/young-scientistresearch-prizes/*. Submission of the prize application form and abstract should be received as a single file via email marked for the attention of the Chief Executive Officer at *rsv@rsv.org.au* before the closing time and date, being **5:00pm on 31 May, 2022.** All late submissions will be deemed ineligible.



2019 Biomedical & Health Sciences Finalist Dr Rachel Brand (Swinburne University of Technology) presenting at the Royal Society of Victoria

Call for Nominations - RSV Medal for Excellence in Scientific Research 2022

Our 2021 Research Medal Winner, Professor Andy Ball, with the Victorian Minister for Energy, Environment and Climate Change, The Hon. Lily D'Ambrosio MP

Nominations are invited for the Royal Society of Victoria Medal for Excellence in Scientific Research 2022 in **Category II: Biomedical & Health Sciences.**

This category includes research in the disciplines of Genetics, Immunology, Human Physiology, Human Anatomy, Pathology, Neurology, Epidemiology, Endocrinology, Radiology, Microbiology, Medical Parasitology, Nuclear Medicine, and related human sciences.

The last Medal recipients in this category were Professors Anthony Burkitt and Jamie Rossjohn (2018).

AWARD CRITERIA:

The award of the Medal is based on demonstration of the candidate's excellence and leadership in scientific research. The candidate's research work shall have been carried out in Australia (including its territories), or on Australia, with preference for work done in Victoria, or on Victoria.

NOMINATIONS:

Nominations open on 31 March, 2022 and close at 5pm on 31 July, 2022.

- Candidates cannot nominate themselves.
- Scientific Societies, Academies, Universities, Research Institutes, CSIRO, and Members of the Royal Society of Victoria are invited to make nominations.
- The nomination statement should demonstrate the candidate's:

1. **Exemplary publication track record** during the ten-year period from 1st January 2012 to 31st December 2021. The track record will be judged on papers published and/or accepted for publication in refereed international journals. Work outside the ten-year period will not be considered, subject to due consideration of career breaks for primary care responsibilities.
2. **Consistent excellence** in innovation or ground-breaking research and patents, incorporating novel scientific techniques and methods – described in plain language.
3. **Exemplary leadership in science** incorporating evidence of a major contribution to the public promotion of science, advocacy for science, partnership building, collaborations, role modelling and influence across the scientific community.

SUBMISSIONS:

The submission should consist of:

- The nomination statement, signed by the nominator, covering points 1 to 3 above. This must be in Times New Roman, 11 point, and no more than three A4 pages please.
- A brief (no more than five A4 pages) Curriculum Vitae of the candidate. A list of publications, attached in supplement, should be constrained to the ten year period from **1st January 2012 to 31st December 2021.**

The nomination submission should in the form of a single PDF file sent via email, attention to the Chief Executive Officer, at *rsv@rsv.org.au*

CONDITIONS:

The Royal Society of Victoria reserves the right to seek independent referees in considering the nominations received, and not to consider nominations that do not comply with the nomination format or do not address the award criteria.

If no candidate of sufficient merit is nominated, no award need be made in a particular year.

No posthumous award will be made.

THE AWARD:

The successful candidate will receive an engraved silver medal which is presented by the Society's patron, the Governor of Victoria or, in the event of Her Excellency's unavailability, a senior leader of Victoria's government or science community.

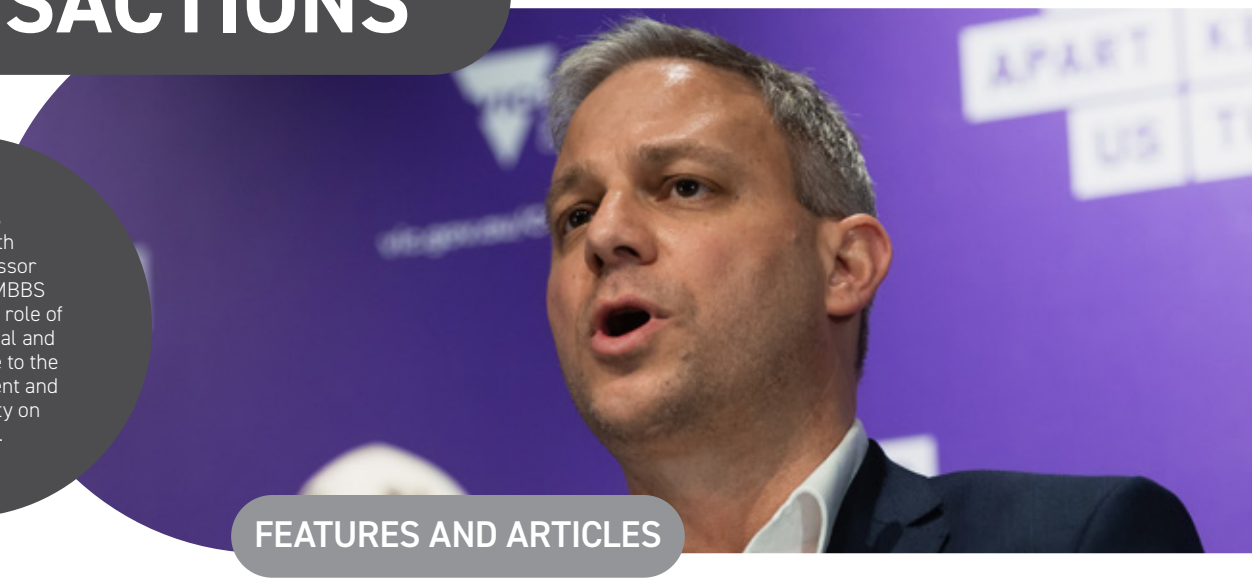
The medallist will be required to present a lecture to the Society Members and guests on the evening of Thursday, 8th December 2022 at which the Medal will be presented.

ENQUIRIES:

CEO, The Royal Society of Victoria, 8 La Trobe Street, Melbourne 3000 Telephone: (03) 9663 5259, or via *rsv@rsv.org.au.*

2018 RSV Medallists Professor Anthony Burkitt (left) and Professor Jamie Rossjohn (right) with Her Excellency the Honourable Linda Dessau AC, Governor of Victoria (centre)

TRANSACTIONS



Victoria's Chief Health Officer Professor Brett Sutton MBBS MPHTM had the role of providing clinical and scientific advice to the state government and the community on COVID-19.

FEATURES AND ARTICLES

Australian Views on Science and Scientists

By Dr Lucy Richardson , Monash University's Climate Change Communication Research Hub

A silver lining of the spread of COVID-19 is that discussion of science has taken over our newsfeeds. As we followed the evolving research on how COVID-19 spreads, the effectiveness of various prevention measures, and the development of vaccines, the Australian public became used to reading about research findings and seeing graphs and statistics tracking infection rates. This comes on the back of decades of sometimes confusing and misrepresented science regarding climate change.

SO HOW DO AUSTRALIANS REGARD SCIENCE?

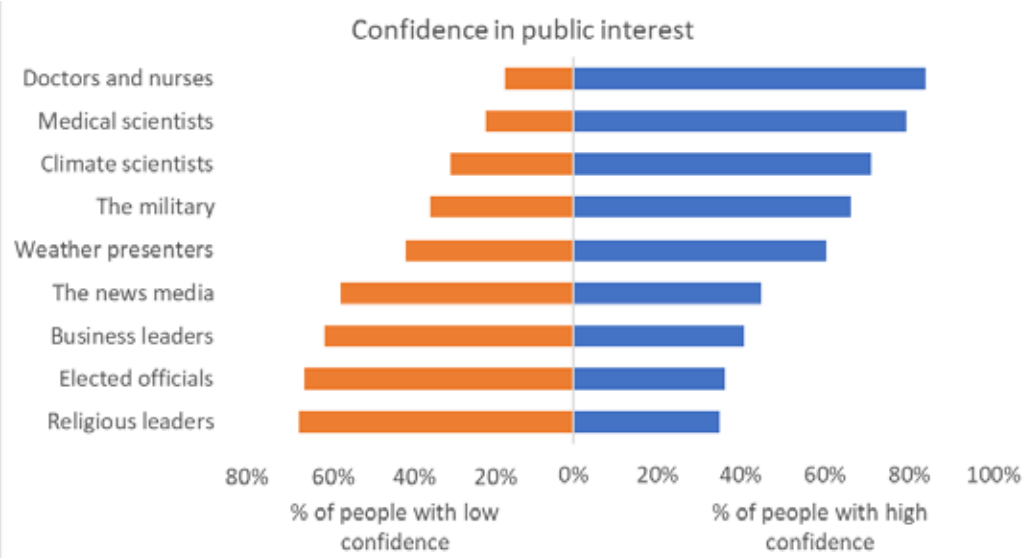
In 2021, the *3M State of Science Index* told us that 91% of Australians were hopeful that 2021 would be a better year than 2020 because of science. Global scientific collaboration around COVID-19 vaccines rose to the challenge and have, indeed, helped reopen much of the world.

At the beginning of 2022, my colleagues and I at the *Monash University's Climate Change Communication Research Hub* and the *University of Auckland* asked Australians for their views on science and found that approximately 60% of people think science and technology are making our lives healthier, easier, and more comfortable, and will bring more opportunities for the next generation.

There is a disconnect, however, when considering the personal, everyday relevance of science, with almost a third of people not seeing the importance of science for their daily lives. Perhaps science feels somewhat distant to us as it's filtered through policy, or is seen as more relevant for policy-makers, or maybe as only relevant for significant events (such as getting vaccinated). This is a question that warrants further investigation.

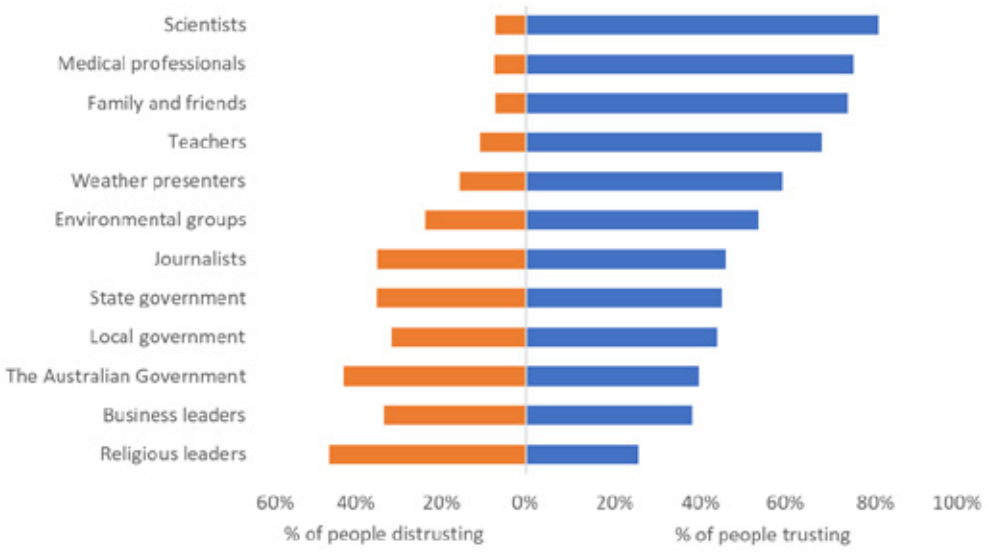
> Despite this, scientists remain among the most trusted professions. Trust in scientists varies depending on the field of science in question, with medical scientists currently slightly more trusted than climate scientists.

How much confidence, if any, do you have in each of the following to act in the best interests of the public?



When asked specifically about trust regarding information within a specific field, however, the order of trust can shift markedly. When we asked who they trusted for information regarding climate science, Australians indicated that scientists were by far their most trusted source.

How much do you trust or distrust the following for information relating to climate change and its impacts?



Political debates can sometimes lead to the politicisation of science to promote certain policy agendas. Climate change offers a good example of this. The high politicisation of science regarding climate change has led some segments of the public to split into opposing views based on political ideology rather than on the science itself.

With ideology at the forefront, individuals tend to accept information that agrees with their ideological beliefs, ignoring evidence to the contrary.

Splitting the public in this way, whether across political, religious, or other beliefs, can significantly hamper the use of scientific evidence in decision-making on critical societal issues, placing many Australians at greater risk and delaying the implementation of effective policies.

This is not to say that we should not debate policy. Such debate is critical in determining the best course of action for society. These debates should, however, focus on evidence-based policy options and open analyses that support informed public decision-making.

Don't Roll the Dice with Science Communication

by Catriona Nguyen-Robertson MRSV

Do you remember your first interaction with science as a child? Do you remember the brand name of any vaccine you have had in the past?

Shane's cigarette tar extractor. The blackened filter paper after "smoking" the cigarette clearly highlighted the health hazard.

WHAT DO WE REMEMBER FROM WHEN WE WERE YOUNG?

You probably remember the advertisements you watched on television, even when you were under ten years old. Marketing companies are good at getting us to remember things, but scientists do not always consider it part of their job.

Dr Shane Huntington remembers a scientific experiment he did back in year 7. The year was 1983, and the message was clear: smoking is bad. At the time, he had a part-time job at the local milk bar where he sold cigarettes. The packaging looked great. At school, students received kits from the Cancer Council to "smoke" cigarettes through filter paper with a syringe, and Shane saw how smokers would breathe in all the black tar that was caught by the paper. This simple yet unexpected result left a mark.

Shane advocates for better communication of science. Done well, it can be transformative. Done badly, it can lead to lives being lost.

'The way we communicate has a real impact on the way science is delivered to our society,' he says.

VALE L'AQUILA

In the town of L'Aquila in central Italy, poor science communication led to the deaths of 29 people. On the 6th of April 2009, a 6.3 magnitude earthquake devastated the town. In the weeks preceding, there were several foreshocks and the frogs disappeared. A technician at the Gran Sasso National Laboratory, Giampaolo Giulliani, predicted the massive earthquake. But he was silenced.

> Giampaolo resorted to driving around a nearby town in a van with a megaphone. Sceptical Italian officials believed that he was sowing unwarranted panic. Perhaps it is fortunate that this particular town did not evacuate – as people would have flocked to the neighbouring L'Aquila, where the devastating quake hit and they would have been in more danger. Seismic events are essentially impossible to accurately predict.

However, the officials were also wrong to communicate that there was no reason to worry. The public were

Rubble caused by the L'Aquila earthquake. Image from Angelo Giordano.

told that the small shocks they were experiencing were releasing stress to reduce the chance of a major earthquake. While this is true, they were not told that 30,000 small shocks would have been needed to avoid the 6.3 magnitude earthquake – they believed there was no reason to think that something larger was coming.

> Post-quake, six scientists and a government official were convicted of manslaughter in 2012 for the advice they gave ahead of the devastating event. Their misleading advice was unjustifiably reassuring and led many, including the 309 victims, to underestimate the threat. The scientists were subsequently exonerated on appeal, as the reassurances were considered the exclusive fault of the government official.

Even more recently, 13 parties were put on trial following the Whakaari White Island volcanic eruption in 2019. The eruption occurred when 47 people were on the island, injuring all and killing 22. Scientists were at the frontline of understanding the volcano and producing hazard forecasts, but every step of the process involved uncertainty.

THE STORY SO FAR...

No scientist can be certain of the future – only the odds. It is unreasonable to prosecute every scientist when predictions are not 100% correct.

In science, it is not always possible to give absolute answers. Science is constantly evolving, and that is one of its strengths: answers can change as we learn more. Shane believes that it is important to consider the longevity of scientific messages and leave them open to being modified down the track. In academia, reputations and jobs are tied to the ability of a scientist to get things right, but when communicating results to the public, they need to be able to update information without appearing foolish.

It is also important to keep reinforcing messages. Shane was interviewing scientists on his 3RRR radio program, Einstein A Go-Go, around the importance of vaccination 10-12 years ago. At this time, vaccines were routine and normalised - which means we stopped making a public case for them. A gap in communication appeared, and was filled by people who started to question the science (healthy), then spread misinformation (unhealthy).

PUBLIC PERCEPTIONS OF RISK

When the public makes choices based on risk, we need to ensure they are well equipped to make their own decisions. We use education to encourage people to eat 3-4 servings of vegetables per day rather than enforcing it. At other times, safety is ensured with legislated mandates such as wearing seatbelts or banning indoor smoking – because we know that they make us all safer. Yet vaccine mandates have been heavily disputed, even if you might die much faster from being infected by someone than passively breathing in their smoke at a restaurant.

> Let's consider the two early COVID-19 vaccine options in Australia: both had their pros and cons. Both were under more scrutiny than any other medicine before. All medicines (including vaccines) have side effects, but rarely does our society have so many people taking the same one at the same time, with so many people vigilantly concerned.

Media sells fear well. In Norway, there were reports of 23 elderly people in nursing homes passing away after receiving the Pfizer vaccine. The lacking contextual detail was that 400 care home residents die each week across the country regardless. It was a correlation, not causation. Conversely, the AstraZeneca vaccine was associated with blood clots. Shane was concerned at the problematic headlines in newspapers and poor government messaging, just as we were trying to convince the public of the importance of vaccine yet again.

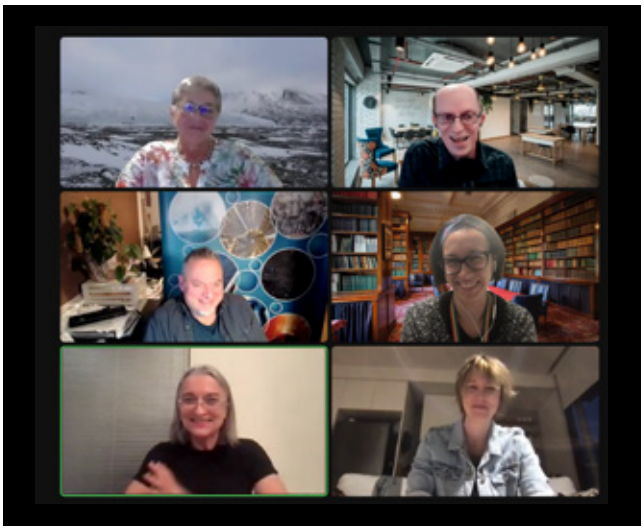
All these numbers are about comparative risk. Of those women taking the contraceptive pill, one in a thousand are at risk of blood clots, compared to three in one hundred thousand with the AstraZeneca vaccine. Yet we never even talk about the risk around the pill as a society.

VISUALISING RISK

Shane believes in the power of visualisation: of the 100,000 people that fit in the Melbourne Cricket Ground, three might get blood clots and, most likely, be successfully treated. If this was in the USA, 289 of those at the MCG would die of COVID-19, never to return home. Here in Australia, it would be 20. When taken as a proportion of the total population of each country, that is a very large number of deaths from COVID compared to the likely development of blood clots.

Even with these comparisons, once fear has spread, it is difficult to put the genie back in the bottle. We are now better at detecting and treating adverse side effects. 'You don't see the progress in the media - it doesn't sell as well as the fear,' says Shane.

To better connect the public with science, scientists need to use simpler descriptions. Analogies are excellent ways of making science memorable. Shane still remembers reading about how mountains and valleys formed as a child; a book compared the planet's crust to an apple skin wrinkling away from the Earth's core and while this turned out to be incorrect, pre-dating tectonic plate theory, it was memorable. Narrative is also a powerful tool, as affirmed by several avid science communicators in a panel discussion following Shane's presentation. Professor Frances Separovic, Dr Jane Canestra, Molly Patton and Shane all communicate science to various audiences, using stories to make people more receptive to facts, figures and science.



Dr Jane Canestra, Dr Shane Huntington, Mike Flattley, Catriona Nguyen-Robertson, Prof. Frances Separovic, and Molly Patton.

Science cannot stand alone. Shane believes that scientists need to work with people who understand society and people who can engage local communities. He also believes that we need more people trained in science – but not necessarily scientists. People who can communicate it to others. Communication is critical. When done poorly, it costs lives.

This article follows a presentation to the Royal Society of Victoria on 24th March titled 'Earthquakes, Pandemics and the Communication of Science.' A video of Shane's presentation is available on the Society's YouTube channel thanks to the support of the Inspiring Victoria program. ***https://www.youtube.com/c/TheRoyalSocietyofVictoria***

Greenhouse in Australia, 50 Years On

Professor Graeme I Pearman AM, FAA, FTSE, FRSV, FAMOS

Charles David Keeling earned renown as the world's foremost specialist in atmospheric carbon dioxide studies through his persistence at developing a continuous and precise record of the carbon dioxide concentrations in the Earth's atmosphere. **Source:** *Scripps Institution of Oceanography, UC San Diego.*

In the early 1970s my CSIRO colleague, John R Garratt and I, were measuring vertical profiles of carbon dioxide above a wheat field in north-eastern Victoria.

We discovered, almost by accident, that the concentration of carbon dioxid3e in the atmosphere was very close to that being observed by C. David Keeling at the Mauna Loa monitoring station in Hawaii.[1]

This was a surprise to us, and we started to read about Keeling's measurements, the only precision measurements at that time, and his suggestion that the concentration in the background atmosphere was increasing.

In 1973 we were quoted in the *Bulletin* as being sceptical about planetary warming. First, because there had been a significant period through the 1960s when global temperatures varied very little, later to be recognised as due to a period of exceptional volcanic activity. Second, because we were not confident that the concentration of carbon dioxide was rising, or indeed that human burning of fossil fuels could impact the concentration of the global atmosphere. Being sceptical, we thought that, perhaps, Keeling had drifting calibration standards.

Soon after, we established a significant atmospheric monitoring program. A month ago (March 20, 2022), was the 50-year anniversary of the very first high precision measurements of carbon dioxide made over south-east Australia from aircraft. Within a little over a year, this measurement programme convinced us that Keeling was correct, the carbon dioxide concentration was rising.

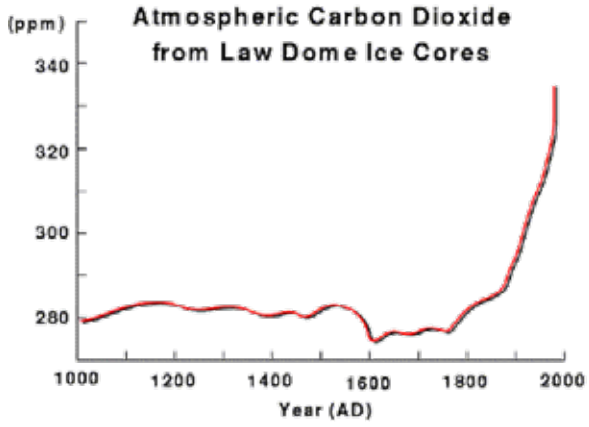
At that time there was a poor understanding of the global biogeochemical cycling of carbon dioxide; that is, if it is added to the atmosphere does it get soaked up by the oceans or the vegetation, or stay airborne? The net result of this was the establishment of a significant carbon cycle research effort that continues today.[2]

It appeared that about 57% of the carbon dioxide emitted from the burning of fossil fuels was remaining airborne. We developed ways of looking back in time at what had happened to carbon dioxide concentrations using air trapped in Antarctic ice cores. Today this allows our colleagues to chart this history over one million years. We also developed techniques to measure and interpret the isotopic composition of carbon dioxide, a key clue to the biogeochemical cycling of the gas.

1 Pearman, G.I., J.R. Garratt and P. J. Fraser. (2018). CSIRO High-precision measurement of atmospheric CO2 concentration in Australia. Part 1: Initial motivation, Techniques and aircraft sampling. *Historical Records of Australian Science*, 28(2) 111-125.

Pearman, G.I. and J.R. Garratt (2022). Carbon dioxide measurements above a wheat crop. II CO2 flux density and the effects of diffuse radiation. *JAgrForMet.*,DOI.10.1016/j.agrformet.2022.1089440.

2 Pearman, G.I., J.R. Garratt and P. J. Fraser. (2018). CSIRO High-precision measurement of atmospheric CO2 concentration in Australia. Part 2: Cape Grim, surface CO2 measurements and carbon cycle modelling. *Historical Records of Australian Science*, 28(2) 126-139.



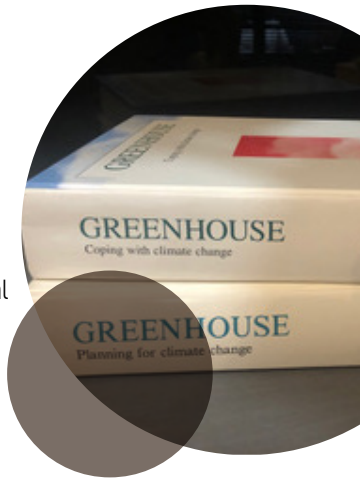
Concentration of Carbon Dioxide from trapped air measurements for the DE08 ice core near the summit of Law Dome, Antarctica. (Data measured by CSIRO Division of Atmospheric Research from ice cores supplied by Australian Antarctic Division) *http://www.chem.hope.edu/~polik/warming/IceCore/IceCore2.html*

It had been known for more than hundred years that increases in concentration were likely to warm the planet. So, in addition, CSIRO commenced work on the modelling of the whole climate system. But in the 1980s it was realised that very few of our Australian colleagues, across a wide range of different disciplines, were either aware of the potential of global warming, or seriously considering, from their own perspectives, whether it was of any importance.

So, in 1986, I contacted about 70 scientists around the country, experts in a wide range of disciplines, oceanography, agriculture, forestry, energy use, conservation, and so on, and asked them to spend time during the next 12 months to consider what climate change might mean for their respective discipline/sector. They were each provided with a climate scenario prepared by our colleague A. Barrie Pittock, projecting what, despite the limited understanding at that time, might happen to the climate of Australia over coming decades. This scenario was based on the climate differences under different average pole-to-equator temperature gradients, climate patterns in warmer and cooler years, and limited paleoclimate data. The scientists were asked to prepare a paper expressing their findings for presentation at a conference, to be called the Greenhouse 87 Conference, and to be held at Monash University in October 1987.

The Conference was attended by 266 scientists, some of whom were the ones who had prepared papers for presentation, but others who, in the interim, had become interested in the climate change issue. The Conference was opened by the Honourable Barry Jones and attended by members of the media. One of the outcomes - not the main objective of the meeting - was a rather significant reporting of the meeting in the media; the beginning of a programme of public communication on the existence of the climate change issue.

The following year, a second meeting was organised with the Commission for the Future, a consequence of which, in 1989, CSIRO and the Commission for the Future were elected to the United Nations Global 500 Honour Roll. The award citation ends with "no other organisation or nation has so far conducted any comparable public awareness programme on climate change."



But the Greenhouse 87 Conference's primary aim was to encourage research activities within all aspects of potential impacts, risks, and mitigation options. Contributors covered a wide range of issues related to hydrology and water resources, changes to the natural environment, agriculture, and societal impacts. The papers, after peer review, were published in a book[3]

This process was, of course, an uncontrolled experiment. But how else could we rigorously identify the potential risks of a changing climate to the Australian community, the economy, and its ecosystems, without serious research and underpinning knowledge development? We could never have anticipated the impact that this would have on the uptake of significant research throughout Australia on all sorts of aspects of the potential for a warming planet and the consequent changes to the climatic system.

So here we are in 2022. Greenhouse 87 is now almost 35 years ago. Action on greenhouse-gas emissions reduction has become urgent. No, it is not about what we do by 2050, but what we do by 2030, this decade. It is not only about what other nations do, but what we do. Australia was well served by the establishment of a community of climate-change scientists those 35 years ago, yet clearly, rather than provide us with a rationale/advantage for taking action, we have been laggards in the quest to minimise emissions and the consequential risks of climate change.

There are many potential reasons for this, a subject for another day. But perhaps there is a lesson in how not to incorporate emerging scientific knowledge into both private and public sector strategic risk assessments, and decision making. Perhaps it also tells us something about the evolution in recent decades of the perceived role of science in modern societies.

3 Pearman, G.I. (1988). Greenhouse gases: evidence for atmospheric changes and anthropogenic causes. p.3–21 in *Greenhouse: Planning for Climate Change*. G.I. Pearman (Edt.). Melbourne: CSIRO. 752pp.

The World of Terrariums

By Priya Mohandoss MRSV

An ensemble of colour mixed with fragments of nature has the potential to provide a sense of ambience in restoring calm and balance to our daily lives in any room setting. While indoor plants might fulfil this role, another is the use of terrariums. Terrariums are glass containers with a removable lid that comprise of soil, rocks and plants and are often referred to as mini forests or gardens in a jar.

Similar to plants, terrariums also mimic the cycles of natural ecosystems but on a smaller scale. Respiration happens when the leaves of plants and soils, or growing media, are in the process of evaporating water from their systems. This is followed with condensation, that is, the appearance of water droplets on the glass walls that allows for a constant source of water. When the warmth of the natural light from the glass walls comes in contact with the air, soil and plants, the plants can then partake in the process of photosynthesis, with moisture being brought back into the soil and air and, in turn, allowing for an influx of nutrients.

Depending on the types of plants that are to be grown, terrariums can either be enclosed or open in structure.

When enclosed with a removable lid, a level of high humidity is generated, and moisture is recycled. Consequently, there is a sufficient amount of water readily available for the plant to develop.

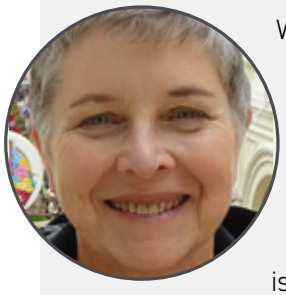
In terms of plants, it is better to sow something that is small and can progress slowly, such as miniature-sized ferns or philodendrons, spider plants or African violets. Also, it is better to use cuttings or seeds instead of established plants.

For open terrariums, cacti or succulents are often the choice of plant to consider since the moisture has an opportunity to escape more readily. While this creates the desired conditions of low humidity for these species, it also requires these plants to be watered more regularly than a closed terrarium in order to persist.

> As a form of living art, terrariums give much pleasure and create a sanctum for anyone to enjoy.

COVID-19 Vaccines – Access and Equity

By Dr Jane Canestra MRSV, RSV Councillor



Whilst eligible Australians have the privilege of pondering whether or not to have third or fourth doses of a COVID-19 vaccine, at least 84.5% of the Australian population is fully vaccinated. In this context, the total population is considered, including children. This compares with the much lower rate of 2.9% for Papua New Guinea, and rates of vaccination being less than 20% for much of the African continent, parts of the Middle East and South Asia. (See fig. 1, below)

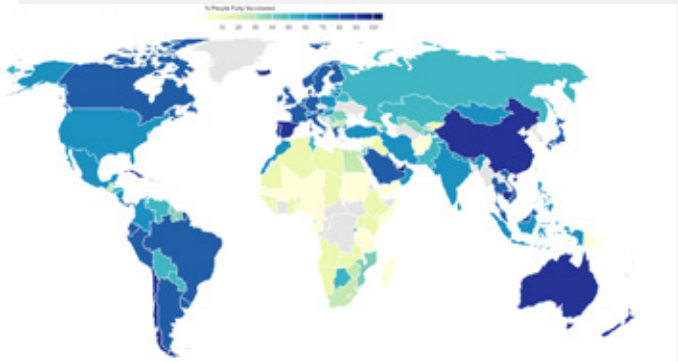


Fig 1: Percentage of people fully vaccinated. Graphic sourced from *https://coronavirus.jhu.edu/vaccines/international*

Mostly lower vaccination rates relate to lower socio-economic indicators, lack of trust in governments and, sadly, scepticism in science.

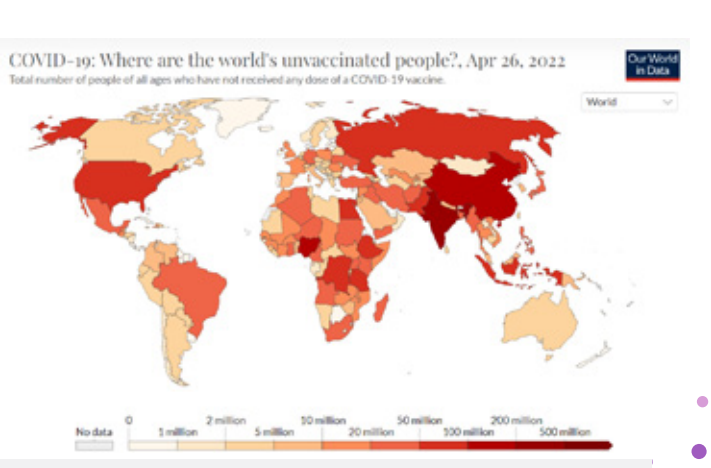
A different perspective is to consider the location of unvaccinated populations. (See fig. 2, right) This illustrates that, despite higher rates of vaccination, some countries have very large numbers of people yet to be vaccinated at all.

Two illustrative examples: India has 61.8% of its population fully vaccinated, but almost 400 million people are yet to receive a vaccine. In Russia, 50.2% are fully vaccinated which still leaves over 65 million people unvaccinated.

> Additional challenges are faced around the logistics of managing large populations and remoteness from major services within countries.

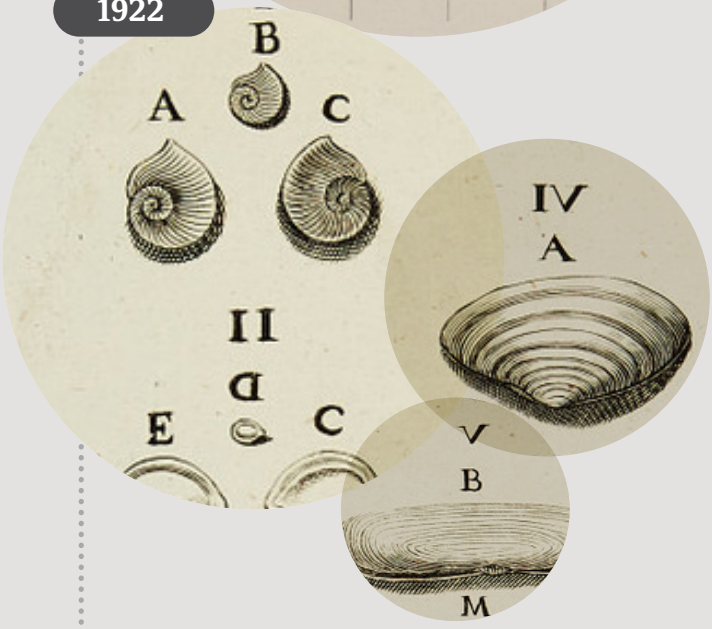
Whilst it is hoped that vaccines will at least be available to all people globally as a matter of basic fairness, the delay in vaccinating large populations is also likely to see new variants emerge. Whilst the Delta variant was first detected in India in late 2020, prior to effective vaccines being available, the Omicron variant was first reported to WHO by South Africa on 24 November 2021.

Since the beginning of the pandemic In Australia, there have been 909 deaths in 2020, climbing to 2226 deaths by the end of 2021, and an alarming 7112 cumulative deaths as at 25 April 2022. This means there have been 4886 deaths already this year, and with very significant pressures on the health system it is clear that new variants still pose a considerable threat to morbidity (illness) and mortality. As a point of enlightened self-interest, we should all be invested in the global equity of vaccine access to minimise the likelihood of new variants of COVID-19 emerging and further impacting us here in Australia.



1972

1922



1872

PREFACE.

THE COUNCIL has to express its great regret that it was impossible to issue any Transactions before, as from the unexpected withdrawal of the Government Grant in 1868, there were no funds to do so, or even to pay the printer for the volume last issued.

FROM THE ARCHIVES

SHAKE THE ROOM!

Studies of Victorian Seismicity by Robert Underwood is published in the Proceedings of the RSV. Cataloguing and characterising hundreds of earthquakes in Victoria between 1841 - 1972, the author notes that they occur mainly in three active areas: in the South Gippsland Hills, near Moondarra (south of Mt Baw Baw), and off the Otway Coast. Many of the larger quakes occurring in and around Victoria have been discussed throughout the history of the RSV, and routinely feature in both the Transactions and *Proceedings of the Royal Society of Victoria.*

HE TELLS OF SEA SHELLS BY THE SEA SHORE

On the 9th of November 1922, Mr Frederick Chapman exhibited a book written by Janus Plancus (the pseudonym of the physician Giovanni Bianchi) that detailed *'shells from the shore of Arimini'* (located in modern-day Italy). Published in 1739, the particular copy displayed at the RSV was notable: *"The signature of Janus Plancus on the fly-leaf is interesting as, according to British Museum authorities, there is no other known."*

Frederick Chapman (1864-1943) was a noted palaeontologist, and President of the Royal Society of Victoria 1929-1930.

STOP THE PRESS!

The printing of the *Transactions and Proceedings of the Royal Society of Victoria* came to a temporary halt in 1868, due to insufficient funds. Printing resumed in 1872 as money became available through the subscriptions of members, and was further assisted by government funding in 1873. The annual reports for years 1870, 1871 and 1872 were subsequently published in the scientific journal, Nature, in 1874. It can be viewed online free at *www.nature.com/articles/011091a0*.

INSPIRING VICTORIA

Call for Applications

Maker Projects – Community STEM Engagement Grants 2022

Funding to foster creative and inquiry-based learning in young people

This opportunity provides grants up to $100,000. It aims to foster creativity and inquiry-based learning to support development of STEM skills in students and youth in design, engineering and programming through hands-on learning.

CLOSING DATE:
09 May 2022 05:00 PM AEST

WHAT CAN YOU GET?
Grants from $20,000 to $100,000.

WHO IS THIS FOR?
Organisations that deliver maker projects to students and youth under 18 years. A particular focus are under-represented groups, including girls, Aboriginal and/or Torres Strait Islander peoples, youth living in regional, rural and remote locations, people with disability and people from educationally disadvantaged backgrounds.

OVERVIEW
The Maker Projects – Community STEM Engagement grants 2022 aims to foster creativity and inquiry-based learning and support the development of STEM skills in students and youth under 18 years of age in design, engineering and programming, through hands-on learning.

The objectives of the grant opportunity are to:

- deliver maker projects where students and youth under 18 years of age can develop and apply their STEM knowledge through experimentation, tinkering and hands-on learning by engaging with a range of technologies
- encourage practical skills, creativity and entrepreneurial thinking through the delivery of hands-on STEM-related events and activities
- inspire students to pursue STEM disciplines in their study and work
- ensure that maker projects are accessible to as many young people as possible, including those in regional, rural and disadvantaged areas
- make a positive and ongoing impact on youth under 18 years of age, particularly those from historically under-represented groups, including girls, Aboriginal and/or Torres Strait Islander peoples, and youth living in regional, rural and remote locations, people with disability and people from educationally disadvantaged backgrounds.

The intended outcomes of the grant opportunity are for students and youth under 18 years to gain:

- practical knowledge and skills in scientific experimentation, design, technology, innovation and entrepreneurship
- increased access to STEM-related events and activities
- positive and ongoing development of STEM skills through inquiry-based learning and participation in STEM events.

CHECK IF YOU CAN APPLY

You can apply if you meet the eligibility criteria, a set of rules that describe who can be considered for this grant.
You can apply if you:

- are an eligible entity
- have an eligible project
- have eligible expenditure.

The rules are in the *grant opportunity guidelines*. For more information and to apply, please visit the website at *https://business.gov.au/grants-and-programs/maker-projects-community-stem-engagement-grants-2022* .

National Science Week – Community Grant Recipients

We're delighted to announce the recipients of Community Grants for National Science Week in Victoria, coming up in August! We have a grant fund of $10,000 to disburse this year, and attracted $20,991 in grant submissions, so it was a real challenge to distribute these equitably through consideration of program quality, geographic distribution, relative disadvantage and value for money, along with an alignment with UN Sustainable Development Goals and the targeting of equity groups.

Please congratulate the following grant recipients, who will be delivering these programs during National Science Week (13 – 21 August) this year:

WARRNAMBOOL LIBRARY - HYDROGEN FUTURES

Held in partnership with the Hycel Technology Hub at Deakin University, the Warrnambool Library will be hosting an introduction to hydrogen, the future of zero emissions energy and hydrogen powered vehicles. Participants will isolate hydrogen with a tabletop electrolyser and experiment with toy hydrogen cars, a hands-on experience that puts science in the hands of our community.

Two one-hour sessions will be delivered for upper primary and lower secondary cohorts, while a renewable energy display will be created during Science Week, including "science on display" tools (model hydrogen car, mini wind turbine, solar panel), infographic posters, and relevant texts from the Warrnambool Library collection.

EASTERN REGIONAL LIBRARY – CITIZEN SCIENCE WITH INATURALIST

At two separate events along Mullum Mullum Creek, Ringwood (with Maroondah City Council) and at Mackenzie Reserve, Yarra Glen (with Yarra Ranges Council), attendees will meet our Digital Literacy Officer, who will provide iPads and demonstrate the use of the iNaturalist™ app. Attendees will then meet with an expert in the local fauna and flora to take a short bush-walking tour and capture data with the iPads. The events will seek participation by older people and those with typically lower mobility, featuring regular breaks to upload data and give participants a chance to rest and recover.

BALLARAT LIBRARY – A GARDEN IN A JAR

Ballarat Library will collaborate with local community organisation Food is Free Inc. to host all-ages "Create a Terrarium" workshops. There will be two sessions, held over the weekend of 20-21 August at two library branch locations.

Participants will use recycled glass containers to create a take-home terrarium, planted with herbs or ferns, in support of the 2022 National Science Week theme "glass." There will be information on the science of glass production and a practical demonstration of reducing waste by reusing common household products. There will be lessons on minimising food waste through composting and worm farming. Participants will receive a take-home bag with seeds, ecopots and relevant community information on the Food is Free and City of Ballarat Libraries programs.

OCEAN GROVE & DISTRICT MEN'S SHED – SCIENCE FROM THE SHED

A two-day event, with Seniors Day being Friday 12th August and Family Science on Saturday 13th August. Groups of 30 will participate in a 55-minute session, with first session beginning at 9 am and the last at 3 pm. There will be a 15-minute science show to start each session. Interactive workstations will be set up in and around the shed where a problem will await participants, who will work together to predict what will happen or develop a solution, then let the scenario play out to observe outcomes. They will then attempt to explain what happened and why it happened with guidance from volunteers, written instructions at each station and booklets of further activities to do at home provided.

ISLAMIC MUSEUM OF AUSTRALIA (THORNBURY) – NATIONAL SCIENCE WEEK: FROM PAST TO PRESENT

An intercultural event on-site at the Islamic Museum of Australia in Thornbury on Saturday, 13 August, tracing the collaborative and multicultural contributions of historic and modern worlds to STEM fields. This youth-orientated program presented in partnership with the Hellenic Museum and STEM activity provider Robofun will feature two 1-hour robotics and coding classes for primary-aged students, a herbal workshop for all ages inspired by the herbs and plants championed in traditional Greek and Islamic medicine, and a pigment mixing session to give participants insight to the science behind some of the world's oldest artworks from Ancient Greece and Late Antiquity, and the types of pigments and inks used in Islamic manuscripts.

The evening will proceed to an outdoor stargazing session. Binoculars will be provided for participants to take turns in spotting constellations in the sky. This will accompany a "Build Your Own Astrolabe" print-out activity, illuminating how the astrolabe was developed by Hellenic astronomers and later improved and refined by Islamic scholars. The program will conclude with a family-friendly evening screening of the "Night at the Museum" (2006) film in the Museum's function room. Light refreshments, as well as freshly popped popcorn, will be provided.

STEMICIAN (BACCHUS MARSH): STEM WORKSHOP

An inclusive, day-long program designed to help students from Foundation to Grade 4 grow interest and build confidence in the world of STEM, with a range of interactive and fun projects in an inclusive and safe environment.

They will work with robots and write codes to instruct them, create CAD models and transform them into real objects using 3D printers, making effective use of digital technologies to design energy efficient and sustainable houses. Working scientists, researchers, academics and industry experts will inspire and guide the students through interactive projects to show what the future holds for them in the exciting world of STEM.

MYLI (WEST GIPPSLAND) - STEM ZONE: EXPERIMENTS WITH GLASS

A range of glass experiments will be created by STEM Zone, a science engagement enterprise, with experienced teachers helping participants to run a range of fun and informative experiments. There will be a series of 3 events held at Drouin Library, Trafalgar Hall (run by the mobile library) and Warragul Library.

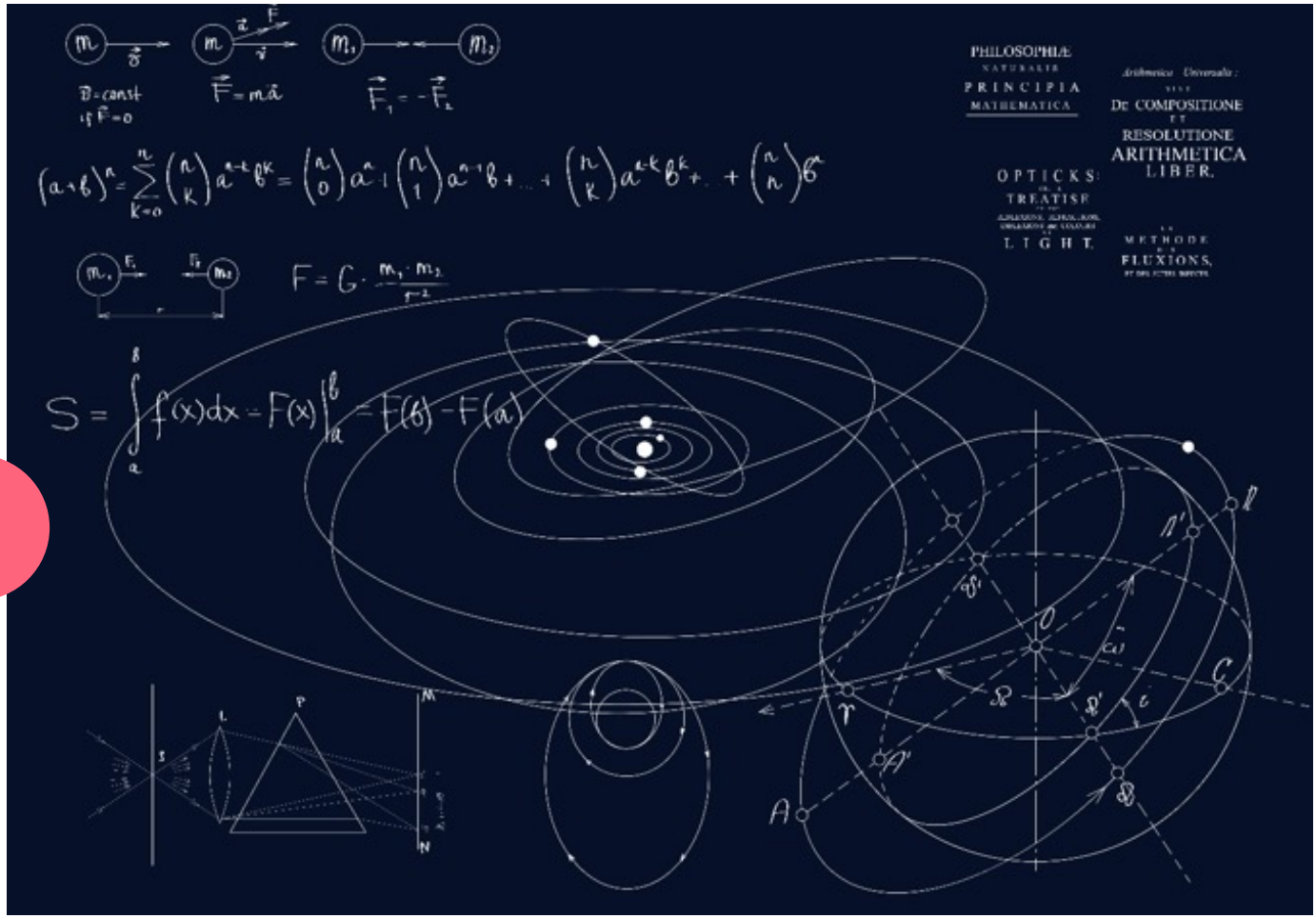
PORT PHILLIP LIBRARIES - BUILD AND LAUNCH ROCKETS

A series of events designed to engage the next generation with Australia's developing space industry and develop a new STEM/Space group in libraries. Offered in partnership with the Australasian Youth CubeSat Initiative, participants will use 3D modelling software and learn to play Kerbal Space Program (approved by NASA) to introduce the principles of space sciences and related industries.

There will be four 2-hour workshops over a month, teaching the basics of orbits and rocket engineering. Students will build on knowledge gained from previous sessions to create an interest in rocket science and engineering while playing Kerbal Space Program. Students aged 12 – 18 will receive an introduction to Kerbal Space Program in a special 2-hour session, while senior secondary students with a demonstrated interest in science will have an opportunity to design, then 3D print, their own CubeSat models for testing in the field!

STEM INCUBATORS (KINGSTON) – SOLVING COMMUNITY PROBLEMS THROUGH SCIENCE

STEM Incubators is a grass-root, for-impact, community-focused charity organization, working to create a thriving innovation platform for young Australians by providing them with a gamut of critical thinking tools and prepare them to approach real-world life problems with more grit and confidence. Over 2021 and 2022, the organisation is rolling out a program for



young Australians to respond to community issues in a structured way, developing skills to shape outcomes, learn the nuances of social skills and an ability to demonstrate community Stewardship. This event will outline the journey of the students (around 20) working on different areas of STEM such as:

- Articulating the students' perspective on real world challenges and their impact on the coming generation
- Explaining what they consider to be a productive approach to the challenges and how they developed solutions using Design Thinking and Problem solving
- Identifying the "pain points" solved by this project for the Kingston City Council
- Outlining how Council engagement helped the students to understand the actual issues facing the community
- Demonstrating the success of the proposed solution to reduce residential waste in Kingston.

GANNAWARRA LIBRARY SERVICE – OZBOT FUN!

Kerang will welcome twistED Science to the Sir John Gorton Library to present the hands-on science show Ozbots, delivering high-tech robot fun to families, without screens. Activities will include colour-coding with the interactive Ozbots, helping kids to start the coding process with simple activities and progress to more complex levels.

GREATER HAMILTON LIBRARY – LIGHT AND SOUND

In this sensory-based 90-minute incursion, early primary years students use their sight and hearing to learn more about the properties of light and sound. From making their own box guitar, to creating shadows, this incursion is packed full of activities that are perfect for younger year levels. Our passionate science educators will carefully guide students through each step, prompting students to predict, observe and reflect on each activity.

BRIMBANK LIBRARIES - SCOPE IT OUT

Brimbank libraries will work with Fizzics Education to running a special schedule of optics-related events. Across a week of science workshops, activities and storytimes, young people in Brimbank will explore the science of optics, magnification and light exploring the vastness of space, the microscopic world of bacteria and making their own periscopes to look around corners.

The thirteen events will be run at Sunshine, Deer Park, St Albans, Keilor and Sydenham libraries, from Saturday the 13th of August through to Friday the 19th of August. The two microscopy sessions have been booked for the 13th and 14th of August, at Sunshine and Sydenham libraries respectively.

BRUNSWICK NEIGHBOURHOOD HOUSE – ROBOTICS AND CODING FUN

An after-school robotics and coding event for primary school aged children aged 8-12 at Brunswick Neighbourhood House's (BNH) De Carle St venue, led by STEM activity provider Robofun. The workshop will introduce coding using a drag and drop program designed to introduce computational thinking, then move to a focus on robotics, introducing basic electronics, including circuits and wiring. The workshop will run for two hours and will include a short break for afternoon tea.

CASEY-CARDINIA LIBRARIES – EXCURSION TO ROYAL BOTANIC GARDENS CRANBOURNE

The Library will partner with the Programming and Audience Development team at the Cranbourne Gardens to offer an excursion to community members, providing a learning experience of science skills, wellbeing and sustainability, nature play and Indigenous culture. The program will be suitable for CALD and low-income community members, many of whom are new to the City of Casey, to mark Science Week 2022.

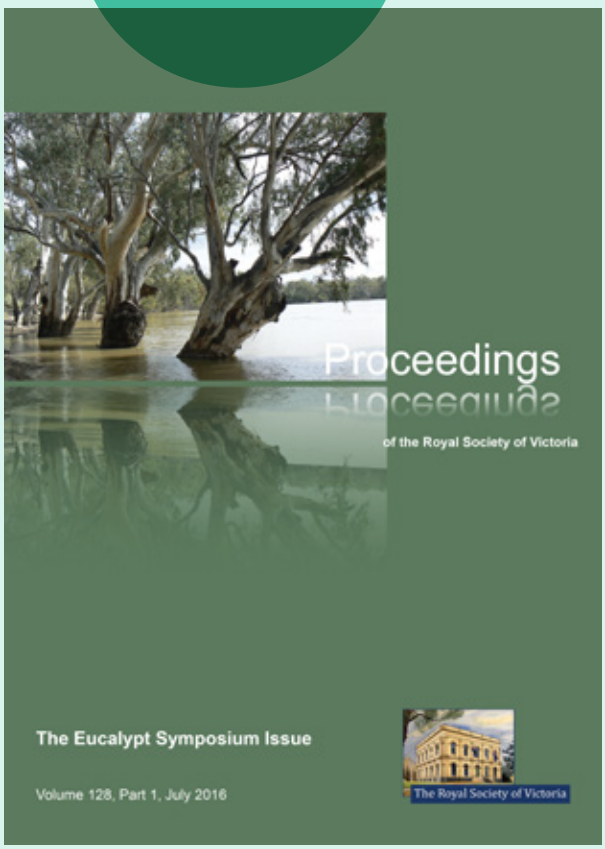
PROCEEDINGS

Proceedings of the Royal Society of Victoria
Call for Papers

The *Proceedings of the Royal Society of Victoria* is our refereed journal, published twice annually by CSIRO Publishing. Current and recent editions are available online in open access format from *http://www.publish.csiro.au/rs*.

> The *Proceedings* is one of Australia's oldest and longest-running science journals, a terrific platform for establishing an individual research presence, grouping papers derived from symposia on specific subjects, or simply joining a distinguished tradition of science published in or about our region that stretches back to the 1850s. We are always interested in hearing from authors.

Papers, Reviews and Reports of experimental or descriptive research, submitted for publication by the Royal Society of Victoria, should not have been published hitherto, nor should they be under consideration for publication elsewhere. Published papers are typically concerned with natural history, encompassing the biological and earth sciences, in the Oceania region.



Those interested in submitting papers should review the *Instructions for Authors*. All enquiries and manuscript submissions should be forwarded via email to *editor@rsv.org.au*.

ENGAGE VICTORIA

Climate action: Victoria's emissions reduction target for 2035

Share your views on a 2035 emissions reduction target for Victoria, and ideas for how we can reach that target.

Open for feedback. Closes 22 May 2022

OVERVIEW

Victoria's Climate Change Act 2017 sets a state target of net zero greenhouse gas emissions by 2050 and requires the Government to set a pathway of short-term targets to reach it.

- Victoria's target for 2020 was to cut emissions by 15-20% below 2005 levels. That target was achieved two years early.
- Victoria's target for 2025 is to cut emissions by 28-33% below 2005 levels.
- Victoria's target for 2030 is to cut emissions by 45-50% below 2005 levels.

The next short-term target, for 2035, must be set by 31 March 2023.

The Minister for Energy, Environment and Climate Change (the Minister) has asked an independent panel of experts (the Panel) to advise on a target for 2035, the best action to reach that target and what the pathways to net zero emissions by 2050 could look like.

You can find more information about the Panel and Victoria's targets at *www.climatechange.vic.gov.au/victorias-greenhouse-gas-emissions-and-targets*.

The Panel will prepare a report with their advice to government by 1 March 2023, and they would like your views to help shape that advice.

HOW TO PARTICIPATE

To have your say and help shape the next steps Victoria should take on climate change, you can either attach a written submission or answer some questions through the links and surveys provided. You are welcome to do both. The issues paper on this site may help to guide your thinking.

If you are a young person, there is a survey titled 'Youth Survey – up to 25 years'.

For more information about Victoria's action on climate change, and the process of setting targets, please visit *www.climatechange.vic.gov.au* or email the team at *climate.change@delwp.vic.gov.au*

To make a submission, please visit the Engage Victoria site at *https://engage.vic.gov.au/climate-action-target-2035*

NEXT STEPS

The Panel will read what you have to say in your submissions and survey answers. The Panel will prepare a report for the Minister with their advice, informed by your views. The Victorian Government will set a target for 2031-2035 by 31 March 2023, taking into account the Panel's advice.

Non-confidential submissions and a summary of all submissions will be published on this website. The Panel's report will also be published in 2023.

Distinctive Areas and Landscapes Program

OVERVIEW

The Victorian Government is committed to protecting the significant economic, environmental, cultural and community values found in the peri-urban areas surrounding Melbourne, Geelong and other regional cities.

In 2018 Macedon Ranges region was declared as the first distinctive area and landscape under the new Part 3AAB of the *Planning and Environment Act 1987*. The government has since declared three new coastal areas - Bass Coast, Bellarine Peninsula, and Surf Coast.

These areas of outstanding environmental and cultural significance are being protected so that they can continue to be enjoyed by current and future generations. They have unique environments with productive and scenic landscapes, and due to their proximity to Melbourne and other regional cities, they are under pressure from urban encroachment and growing visitor numbers. These areas are also susceptible to the impacts associated with climate change, including extreme weather events.

By declaring an area as a Distinctive Area and Landscape it will:

- Require the preparation of a Statement of Planning Policy (SPP) led by the State Government in partnership with local government and Traditional Owners.
- Require the development of a long-term vision and strategies to protect distinctive areas in consultation with local communities
- Introduce the opportunity for protected settlement boundaries for townships – like Melbourne's urban growth boundary.

We invite you to help shape the visions and strategies of the places you care most about. Please visit *https://engage.vic.gov.au/distinctive-areas-and-landscapes-program* to learn more and contribute your thoughts.

ENGAGE VICTORIA

ENGAGE VICTORIA

Have your say on a new regional park in Melbourne's south east!

Open for feedback.
Closes 15 May 2022

Clyde Regional Park

OVERVIEW

Thank you to everyone who contributed ideas and aspirations in 2021 for a new regional park in Clyde. This input has been analysed and used to prepare a draft strategic directions plan to outline what the park could be like.

You can now view the draft strategic directions plan and draft visitor experience plan for Clyde Regional Park. We are keen to hear what community and stakeholders think of the plan by completing the below survey or by attending an *online information session* on **3 May 2022.** Consultation on this phase of the project will be open until **15 May 2022**.

BACKGROUND

There's an exciting investment in natural parks in the Clyde and Cranbourne area with a new regional park being planned in Clyde on Bunurong Country.

The Victorian Government has provided $315 million to deliver the Suburban Parks Program which includes 6,500 hectares of new and upgraded parks. This includes a 120-hectare regional park in Clyde east of Cranbourne which will be created adjacent to Ballarto Road beside a new sports precinct. Together, the regional park, sports precinct and adjacent drainage basin will create a large community space three times bigger than the Royal Botanic Gardens in Melbourne and approximately half the size of the entire Cranbourne Botanic Gardens and bushland area).

The new park aims to provide space where people can connect with nature, provide important habitat for plants and animals and enable community to walk, run, ride, canoe and picnic.

PROVIDE FEEDBACK ON THE PLAN FOR THE NEW PARK

To provide feedback, please complete the survey on the Engage Victoria site.

You can also learn more by attending an *online information session on Tuesday 3 May, 6.00 - 7.30pm.* We will also be popping up around the community - contact us at *engage@parks.vic.gov.au* for more information.

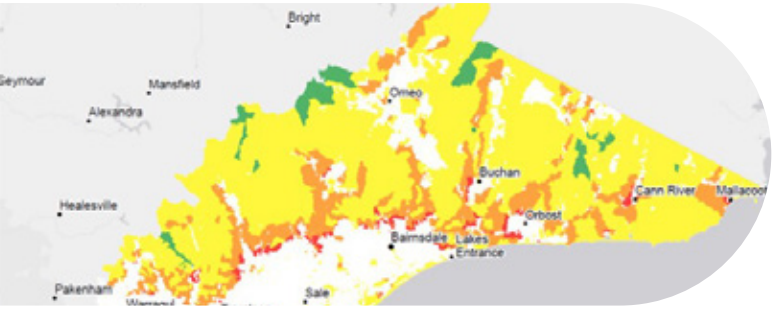
To make a submission, please visit the Engage Victoria site at *https://engage.vic.gov.au/clyde-regional-park*

ENGAGE VICTORIA

Have your say on a new regional park in Melbourne's south east!

Open for feedback. Closes 08 May 2022

Gippsland Fire Management Zones Review



Gippsland's Bushfire Management Strategy identifies four Fire Management Zones (FMZs) that guide how often planned burning or other fuel management should occur in different areas of public land for our bushfire risk to be at acceptable levels.

The Fire Management Zones inform our *Joint Fuel Management Programs* (JFMPs) which are rolling three year programs of fuel management activities on public land across Gippsland.

The current FMZs were determined in 2019 following extensive consultation with fire management practitioners, land management agencies, industry and environment groups and community members with an interest in bushfire risk reduction. (You can read more about how the FMZs were determined *here*.)

We are currently reviewing a number of proposed amendments to the Fire Management zones in DELWP's Latrobe Fire District and would like your input in the Map Survey linked below.

The Proposed FMZ Amendments document gives some information about why these proposals have been made. You can drag and drop pins on the map to show if you agree or disagree with the proposed changes. You can also drop pins on the map to show if there are other areas of public land that you think should have amendments to their FMZs.

We are also asking you to fill in a short survey that will provide some information about your experience and knowledge of bushfire risk reduction and which DELWP fire management district is responsible for fuel management where you live.

To make a submission, please visit the Engage Victoria site at *https://engage.vic.gov.au/GippslandFMZreview2022*

Wilsons Promontory Revitalisation

The Victorian Government is investing $23 million to revitalise Wilsons Promontory National Park. It will become Victoria's largest conservation sanctuary and have improved visitor experiences.

The current scope for Wilsons Prom Revitalisation includes:

- **a 10km predator-proof fenc**e across the Yanakie Isthmus - together with conservation programs, the fence will keep predators out of the Prom and let native animals and plants thrive.
- an upgrade of the **Tidal River visitor area**
- improved **carparking** and traffic management options
- three accommodation units outside the northern park boundary
- **two accommodation units** at Tidal River
- a new **Telegraph Saddle trail** to connect Tidal River and Mount Oberon.

Please note, this project scope may be adjusted as more information becomes available (such as from environmental, cultural heritage studies and approvals processes).

The project upgrades will help reduce visitor impacts at peak times and will allow people to visit, stay and learn about the Prom in a sustainable way.

In 2022, Parks Victoria will do feasibility studies, assessments and talk to the community about their ideas and preferences. Most of the on-ground work will happen in 2023 and 2024.

To make a submission, please visit the Engage Victoria site at https://engage.vic.gov.au/wilsons-prom

Parks VICTORIA

Join the conversation to protect Wilsons Prom's unique environment and biodiversity; and shape visitor experiences for future generations.

Open for feedback. Closes 08 May 2022

ENGAGE VICTORIA

Have your say on intended changes to the 2012 Code of Practice for Bushfire Management on Public Land (the Bushfire Code) to extend its expiry date and update references

Open for feedback.
Closes 06 May 2022

Intent to vary Code of Practice for Bushfire Management on Public Land

OVERVIEW

The Bushfire Code outlines how the Department of Environment, Land, Water and Planning is to deliver its bushfire management responsibilities on public land managed under the *Forests Act 1958*.

The Bushfire Code sets out two key objectives:

- To minimise the impact of major bushfires on human life, communities, essential and community infrastructure, industries, the economy and the environment. Human life will be afforded priority over all other considerations.
- To maintain or improve the resilience of natural ecosystems and their ability to deliver services such as biodiversity, water, carbon storage and forest products.

The Victorian Government intends to vary the Bushfire Code. The variation will extend the Bushfire Code's expiry date to December 2024 and make minor changes to Acts and agency names so that they are up to date. No substantive change to the operation of the Code is proposed as part of this variation process.

In response to recommendations of the Inspector General for Emergency Management's (IGEM) *Inquiry into the 2019-20 Victorian Fire Season – Phase 1*, the Victorian Government is implementing a range of reforms to continually improve how bushfires are managed. This includes:

- development of a whole-of-sector bushfire management strategy
- establishment of an Office of Bushfire Risk Management to lead and coordinate the implementation of evidence-based fuel management policy, practice, assurance and reporting across all land tenures
- review of fuel management legislation
- improvements to monitoring, evaluation and reporting, and
- identifying opportunities to support cultural fire.

The role of an expanded Code of Practice for Bushfire Management in supporting these reforms is being considered as part of the review of fuel management legislation.

Extension of the Bushfire Code to December 2024, will enable an in-depth review to be undertaken in the context of the broader legislative review and bushfire management reforms, ensuring opportunities the Code presents to address the IGEM's findings are fully realised.

Victorians will have opportunities for input and feedback through 2023 and 2024 as part of the in-depth Bushfire Code review process.

To make a submission, please visit the Engage Victoria site at *https://engage.vic.gov.au/Varying-the-Code-of-Practice-for-Bushfire-Management-on-Public-Land*

NEXT STEPS

In accordance with the *Conservation, Forests and Lands Act 1987*, following the closing date, all submissions will be provided to the Minister for Energy, Environment and Climate Change for consideration.

Responses to the survey will be reviewed by the project team and any necessary amendments will be made ahead of the variation to the Bushfire Code.

A summary of the feedback received will be published on Engage Victoria.

ENGAGE VICTORIA

Have your say on Regional Parks in Melbourne's north west - Kororoit Creek and Toolern Creek Regional Parks!

Open for feedback.
Closes 15 May 2022

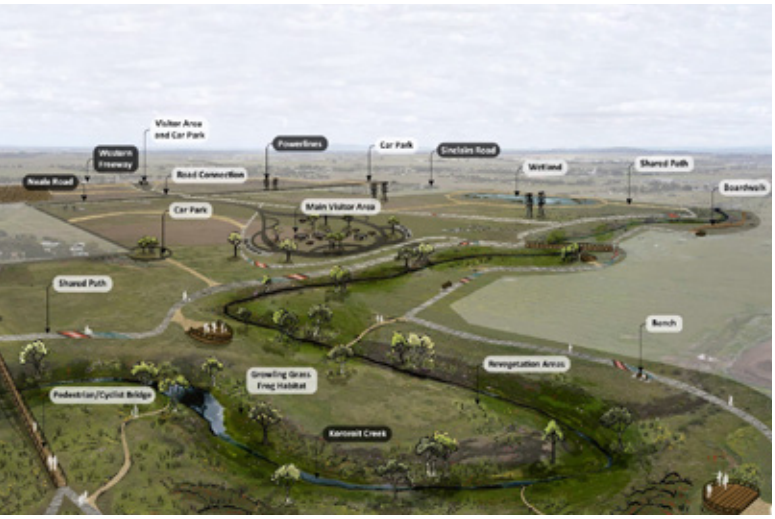
North West Regional Parks

OVERVIEW

You can now give feedback on the draft Park Plan for Kororoit Creek Regional Park until 15 May 2022.

There is an exciting investment in natural parks in the north western Melbourne area with a new regional park in Deanside on Wurundjeri Country and a refresh of the existing Toolern Creek Regional Park.

The Victorian Government has provided $315 million to deliver the Suburban Parks Program, which includes 6,500 hectares of new and upgraded parks. In Deanside, there will be a new 215-hectare regional park - that's more than 100 AFL fields of open space! There will be a also be a 45 hectare conservation area beside the new park, providing 260 hectares in total of new green space.



The future Kororoit Creek Regional Park is home to some of Victoria's endangered grassland and many important animals and creatures. For visitors it will provide the chance to do activities, like walking, playing in nature, picnicking and spend time in the natural environment.

A plan has been drafted to show what this park might be like. Parks Victoria wants your ideas about this plan that will be delivered over many years to come.

As part of the Suburban Parks Program, Parks Victoria are also updating the Park Plan for the existing Toolern Creek Regional Park on Wurundjeri Country. This plan will be released in the coming months.

PROVIDE FEEDBACK ON THE PLAN FOR THE NEW PARK

Kororoit Creek Regional Park will be a completely new park. The community now has a chance to help shape the park - what it offers for the community, what will make it special and what will attract people to visit.

We have created a draft park plan for the new park and are seeking feedback. You can view a proposed layout of the park below or read the full Strategic Directions Plan on the Engage Victoria site.

You can also learn more by attending an **online information session on Wednesday 4 May, 6.00 - 7.30pm.**

To provide feedback, please visit the Engage Victoria site at *https://engage.vic.gov.au/north-west-regional-parks*

ENGAGE VICTORIA

Have your say on Regional Parks in Melbourne's west - Werribee Township Regional Park and Werribee River Regional Park!

Open for feedback.
Closes 15 May 2022

Western Melbourne Regional Parks

OVERVIEW

You can now give feedback on the draft Park Plan for Werribee Township Regional Park until 15 May 2022.

There is an exciting investment in natural parks in the Werribee area with a new regional park in Werribee Township and refresh of the existing Werribee River Regional Park.

The Victorian Government has provided $315 million to deliver the Suburban Parks Program, which includes 6,500 hectares of new and upgraded parks. In Werribee, there will be a new 340 hectare regional park - that's approximately 160 AFL fields of open space!

The new Werribee Township Regional Park in Tarneit and Wyndham Vale will be on Wadawurrung and Bunurong Country at the northern boundary of Presidents Park. This new park aims to provide space where people can connect with nature and the river, provide important habitat for species including the Growling Grass Frogs, and also enable community to walk, run, ride, canoe and picnic.

A plan has been drafted to show what this park might be like. Parks Victoria wants your ideas about this plan that will be delivered over many years to come.

As part of the Suburban Parks Program, Parks Victoria have also updated the park plan for the existing Werribee River Regional Park which is on Wadawurrung Country. This plan will be available in the coming months.

PROVIDE FEEDBACK ON THE PLAN FOR THE NEW PARK

Werribee Township Regional Park will be a completely new park. The community now has a chance to help shape the park - what it offers for the community, what will make it special and what will attract people to visit.

We have created a draft plan for the new park and are seeking feedback. You can view a proposed layout of the park below, or read the full Strategic Directions Plan online.

You can also learn more by attending an **online information session on Wednesday 4 May, 6.00 - 7.30pm.**

We will also be popping up around the community - contact us at engage@*parks.vic.gov.au* for more information.

To make a submission, please visit the Engage Victoria site at *https://engage.vic.gov.au/western-regional-parks*

RSV Services and Facilities

The RSV engages communities with scientific knowledge through aligned partnerships, special events, festivals, conferences, and education programs. **Email** *rsv@rsv.org.au* to discuss your needs and ideas!

We provide services in **event managemen**t, meeting **venues**, grants and awards **administration**, broadcasting and video **production**, social media c**ampaign management**, **recruitment** of scientific panels, and **convening** community engagement and deliberation processes where scientific work contributes to social, environmental, and economic impacts and benefits.

Social Traders CERTIFIED SOCIAL ENTERPRISE Business for good

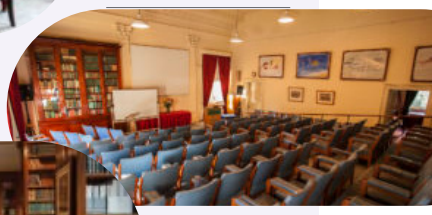
We are registered as a **Certified Social Trader** working for the benefit of Victorian communities, which makes our services eligible under the *Victorian Government's Social Procurement Framework*, as well as the social procurement guidelines of the governments of New South Wales and Queensland. Our certification also assures *industries* of our authenticity in building social procurement into services and supply chains.

For more information and bookings please contact our Business Manager at *james@rsv.org.au* or on +61 3 9663 5259

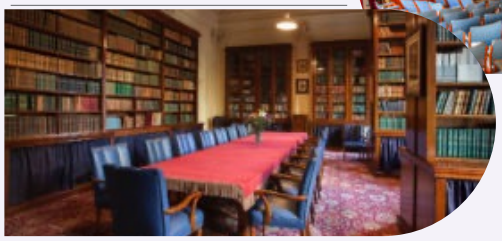
SERVICES AVAILABLE

The Burke and Wills Room
Multi-functional space with adjoining kitchen, suitable for: Workshops ***‹30 people; Dinners ‹60 people; Seminars, functions, catering, etc., ‹80 people.***

The Von Mueller Room
Seminar room for ***‹15 people.***



The Ellery Lecture Theatre
Raked seating for ***‹110 people.***



The Cudmore Library
Capacity for ***‹24 people***

FACILITIES FOR HIRE

The Royal Society of Victoria's facilities are available for hire to organisations, companies, or private groups. This heritage-listed building opposite the Carlton Gardens is suitable for a wide range of events, including conferences, seminars, meetings, and private functions. Limited parking is available on-site and a commercial parking operator is adjacent on La Trobe Street.

The RSV has audio visual and seminar equipment available for use, including videoconferencing facilities. There is a commercial kitchen on the ground floor, suitable for your own use or by a caterer.

Support Victoria's Science Society

To support our programs with your donation, please fill out this form and return it to the Royal Society of Victoria, 8 La Trobe Street, Melbourne VIC 3000. You can also support our efforts through online donations and bequests at https://rsv.org.au/support-the-rsv/

RSV 2020 FUNDRAISING CAMPAIGN AMOUNT	*AMOUNT*
The Area of Greatest Need, as identified by the Society's Council	$
Inspiring Victoria – Community Science Engagement Program	$
Science Awards & Prizes	$
Science History & Heritage	$
Science for All - Citizen Science Programs	$
BioQuisitive Community Lab	$
The Phoenix School Program	$
The BrainSTEM Innovation Challenge	$
Australian Indigenous Astronomy	$
TOTAL	**$**

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☐ **Cheque or Money Order**

I enclose my cheque or money order made out to **The Royal Society of Victoria**.

Electronic Funds Transfer (EFT)

I have transferred my donation to the Royal Society of Victoria as follows:

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Account Name: The Royal Society of Victoria
Reference: Your Surname and "donation"

The Royal Society of Victoria