The Royal Society OF VICTORIA

Inspiring AUSTRALIA Victoria

SCIENCE VICTORIA

MAY 2023

MAKING THE MOST OF IT

The Water we are Wasting in Victoria

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TREATMENTS MISTREATED

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IN THIS ISSUE

SCIENCE VICTORIA

This Edition: Waste and Water

Clean water is essential for all animal and plant life, and human settlement depends on its availability and relies on its placidity. In this edition, we look at the water cycle in Victoria, our usage of water, and our treatment of waste relating to water - sewage and chemical contamination - especially in the face of climate change.

On the Cover: Western Treatment Plant, in Werribee, has been the final destination for most of Melbourne's sewage since it first started operating in 1897. However, spanning an area the same as Phillip Island, and sitting on Port Phillip Bay, it poses an increasing risk to water quality in the event of flooding.

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Please note that the submission deadline for content to be included in the June 2023 edition of *Science Victoria* is **5pm, Friday 19th of May 2023.**

SCIENCE VICTORIA EXPLAINED

Mike Flattley
CEO, The Royal Society of Victoria

Those new to *Science Victoria* or the Royal Society of Victoria (RSV) may be wondering what's going on here exactly! So I thought I'd take a shot at explaining.

Science Victoria is an evolving "open science" initiative; it aims to provide intelligence on science-based work underway in our state, across all sectors, aligned with themes of social, economic and environmental importance. We seek to engage thoughtful readers in the work of Victoria's scientists, and to communicate matters of interest or importance to those pursuing skills or careers in scientific research, science teaching, science communication and scientific publishing.

From 2022, the RSV began producing *Science Victoria* as a masthead of the Inspiring Victoria program, a community science engagement initiative that includes National Science Week, delivered in partnership with the Victorian and Commonwealth Governments, Museums Victoria, the Royal Botanic Gardens Victoria, Neighbourhood Houses Victoria, Public Libraries Victoria, the Arthur Rylah Institute for Environmental Research and the Parliament of Victoria.

The Partnership Board is Chaired by Victoria's Commissioner for Environmental Sustainability, Dr Gillian Sparkes AM, and we map our activities against the Sustainable Development Goals (SDGs) to offer the Commissioner's office a data set on community action and partnerships for the Goals, informing Victoria's State of the Environment reporting cycle.

We've now opened a small grants round this month for running events during National Science Week in August, and I warmly encourage applications for seed funding through auspicing community organisations, particularly members of Public Libraries Victoria and Neighbourhood Houses Victoria community networks. For more information, visit: **inspiringvictoria.org.au/programs/national-science-week-victoria/grants/**

As for the RSV, you could say we're "old-school open science" - having been around since 1854.

As a science society, membership is open to anyone interested in the vast field of knowledge that falls under the banner of Science, Technology, Engineering, Mathematics and Medicine, and in particular the application of that knowledge in the interests of our state's future health and prosperity. We are an independent not-for-profit with a long association with the "natural history" of Victoria; accordingly, our broad membership has typically been concerned with the environmental sciences and the conception and application of environmental policy.

Yes, we have opinions and positions – see **rsv.org.au/publications/position-papers** – and we encourage you to respectfully share yours with our readership, with reference to a robust evidence base where appropriate.

We aim to connect people with each other and, in particular, with the world of knowledge and ideas. Our regional science journal, *The Proceedings of the Royal Society of Victoria,* has been published continuously since 1855, offering an incredible knowledge resource on the geological and ecological features of colonial Victoria, and a valuable baseline from which to chart change over time. You can take a dive into the historic editions, digitised and hosted online by the State Library of Victoria, or read more recent editions (2009-2023), also online, open access thanks to our recently-renewed agreement with CSIRO Publishing out to 2026. For more detail, visit **rsv.org.au/publications/proceedings/**

Mike Flattley
CEO, The Royal Society of Victoria

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Acknowledgement of Country:
The Royal Society of Victoria acknowledges the many First Peoples of our continent, their vast history and connection to the lands and waters within and beyond the State of Victoria, and the valuable cultural and scientific knowledge held by the Elders to care for Country. We acknowledge our headquarters are located on Wurundjeri land, never ceded, and convey our respect to Elders past and present. The RSV welcomes all First Nations people, and seeks to support and celebrate their continued contributions to scientific knowledge.

HARD LESSONS, HARDLY LEARNED

Rob Gell AM MRSV
President, The Royal Society of Victoria

Our theme for this month's edition of *Science Victoria*, Water and Waste, enables me to consider a range of current issues.

Following floods in November 2022, many rivers and beaches around Port Phillip Bay became unswimmable due to contamination with sewage and other waste.

CLIMATE CHANGE, POLLUTION, BIODIVERSITY LOSS

At the time of the release of the Synthesis Report of the Sixth Intergovernmental Panel on Climate Change (IPCC) Report[1] in late March, I was very interested to see the Executive Director of the United Nations Environment Programme Inger Andersen take the opportunity to remind us of the three, interlinked planetary crises that humanity faces: climate change, pollution, and biodiversity loss.

> "By acting on climate we are also acting on nature and biodiversity loss, and pollution and waste - the other two prongs of the triple planetary crisis."
>
> UNEP Executive Director Inger Andersen

The Royal Society of Victoria established new position statements on climate and biodiversity in 2022. Perhaps our next focus should be pollution and waste.

THE BIG CON

Our current economic system is not managing these interlinked existential crises and a case for change needs to be built. I have recently been enjoying interviews with Mariana Mazzucato about her new book with Rosie Collington, The Big Con - How the Consulting Industry Weakens our Businesses, Infantilizes our Governments and Warps our Economies. It examines the entrenched relationship between the consulting industry and the way business and government are managed today and suggests this relationship 'stunts innovation, obfuscates corporate and political accountability and impedes our collective mission of halting climate breakdown'.[2]

New models for an economic transition must understand a planet of finite resources, the co-dependencies in those resources and now, importantly the limited time we have as a society to manage pollution and waste as our third critical crisis.

ROBERT ELLERY, AND WARNINGS UNHEEDED

I have come to understand that there are several RSV fans of Dr Robert L. J. Ellery, RSV President 1866 -1884, after whom our lecture theatre is named. I think our editor Scott Reddiex heads up the former Government Astronomer's fan club.

Our CEO Mike Flattley recently brought the following passage to my attention. It's from Ellery's 1877 Presidential Address:

"The rapid denudation of our Forests, and almost reckless destruction of our indigenous timber, has from time to time been strongly and warningly commented upon by scientific men and by the public press of the colony; but as the want of useful timber does not immediately stare the community in the face, it is allowed to pass.

"If any of you have ever seen, as I have too often done, the gigantic timber trees lying rotting in some of the ranges near Melbourne, where they have been felled by saw-mill proprietors, but never used, and in many cases magnificent trees with inferior trees felled by rival proprietors across them to prevent their being readily removed to the mills of those who felled them, you will at once admit that the term "reckless destruction" is not too strong. The necessary clearing away of timber for agriculture is rapidly altering the face of the country, and will doubtless alter the climate, most probably for the worse; but the indiscriminate denudation of our mountain forests will certainly tend to reduce the precipitation of water on our soil, which already we often eagerly hope for and sometimes pray for." - R.L.J. Ellery, 1874[3]

FROM THE PRESIDENT

In the context of understanding the nature of waste Ellery is clearly insightful. He also understands the impacts on our climate from land cover change - *146 years ago*!

Land clearing continues to be a major problem in Australia. In 2000 the Bureau of Rural Sciences reported that by the 1980s only five percent of the continent remained forested:

"Comparison with Carnahan's Natural Vegetation (1780s) data set indicates that around 70 percent of the study area was covered by woody vegetation at the time of European settlement; almost half of this woody vegetation (92.5 million ha) has been cleared since this time."[4]

Ellery also flagged the inevitable impact of forest loss on our climate. When Mike showed me Ellery's report, I immediately thought of work published in 2007 that supported Ellery's expectation of regional climate impacts in response to land cover change, concluding that replacement of native woody vegetation and with crops and grazing has resulted in significant changes in regional climate with a shift to warmer and drier conditions especially in southeast Australia.[5]

While the IPCC's 6th Assessment Report is clear, anthropogenic global warming is an immediate threat, Ellery's prescient observation in 1877 about land clearing and forest loss should remind about the biosphere's primary relationship with the hydrological cycle. Warming will be enhanced and droughts exacerbated until we recognise the impact of land cover change and the urgent need to establish regenerative practices to restore biodiversity and soil health, to promote plant growth for photosynthesis, carbon storage, and animal life in environments that hold more water and make the land surface cooler.

Stronger restrictions on vegetation removal are required in parallel with investment in landscape restoration at scale and implementation of restorative grazing practices which together are likely to provide the added benefit of moderation of drought conditions in future years.

Rob Gell
President, The Royal Society of Victoria

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3. Transactions and Proceedings of the Royal Society of Victoria, Vol XIV, 1878. Presidential Address (1874).
4. Barson, M. M., Randall, L. A. and Bordas, V. (2000) Land Cover Change in Australia. Results of the collaborative Bureau of Rural Sciences - State agencies' Project on Remote Sensing of Land Cover Change. Bureau of Rural Sciences, Canberra.
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Robert Ellery, RSV President and Government Astronomer, at his desk in the Astronomer's office, Melbourne Observatory (c. 1880).

Logging in the Otway Ranges, Victoria.
(Gryffyn M., via Unsplash)

WESTERN PORT BIOSPHERE FOUNDATION

A BIOSPHERE IN OUR BACKYARD

By Colette Day
Chair, Science and Education Committee, Western Port Biosphere Foundation

Did you know that Melbourne has a UNESCO Biosphere Reserve on its doorstep? Only an hour's drive from the CBD, the Mornington Peninsula and Western Port Biosphere Reserve is one of five biosphere reserves in Australia, and the only one in Victoria.

Like all biosphere reserves, it has been recognised by UNESCO for the way in which it demonstrates a balance between people and nature. As one of 738 reserves within the World Network of Biosphere Reserves,[1] it aims to achieve three main functions set out by UNESCO:

- **Conservation** of biodiversity and cultural diversity
- Economic **development** that is socio-culturally and environmentally sustainable
- **Logistic support**, underpinning development through research, monitoring, education, and training.

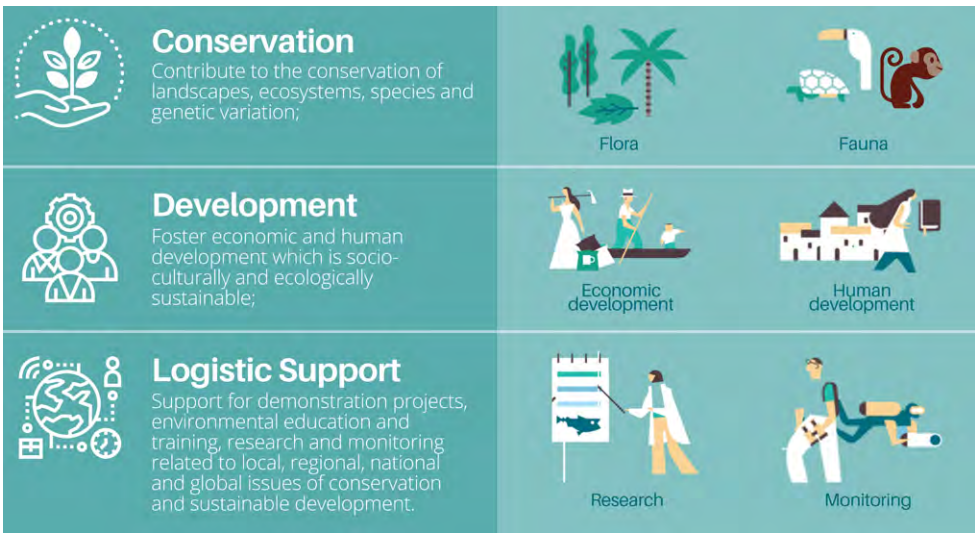


Figure 1. The three main functions of a UNESCO Biosphere Reserve.

Biosphere reserves are designated areas comprising terrestrial, marine, and coastal ecosystems, that strike a balance between conservation and sustainable use of the environment.[2] Our Biosphere is vast, covering 2,142 square kilometres and spanning five local government areas, on what has been the traditional country of the Bunurong/Boon Wurrung peoples for many thousands of years. At its core is the internationally significant Western Port Ramsar Wetlands,[3] which support more than 20,000 migratory shorebirds and waders – many of which are vulnerable or endangered. The Ramsar Wetlands include significant expanses of saltmarsh, mangroves and mudflats which provide important habitat, spawning grounds, and fish nurseries.

Beneath the waters of Western Port are hidden reefs of fragile corals and the seagrass meadows that form the basis of the bay's food chain. The seagrasses act as a major carbon sink, allowing them to play a role in slowing climate change, and highlighting the importance of their conservation and restoration.[4]

Within the Biosphere, the hinterland surrounding Western Port also contains significant zones of terrestrial biodiversity with various levels of protection. This area is home to a population of hundreds of thousands of people and includes large areas of agriculture, horticulture, and industry. The map in Figure 2 shows the Biosphere's boundary and areas designated as core, buffer, and transition according to UNESCO guidelines.

Thanks to its idyllic location and distance from Melbourne, areas within and surrounding the Biosphere are among the fastest growing regions in Australia. While it is clearly a great place to live and work, we need to ensure that continued growth only enhances its liveability and enables nature to flourish.

THE MORNINGTON PENINSULA AND WESTERN PORT BIOSPHERE RESERVE FOUNDATION

The Mornington Peninsula and Western Port Biosphere Reserve is overseen by the Western Port Biosphere Foundation. The Foundation champions approaches that focus on biodiversity conservation and sustainable development. We link people and resources to deliver projects that benefit the community and the natural environment.

The Foundation aligns its work to the three pillars of Climate Action, Environment Preservation & Restoration, and Sustainable Development. These pillars address the strategic objectives of the World Network of Biosphere Reserves, and provide the direction of all new projects run by the Foundation alone or in partnership with other groups. Additionally, the Foundation uses five of the seventeen UN Sustainable

Development Goals (UN-SDGs)[5] as the basis for measuring and reporting against objectives and outcomes.

CURRENT PROJECTS

Three of our key current projects are Blue Carbon, Water Stewardship, and Healing Water Country.

Blue Carbon[6]: This project is funded by the Victorian Department of Energy, Environment and Climate Action (DEECA). A set of management plans will detail how and where the maintenance and restoration of mangrove, seagrass, and saltmarsh ecosystems in Western Port will contribute to local and national achievement of net zero carbon emissions. These ecosystems are capable of capturing carbon up to 30 and 50 times faster than terrestrial forests, locking it into marine sediments for thousands of years. The project builds on work the Foundation has already completed in partnership with member councils of the South East Councils Climate Change Alliance (SECCCA), and Deakin University's Blue Carbon Lab.

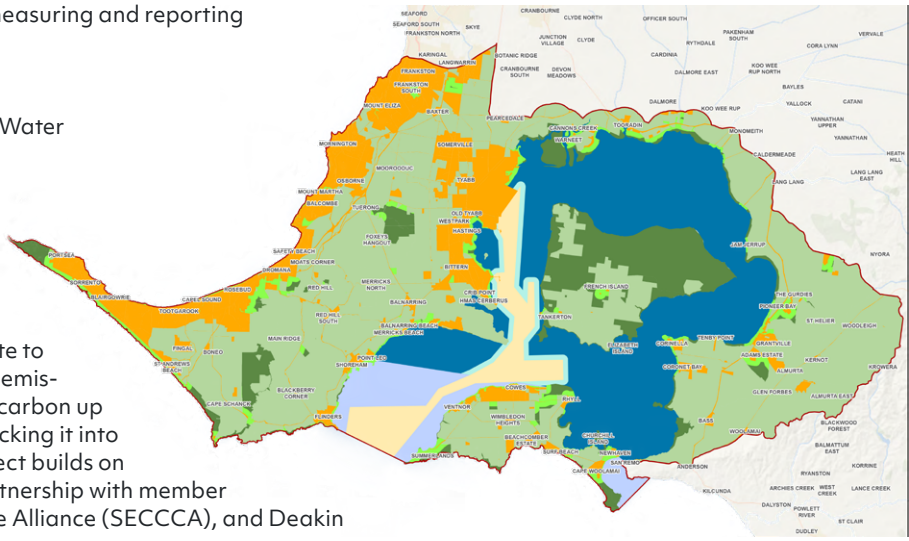


Figure 2. The Western Port Biosphere, situated in south-eastern Victoria.

Water Stewardship[7]: This project provides an opportunity for landholders and site managers to develop water management plans that assist them to manage their water needs while also ensuring water supplies for environmental purposes and improvements to biodiversity and water quality. The plans can be easily implemented and are externally accredited. The Biosphere has established the first regional recognition program under the international water stewardship framework and is being considered as a model for other programs in Europe, the US and China.

Healing Water Country[8]: This project, in partnership with Willum Warrain Aboriginal Association supports and maintains the conservation of Hastings area waterways and surrounds, whilst fostering connections with the community. The goal is to restore Warringine Creek so that it becomes a functioning habitat corridor, thereby supporting the conservation efforts underway at either end, while also restoring more natural drainage. The project design incorporates community engagement events to generate the public momentum required to restore and protect their environment.

Further details of these and other projects can be accessed via the Biosphere Foundation's website at **biosphere.org.au**.

The Foundation is often called upon to take positions of advocacy on community issues which affect our Biosphere Reserve. Given our limited resources, we are not able to act on all requests and use an Advocacy Strategy to guide us. When we do advocate on an issue, we base our position on the best available science combined with an understanding of indigenous knowledge, culture, and practices. This must also recognise the UNESCO requirement for a balance between the need to conserve biodiversity while allowing for sustainable development in the area.

The Foundation is keen to consult with local scientists who are interested in contributing to these community discussions and in assisting us to make submissions to planners and policy makers.

If you would like to be included on our register of experts, please contact us by email at **science_edu@biosphere.org.au**, including your name, qualifications, and field of study.

The Western Port Biosphere Foundation is an Affiliate Organisation of the **Royal Society of Victoria**.

You can connect with the Western Port Biosphere through the following channels:
Web: **www.biosphere.org.au**
Twitter: **twitter.com/Biosphere_VIC**
Facebook: **facebook.com/westernportbiosphere**
Instagram: **instagram.com/westernport_biosphere**
LinkedIn: **linkedin.com/company/mornington-peninsula-and-western-port-biosphere**

References:

1. World Network of Biosphere Reserves en.unesco.org/biosphere/wnbr
2. What are Biosphere Reserves? en.unesco.org/biosphere/about
3. Western Port Ramsar Awareness Project biosphere.org.au/biosphere-projects/current-projects/western-port-ramsar-awareness-project/
4. Seagrass—secret weapon in the fight against global heating unep.org/news-and-stories/story/seagrass-secr et-weapon-fight-against-global-heating
5. The 17 UN Sustainable Development Goals sdgs.un.org/goals
6. Blue Carbon Project biosphere.org.au/biosphere-projects/current-projects/blue-carbon/
7. Water Stewardship Project biosphere.org.au/biosphere-projects/current-projects/water-stewardship/
8. Healing Water Country Project biosphere.org.au/biosphere-projects/current-projects/healing-water-country/

Figure 3. The work of the Western Biosphere is aligned with five of the seventeen UN Sustainable Development Goals (UN-SDGs).

GEOGRAPHY VICTORIA

GOING PLACES

By Geography Victoria

Geography Victoria (GV) is certainly going places. The organisation has not even formally launched yet, but in this update you will discover that we are already spoiled for geographical activities over the next months.

GV's fabulous inaugural activities in 2022 (auspiced by Royal Society of Victoria) included field trips to Studley Park and the Port Phillip Bay coast, and the very successful Christmas Treasure Hunt in conjunction with the City of Melbourne. Over 700 people took part in the CBD Treasure Hunts in December, and it was great to see so many people of all ages and from all cultural backgrounds, armed with maps and searching for the treasures of Melbourne!

We also had the pleasure of meeting with the Victorian Surveyor General and staff from the new Department of Energy, Environment, and Climate Action. We discovered strong alignment between us and very much look forward to working with the Surveyor General and his team as GV gets established.

This year an Interim Board has been established and continues to be ably supported by the founding steering group members. The required documentation to register as a Company Limited by Guarantee has been lodged and our logo, website and membership management system are under development in preparation for an official launch later this year.

I would like to thank the Interim Board and Steering group for their tireless work, and Rob Gell and the Royal Society of Victoria for their ongoing support.

Above: Winners of the 2022 Treasure Hunt
Right: The inaugural Geography Victoria field trip to Studley Park.

UPCOMING GEOGRAPHY VICTORIA EVENTS

I urge you to join us on an upcoming planned activity.

PORT OF MELBOURNE BOAT TRIP (SUNDAY MAY 7):

All aboard for the Port of Melbourne Boat Trip. Bookings open now via RSV website.

COASTAL FIELD TRIP (SATURDAY JUNE 10):

Due to popular demand, we will head back to the beach for a full day coastal field trip.

MOVIE NIGHT (SUNDAY JULY 23):

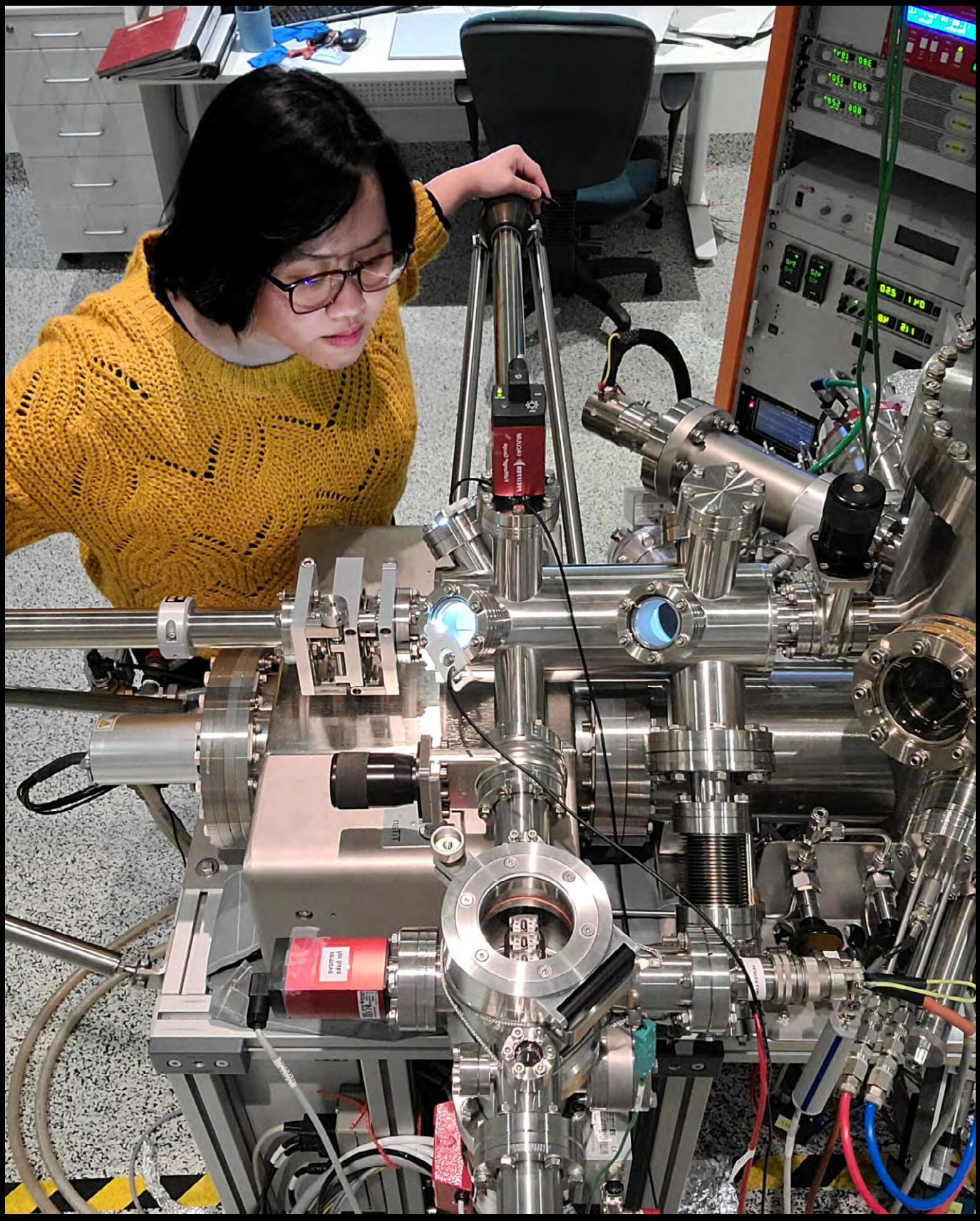
A social get together and a movie. Following on from the success of the CBD treasure hunts, we have booked out the Thornbury Picture House for a screening of the highly acclaimed The Lost City of Melbourne.

Ian Rutherfurd
Chair of the Geography Victoria Interim Board
Professorial Fellow, The University of Melbourne

Flooding in Melbourne in November 2022 resulted in the closure of beaches around Port Phillip Bay

SNAPSHOTS OF STEMM

Images from everyday science.



Dr Chi Xuan Trang at Monash University and the ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET) studying topological materials.

Source: FLEET

SNAPSHOTS OF STEMM

Dr Karen Roberts, Collection Manager (Vertebrate Zoology) at Museums Victoria, with a fin whale (*Balaenoptera physalus*) specimen.

Source: Museums Victoria
Photographer: Robert French

SNAPSHOTS OF STEMM

Professor Bob Wong (left), head of the Behavioural Ecology Research Group at Monash University, Prof Ross Thompson (crouched), and Dr Topi Lehtonen (standing) performing field work in central Australia to study impacts of environmental disturbance on behaviour of desert-dwelling fishes.

Photo credit: Andreas Svensson

NEW RSV MEMBERS

INDIVIDUAL MEMBERS

Mr Ashley Willis
Structural Engineer

Dr Jiaqiang Luo
Food Scientists
The University of Melbourne

Mr Justin Howden
Principal
Corporate Affairs Advisory

Dr Athol Whitten
Director, Advanced Analytics
& Data Science, Nous Group

Mr George Gatchell
Secondary Student

Mr Oliver Anderson
Doctoral Candidate
Monash University

Mr Robel Hussen Kabthymer
Doctoral Candidate
Monash University

Mr Koku Sisay Tamirat
Doctoral Candidate
Monash University

Mr Wubet Takele
Doctoral Candidate
Monash University

Mr Bekele Meteku
Doctoral Candidate
Monash University

ORGANISATIONAL MEMBERS

Skafold Global
Representative: Miss Harlan Wilkerson, Head of Enablement

Skafold is a full-service, global innovation ecosystem, focused on delivering best practice and new practice value creation and start-up infrastructure. For more information head to **skafold.global**

BECOME A MEMBER OF THE RSV

The Royal Society of Victoria is the State's oldest scientific society, a part of Australia's intellectual life since 1854. We bring together an independent community of science practitioners, educators, industrialists, and enthusiasts to promote an understanding and utilisation of scientific knowledge for the benefit of the state of Victoria.

$40/YEAR

Student Membership

For students enrolled full-time at a recognised Victorian education and/or research institution (proof of current, full-time enrolment required for Student Membership commencement/renewal)

$120/YEAR

Full Membership

Open to all adults (18+) with an interest in science! A current membership of the Royal Society of Victorian entitles the use of the professional postnominal 'MRSV.' Those elected as Fellows of the Society are entitled to the postnominal 'FRSV.'

$1000/YEAR

Organisational Membership

For organisations to claim membership of the RSV. Provides a method for general sponsorship of the RSV's programs, along with discounted rates for access to RSV facilities throughout the year.

The Royal Society OF VICTORIA
Promoting science since 1854

To join the Royal Society of Victoria please go to **rsv.org.au/how-to-join**. You can also choose to support science in Victoria by completing the donation form in this edition or visiting **donorbox.org/royal-society-victoria**

ORIGINS – AN ORATORIO OF THE CREATION STORY FROM SCIENCE

by Prof Jenny Graves AC

There is so much beauty in science, and so many beautiful stories from the history of scientific endeavours, yet so few orchestral pieces inspired by it. For decades I waited for somebody to write a secular successor to Haydn's 200-year-old "Creation" ...but nobody ever did.

With my experience as a singer and evolutionary geneticist, I wondered if I could take on the challenge of putting together a libretto that tells the creation story from science – using beautiful words and images from cosmology, molecular biology, evolutionary genetics, ecology, and anthropology, to describe our origins from the big bang to the emergence of humanity.

Last year, the timing was right: with Melbourne set to host the International Congress of Genetics in July 2023, I got together with fellow singer and poet Leigh Hay to co-write the libretto for Origins – of the Universe, of Life, of Species, of Humanity. Our choir, the Heidelberg Choral Society, commissioned brilliant young Melbourne composer Nicholas Buc to compose the score, and we booked the Melbourne Recital Centre for July 18th, 2023.

We started rehearsing in the first week of April – wow, what an intense experience. Origins moves from the profound "A Universe from Nothing", through to the exquisite intricacy of molecular life, and a dramatic retelling of the DNA story (as Watson and Crick build their model and Rosalind Franklin sings a plaintive aria). Darwin and his hecklers introduce sparkling descriptions (many drawn from famous Australian examples) of early life, selection, speciation, and extinction. It then follows the rise of homo sapiens, the dominant mammal, presiding over the sixth extinction, and asks if we too will perish. It ends with 'man the astronomer' overlooking the galaxies, and expresses the hope that we puny humans may yet understand the cosmos and our place in it, and keep our planet safe.

The aim of Origins is to share the beauty and wonder of science with everyone, and to express some of the most profound scientific truths in inspirational music. It will fill an oft-lamented gap in the choral repertoire for major contemporary secular works, and we expect it will be performed in Australia and overseas for decades to come.

Origins is an absolutely unique work. A musical description of the fundamentals of molecular life and evolution has never before been attempted on this scale.

Origins will be premiered at the Melbourne Recital Centre by the 100-voice Heidelberg Choral Society (HCS), accompanied by a full orchestra and professional soloists under the baton of well-known conductor Peter Bandy.
I hope many readers of Science Victoria and members of the RSV will want to attend the concert. You can also support the creation and performance of the work (you can even sponsor a movement that particularly resonates) – information on content and sponsorship is at hcs.asn.au/sponsorship.

It will be a night to make scientists and non-scientists think, despair, laugh, and celebrate the role of science in our understanding and stewardship of our beautiful little planet.

DATE/TIME:
Tuesday 18 July 2023, 7.30pm

LOCATION:
Elisabeth Murdoch Hall, Melbourne Recital Centre

PRICE:
$50 - $100 (+ transaction fees)

LINK:
melbournerecital.com.au/events/2023/origins

IN THE SKY AND AT SEA: MAKING CONNECTIONS AT THE PORT OF MELBOURNE

A field trip organised by Geography Victoria – auspiced by The Royal Society of Victoria.

Melbourne's port is Australia's largest container and general cargo port and a vital trade gateway. It handles around 35 percent of the nation's container trade, with more than 3,000 ships calling at the port each year.

Join us for a BYO lunch at the Library at the Dock at 12pm, before hearing from the Port Melbourne based company Swoop Aero, who are realising the next giant leap in how essential services are delivered. Currently the only end-to-end drone logistics platform on the planet, their services include medical transport, first responder and emergency response, as well as mapping and monitoring data collection across 6 continents.

The presentation will be followed by a 90-minute boat tour of the Port of Melbourne at 2:30pm (afternoon tea included). This trip is part of the port open day boat tours operated by the Port of Melbourne and provides:

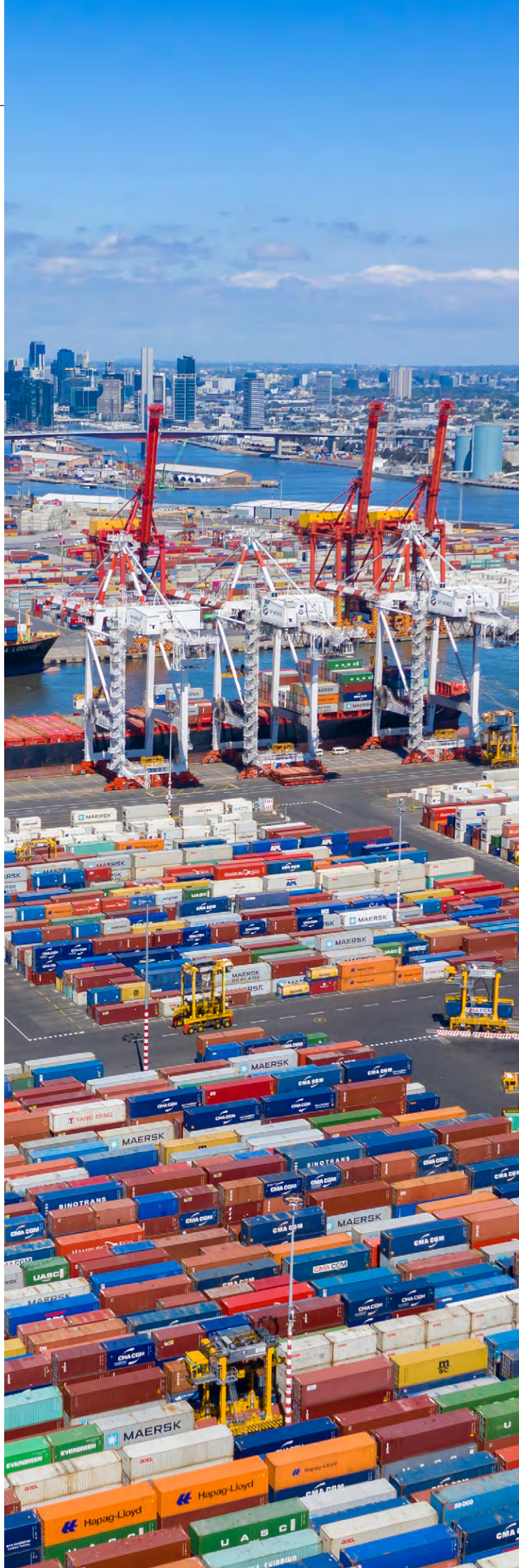
- a chance to explore Australia's busiest port, right on the city's doorstep.
- guided commentary from port staff.
- the opportunity to see the port from a whole new angle.

DATE/TIME:
Sunday May 7 2023, 12pm - 4pm

LOCATION:
Meet at Library at the Dock, Port Melbourne

PRICE:
$25 (+ booking fee)

LINK:
rsv.org.au/events/port-of-melbourne/



VICTORIAN LANDCARE GRANTS

Applications are now open for Victorian Landcare Grants.

These grants support Landcare and environmental volunteering groups and networks for on-ground works, education and capacity building projects that protect and restore our land and natural environment.

Project Grants of up to $20,000 will be awarded for on-ground works, capacity building activities, community education and engagement that protects or improves our natural environment such as native vegetation, native fauna, waterways, wetlands, and soils.

Additionally, Support Grants of up to $500 are available to assist with costs such as insurance, incorporation and operational needs, or meetings and events or newsletters, websites and other communication.

Applications close on **Tuesday 16 May 2023 at 5pm**.

For more information, visit **environment.vic.gov.au/grants/victorian-landcare-grants**

VICTORIAN JUNIOR LANDCARE AND BIODIVERSITY GRANTS

Applications are now open for Victorian Junior Landcare and Biodiversity Grants.

The Victorian Junior Landcare and Biodiversity Grants provide funding for projects that involve and educate young people in valuing and actively caring for Victoria's biodiversity and natural environment. These grants provide young Victorians with an opportunity to participate in biodiversity focused hands-on projects and/or learning activities.

Grants of up to $5,000 (excl. GST) are open to all schools, kindergartens, childcare centres, Scouts, Girl Guides, youth groups, and Junior Landcare groups in Victoria.

Funding is available for the following types of activities or projects under two focus areas. Projects can be for either of the two focus areas or a mixture of both:

Focus Area 1 - Biodiversity focused on-ground projects: improving biodiversity through creating, enhancing, or restoring habitat for Victoria's native plants and animals.

Focus Area 2 - Biodiversity focused education activities: educating, involving, and engaging young people in valuing and actively caring for Victoria's biodiversity and natural environment.

Applications close on Friday **12 May 2023 at 3pm**.

For more information, and to apply, visit **juniorlandcare.org.au/grant/2023-victorian-junior-landcare-and-biodiversity-grants**

Australian Academy of Science

Applications close **1 June 2023**.

For more information on these funding opportunities, visit **science.org.au/2024-awards-funding**

AUSTRALIAN ACADEMY OF SCIENCE FUNDING OPPORTUNITIES 2024

Applications are currently open for research awards, travelling fellowships, and research conference funding from the Australian Academy of Science.

Research Awards
- Aboriginal and Torres Strait Islander Scientist Award
- Margaret Middleton Fund for Endangered Australian Native Vertebrate Animals
- Max Day Environmental Science Fellowship Award
- Thomas Davies Research Fund for Marine, Soil and Plant Biology

Travelling Fellowships
- Graeme James Caughley Travelling Fellowship for ecologists resident in Australia or New Zealand to travel to overseas scientific centres
- Rudi Lemberg Travelling Fellowship for Australians or overseas scientists to visit Australian scientific centres and to deliver lectures
- Selby Fellowship for overseas scientists to visit Australian scientific centres

Research Conference Funding
- Boden Research Conference in the Biological Sciences
- Elizabeth and Frederick White Research Conference in the Physical Sciences
- Fenner Conference on the Environment

UPCOMING RSV EVENTS

The RSV hosts many STEMM-related events, public lectures, and meetings throughout the year. These are predominantly held at the RSV Building at 8 Latrobe St, Melbourne (unless otherwise indicated), and simulcast online via YouTube/Facebook Live.

Our public lectures comprise the "Scientists in Focus" component of the Inspiring Victoria program in 2023.

18 MAY

RSV ANNUAL GENERAL MEETING (AGM)

The RSV AGM is the annual review of the Society's financial and programmatic performance. Members of the RSV can register to attend via Zoom or otherwise nominate a proxy. For more details, visit **rsv.org.au/events/2022-annual-general-meeting**

22 JUNE

A. W. HOWITT LECTURE

Joint Meeting and Public Lecture with the Geological Society of Australia, Victoria Division.

13 JULY

FOREST GROWTH, SUCCESSION & FIRE RESPONSE

A/Professor Philip Zylstra, Curtin University.

17 AUGUST

YOUNG SCIENTIST RESEARCH PRIZES

Finalists of the RSV's annual Young Scientist Research Prizes will present their work and the winners announced at this event in August. For more information, see **Awards, Prizes, and Fellowships**, or visit **rsv.org.au/awards-and-prizes/young-scientist-research-prizes/**

12 OCTOBER

RSV + AATE MEETING & PUBLIC LECTURE

Joint Meeting and Public Lecture with the Australian Academy of Technology and Engineering

23 NOVEMBER

PHILLIP LAW POSTDOCTORAL AWARD LECTURE

The winner of the RSV's Phillip Law Postdoctoral Award will present their work to a special meeting of the RSV at a public lecture scheduled for the evening of Thursday, 23 November 2023. This will be professionally filmed and shared online. For more information, visit **rsv.org.au/awards-and-prizes/phillip-law-award/**

7 DECEMBER

RSV RESEARCH MEDALLIST LECTURE

The winner of the annual RSV Medal for Excellence in Scientific Research will present a lecture to RSV members and guests on the evening of Thursday, 7th December 2023, at which the Medal will be presented. For more information, see **Awards, Prizes, and Fellowships**, or visit **rsv.org.au/awards-and-prizes/research-medal/**

RSV Young Scientist Research Prizes

Applications are now open for the 2023 RSV Young Scientist Research Prizes.

Four prizes are awarded annually to final year PhD students, one each for Biomedical & Health Sciences, Biological Sciences (Non-human), Earth Sciences, and Physical Sciences.

The Society is grateful for the generosity of our members, past and present, in supporting these prizes. The Biological Sciences (Non-human) prize and Earth Sciences Prize are supported by the legacy of previous Presidents, Edmund D. Gill and Neil Archbold respectively.

The category of Biomedical and Health Sciences includes the fields of Endocrinology, Epidemiology, Genetics, Human Physiology, Human Anatomy, Immunology, Medical Parasitology, Microbiology, Neurology, Nuclear Medicine, Pathology, Pharmacology, Radiology, and related human sciences (excluding clinical trials).

The category of Biological Sciences (Non-human) includes the fields of Agriculture, Biochemistry, Botany, Cell Biology, Ecology, Evolutionary Biology, Forestry, Zoology, and related non-human science.

The category of Earth Sciences includes the fields of Geochemistry, Geochronology, Geology, Geophysics, Planetary Physics, Meteorology, Oceanography, Palaeontology, Physical Geography, and related sciences.

The category of Physical Sciences includes the fields of Astronomy, Astrophysics, Chemistry, Mathematics, Physics, all branches of Engineering, and related sciences.

Applications close **31 May 2023**

For more information, including eligibility criteria and application details, visit **rsv.org.au/awards-and-prizes/young-scientist-research-prizes**

Finalists of the 2022 RSV Young Scientist Research Prizes

RSV Medal for Excellence in Scientific Research 2023

Nominations are invited for the RSV Medal for Excellence in Scientific Research. In 2023, this award will recognise excellence in Category III: Earth Sciences.

The Earth Science Category includes research undertaken in the disciplines of Geology, Geochemistry, Geochronology, Geophysics, Planetary Physics, Meteorology, Oceanography, Physical Geography, Palaeontology and related sciences.

In its centenary year (1959), the Royal Society of Victoria instituted a Medal for Excellence in Scientific Research. The Award consists of a Silver Medal, which is awarded annually for scientific research in one of four categories (rotating each year).

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 or on Australia (including its territories), with preference for work done in or on Victoria.

Nominations close **31 July 2023**

For more information, including criteria and details on how to nominate, visit **rsv.org.au/awards-and-prizes/research-medal/**

Right: 2022 RSV Medallist Prof Rachelle Buchbinder accepting the prize from Nobel Laureate Prof Peter Doherty AC

On behalf of ATSE

Elevate: Boosting women in STEM

Applications for the Australian Academy of Technological Sciences & Engineering's Elevate: Boosting Women in STEM Program commencing in 2024 are currently open.

The Elevate: Boosting Women in STEM program will award up to 500 undergraduate and postgraduate scholarships to women in STEM. The program aims to address gender inequities in STEM through fostering more women-led industry-academia collaborations in applied research and business, growing professional skills of women in STEM, and propelling women into leadership.

The Elevate program provides:
- A scholarship
- Access to events and networking
- Mentoring
- Ongoing support during scholars' university studies

Applicants are required to meet three eligibility criteria:
- Identify as a woman or non-binary person
- Be enrolling as a domestic student
- Be planning to undertake a STEM degree or higher studies to improve business acumen at an Australian university, commencing in 2024

Applications for the 2024 Elevate program close at 5:00pm (AEST) **31 August 2023**.

For more information, including application and eligibility guidelines, visit **atse.org.au/career-pathways/elevate/**

140 billion litres of 'secondary treated' sewage water is discharged into Port Phillip Bay each year. Tertiary treatment of this water would bring it up to drinking standards.

(Seaford, Victoria. Jacob Dyer, via Unsplash)

MAXIMISING BENEFITS OF RECYCLED WATER IN THE CLIMATE RISK ERA

By Gordon Noble MRSV

Victoria can simultaneously solve Melbourne's future sewerage crisis whilst building a sustainable carbon credits sector.

A common sight for Melbourne's residents in the 1850's would have been carts full of "nightsoil" trundling down Flemington Road.[1] Melbourne, or "Smelbourne" as it was known, subsequently built one of the world's best municipal water systems, supporting the quality of life its residents enjoy today. Thankfully, we are no longer living in the Victorian era. But our generation has a duty to solve a new set of challenges.

> Over the next thirty years and beyond, depending on the actions that are taken to reduce emissions globally, we can expect global temperatures to rise by 1.5˚C to 2.0˚C

A key risk facing Victoria is climate change, and we know that Victoria's weather patterns are already changing. According to the Bureau of Meteorology State of Climate 2022 Report, rainfall in the north and west of the continent is above average, whilst rainfall in the southeast during winter months have been very much below averages[2].

Why does this matter? Climate science tells us that the drying of the southeast of the continent is likely to get worse.[3] Over the next thirty years and beyond, depending on the actions that are taken to reduce emissions globally, we can expect global temperatures to rise by 1.5˚C to 2.0˚C. With these values, it is key to note that these are global temperatures: with most of the planet covered in water, the actual temperature rises over land masses are likely to be higher than this averaged value. Victoria can expect less rainfall, higher temperatures, and, when rain does come, we are likely to see intense weather events. Recent floods are an indication of what we can expect in the future.

The good news is that Victoria has access to surplus water.

The bad news is that we are quite literally tipping it down the drain.

Currently around 140 billion litres of 'secondary treated' sewage water is discharged into Port Phillip Bay each year.[4] We can expect this volume to grow: growth in population in Melbourne's north, west, and inner city will translate into increased flows of Class C recycled water into Port Phillip Bay. It is projected that the north and west of the city alone will grow by 1 million in coming years.[5]

In a climate-risk era, water has increased economic, social, and environmental value. What role can Melbourne's recycled water play in this environment?

One of the key challenges with water is how to shift it from one location where it is not needed, to one where it is needed. The Snowy Mountains Hydro-Electric Scheme demonstrated that from an engineering perspective this can be done. There are already pilots to build purple lines to transport recycled water to Melbourne's southeast which will support the future sustainability of Melbourne's golf courses. How can we scale this? And, most importantly, who pays?

Carbon credits may provide an avenue for funding.

It is worth noting from the outset that carbon credits are not a long-term solution to addressing climate change, but they play a part in Australia's transition to net zero emissions. The passage of the Safeguard Mechanism legislation by the Australian Government will support the development of carbon credit markets.[6]

A key issue with carbon credits has been their integrity. There are some positive signs that a foundation for quality carbon credits is now being built. On the 29th of March 2023, the Integrity Council for the Voluntary Carbon Market (ICVCM) launched its Core Carbon Principles.[7] ICVCM is part of a suite of regulatory measures that have been driven by Mark Carney, former Governor of the Bank of England, who is the UN Special Envoy on Climate Action and Finance.

ICVCM's Core Carbon Principles aim to become the gold standard for carbon credits. It is likely that over time they will become the only standard. Voluntary carbon credits that do not align to global standards of integrity are not likely to be supported by financial system regulators.

> The good news is that Victoria has access to surplus water. The bad news is that we are quite literally tipping it down the drain.

Core Carbon Principles, combined with the Safeguard Mechanism, will create the environment that will support investment. Where will this investment flow?

It is likely that, as it currently stands, demand for carbon credits will flow into plantations on quality arable land. From a Victorian perspective, the development of carbon credit projects needs to acknowledge the science of climate change. In particular the drying of the southeast of the continent, as identified by the Bureau of Meteorology, raises the question on whether plantations will survive in times of water and heat stress.

This is where there is an opportunity for Melbourne's surplus Class C recycled water.[8] Thanks to the Victorian Desalination

Plant, the streams of recycled water that will flow through to Port Phillip Bay will be consistent and largely unaffected by droughts. The nutrients in the water, which threaten to overwhelm Port Phillip Bay, are an asset in terms of supporting sustainable growth of plants.

How then to structure opportunities? Three pathways are briefly considered.

The first opportunity is for Melbourne's water corporations to support development of the necessary infrastructure to pipe water to farmers who wish to develop carbon credits. A key challenge is that farms that wish to develop carbon credits may not be conveniently located. The inevitable delay between developing infrastructure and the flow of income from carbon credits would result in additional debt burden on the Victorian Government which is already experiencing fiscal challenges.

A second option is a traditional Private Public Partnership (PPP). PPPs have been commonly used to build infrastructure, with Melbourne's toll roads being well-known examples. A challenge with PPP models is that the development of carbon credits is not a single project to be delivered at a set time. The development of carbon credits will involve many projects, over many years. The investment return expectations of investors do not align with the likely revenues from carbon credits.

> Given the land-use planning issues associated with carbon credits, a key stakeholder is local government.

The third option is to consider the development of a modern mutual. Mutuals can be regarded as the 'missing middle' of Australia's financial system. Historically, mutuals played a significant role in financing communities. Mutuals such as AMP, National Mutual, IOOF, Manchester Unity as well as scores of building societies and credit unions were a core fabric of Australia's financial system. Today, for a variety of reasons including the sophistication of financial services, mutuals have largely disappeared from the finance sector. Where mutuals remain outside of finance, they have proved resilient to economic fluctuations. An example is the RACV, which has continued to develop new member services supported by its mutual structure.

> The way in which solar is being supported through Renewable Energy Zones is an example of how legislation and regulation can support the development of regions.

The challenge is that creating new mutuals is not easy. There is potentially a role for the Victorian Government to play in facilitating the establishment of a modern mutual that would develop recycled water to support carbon credits. There are a number of models that can be considered to develop a modern mutual, with one being to simply use a standard corporation structure with shareholders that include the Victorian Government and Victoria's largest carbon emitters. Given the land-use planning issues associated with carbon credits, a key stakeholder is local government.

A modern mutual has the potential to align with ICVCM's Core Carbon Principles focus on sustainable development. We can imagine an agreement where a new mutual is provided with a long term 99-year licence to access Melbourne Water's recycled water. With appropriate land-use planning support, a mutual can build the infrastructure to transport Class C recycled water to regions that develop carbon credits. The way in which solar is being supported through Renewable Energy Zones is an example of how legislation and regulation can support the development of regions. Class C recycled water would be used to support the development of carbon credits through plantations. The ability to access a stream of water even in drought conditions would ensure the integrity of carbon credits which would translate into higher market prices for Victorian carbon credits.

There is also an opportunity to maximise the social and environmental benefits that come from investment in carbon credits. The ICVCM Core Carbon Principles provide a framework to recognise sustainable development benefits. Indications in global carbon markets suggest that carbon credits that deliver biodiversity benefits attract a higher price. The ability to use surplus water to support biodiversity is perhaps the biggest benefit for Victoria. In 2020 the platypus was officially recognised as vulnerable in Victoria.[9] Climate change represents a significant risk for the platypus which needs access to fresh water to breed. The infrastructure developed by a new mutual can provide a means to supplement existing water flows in times of environmental stress.

What role does the Royal Society of Victoria have to play in developing tomorrow's water system? The RSV's played a critical role in the original establishment of Melbourne's municipal water system. As Victoria's oldest science society, the RSV can play a role in designing the new structures to manage waste and water for the benefits of Victorians and the environment.

Gordon Noble is a Research Director at the Institute for Sustainable Futures, University of Technology Sydney.

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THE FISHY SIDE EFFECTS OF PHARMACOLOGICAL WASTE IN OUR WATERWAYS

By Dr Catriona Nguyen-Robertson MRSV

When we think of pollution in streams and rivers, we tend to think first of rubbish in water; the litter traps along the Yarra River in Melbourne's CBD that are often overflowing, or the empty plastic bottles along the Moonee Ponds Creek

But water pollution takes many forms, from physical trash to invisible chemicals that also accumulate in our waterways. Emerging contaminants like pharmacological waste and microplastics are not filtered out by current wastewater treatment plants. These chemicals instead flow into water ecosystems where they can have devastating ecological impacts.

We are literally medicating our waterways. Pharmacological waste is now ubiquitous in the environment and many drugs have long half-lives, persisting even in the most remote places on the planet, including Antarctica.

Pharmaceutical drugs enter our water supply when people release traces in their urine (or flat-out flush unused medication down the sink or toilet). Surprisingly, 50-60% of the active ingredients of some pharmaceuticals, such as oestrogen in the conception pill, pass through our bodies and are flushed out in urine. These active ingredients subsequently pollute waterways, virtually unchanged even by wastewater treatment, and now many wild fish are swimming in an active drug cocktail that contaminates rivers and streams.

These compounds – including antidepressants, painkillers and blood-pressure medicine – are working their way through the food web. In 2018, freshwater ecologist Dr Erinn Richmond and her colleagues at the Water Studies Centre, Monash University detected 69 out of 98 pharmaceutical compounds tested for in aquatic insects living in Victorian creeks.[1] The most commonly detected pharmaceuticals in the tissues of these insects were memantine (a treatment for Parkinson's); codeine; fluconazole (an antifungal medicine); metoprolol (a treatment for high-blood pressure and angina); and mianserin (an antidepressant). Alarmingly, these compounds were also detected in spiders that feed on aquatic insects, highlighting that predators further up the food chain are potentially also exposed to high levels of drugs.

A large issue with pharmaceuticals is that the receptors on our cells that drugs are designed to target tend to be evolutionarily conserved among animals. Medicines that are developed for

A large issue with pharmaceuticals is that the receptors on our cells that drugs are designed to target tend to be evolutionarily conserved among animals. Medicines that are developed for humans can therefore have similar effects on other non-target species. However, only a fraction of the dose used for humans is needed to affect smaller animals – and the effects can be quite drastic.

humans can therefore have similar effects on other non-target species. However, only a fraction of the dose used for humans is needed to affect smaller animals – and the effects can be quite drastic.

Psychoactive drug and antidepressant pollutants have been found in water habitats all around the world, including here in Australia.[2] They have been detected in drinking water, surface water, ground water, seawater, and other water bodies. The purpose of these drugs is to alter behaviour and mood in people – and they are starting to do that in wildlife too. Professor Bob Wong's team at Monash University found that exposure to the antidepressant fluoxetine (Prozac®), disturbed a freshwater fish's foraging behaviour or ability to escape from predators.[3] Additionally, an anti-anxiety drug, oxazepam, is present in the Fyris River in Sweden at concentrations that can affect fish behaviour, making fish less social, more active, faster feeders, and more bold.[4] Fish with drug-enhanced appetites could more quickly deplete their food resources, and bold, active fish that do not congregate with others can also make themselves easier targets for predators. These drugs that accumulate in waterways thus negatively impact the ability of fish to survive.

Another drug that ends up in waterways is the contraceptive pill, containing progesterone and oestrogen. These so-called hormone-disruptors have unintended consequences in aquatic animals as it disturbs their normal, delicate hormone balance. Professor Wong's research into this area began 15 years ago when he observed declining biodiversity in the streams of Mexico as female sawtail fish struggled to seek males of their own species and were instead mating with the wrong species.[5]

In addition to behavioural changes, studies have seen abnormalities in the genitalia of both terrestrial and aquatic life due to exposure to hormone-disruptors like the contraceptive pill. Male fish exposed to hormone-disruptors can become feminised, in which female egg cells grow in their testes. Some fish species, such as clown fish, are naturally hermaphroditic and can change sex to increase their chances of reproducing. However, when female eggs are present in male fish that are not hermaphroditic, it greatly impedes their reproductive success. Over the past decade, feminised male fish have been discovered in 37 species in lakes and rivers throughout North America, Europe, and other parts of the world.[6] Furthermore, an astonishing 60 to 100 percent of all the male smallmouth bass examined in 19 US National Wildlife Refuges have become feminised.[7] A similar feminisation phenomenon has also been seen in alligators, turtles and frogs. Pharmacological contaminants in water hence negatively influences the fertility and reproductive capacity of animals, and ultimately, biodiversity in aquatic ecosystems worldwide.

There is no easy solution to prevent drugs from entering our waterways. We cannot simply get rid of or ban all these products given that many people take them out of necessity. We can, however, be more considerate of their whole lifecycle. Could we get pharmaceutical companies to research the impact of their products once we have consumed them? Can we get consumers to be more mindful, especially when disposing unused tablets? And can we further improve their removal in wastewater treatment plants? It is encouraging to see some governments and environmental agencies begin to assess different methods of removing hormones during sewage treatment. For example, a wastewater treatment facility in Canada has made small upgrades to reduce oestrogen levels, leading to a drop in incidences of feminised rainbow darter fish found downstream.[8]

When we take pharmaceutical drugs, they are not always entirely used within our bodies, and they therefore have these unintended consequences. The drugs we take have a targeted physiological response on humans – that is why we take them. However, we do need to be more considerate about how the pollution from the waste we wee impacts fauna in rivers and streams.

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Monash University's Professor Bob Wong studies the effect of pharmacological and other chemical pollutants on aquatic life.

OUR GREAT (BUT TRICKY) BENEFACTOR – THE HYDROLOGIC CYCLE

By Dr. Leon Bren

Most of us don't think about water resources in terms of an abstract concept of the hydrologic cycle; rather we think in terms of tapping a big river or water flooding our house or town. But these are really subsets of what the hydrologic cycle does.

WHAT IS THE HYDROLOGIC CYCLE?

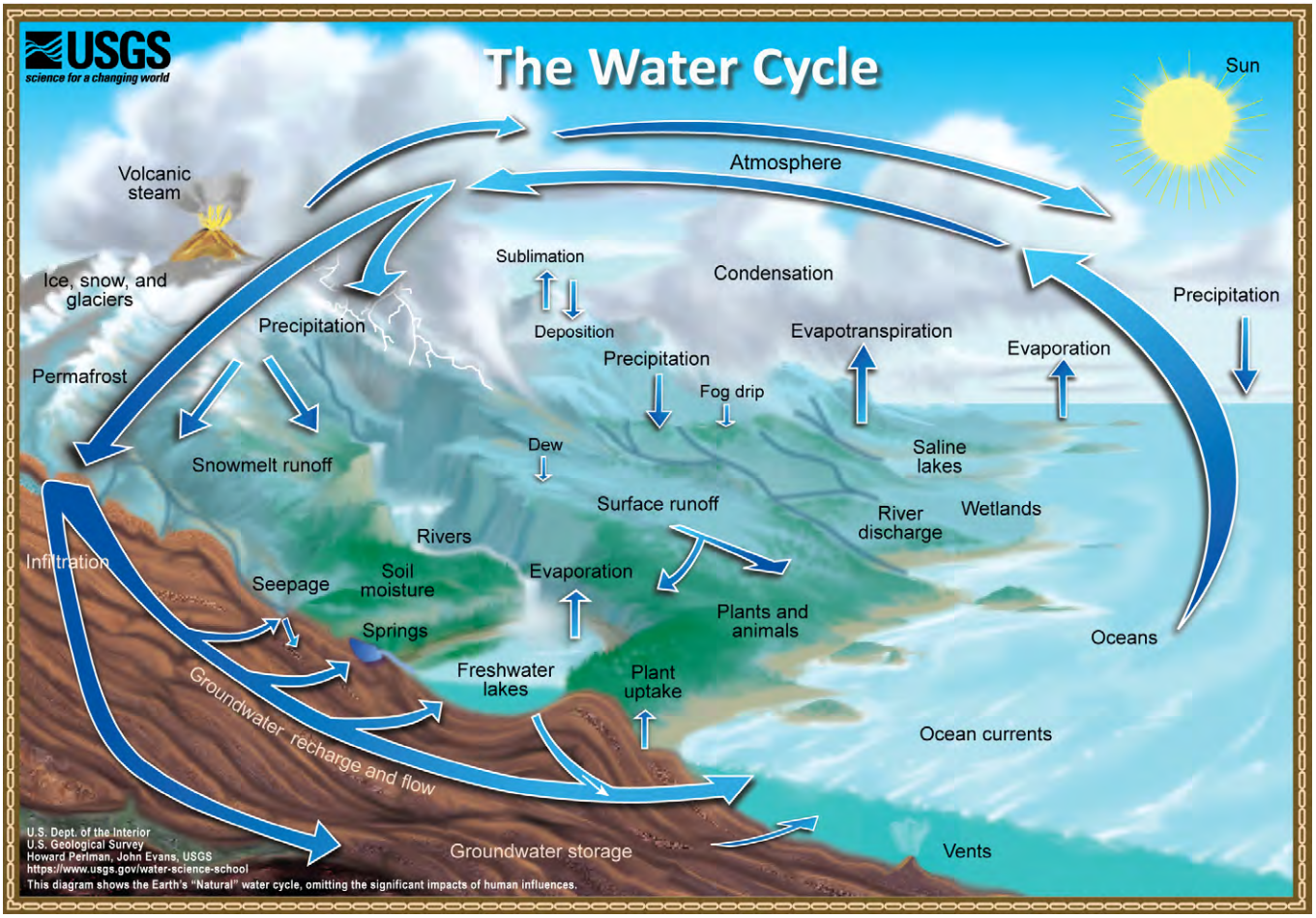
For most, the hydrologic cycle is a diagram (Figure 1). It shows water evaporating from a benevolent, tranquil ocean to form pretty, fluffy, cumulus clouds. These pass inland and, by some action, cool, causing rain to fall. This then runs down the hillside to form rivers and streams. Usually, they show grass and trees busy evaporating. All in all, they are a pleasant, tranquil scene of hydrology at work. The concept goes back to veteran hydrologist Robert Horton in the 1930's. Hydrologists Langbein and Hoyt in 1959 noted that "the hydrologic cycle is one of nature's grand plans".[1]

It is only recently that the hydrologic cycle concept has come under some scrutiny. Sociologist Jamie Linton has noted that the hydrologic cycle is better viewed as a hydro-social cycle since each component has large implications about how we live.[2] He also observed a "temperate bias" since Figure 1 could just as logically show deserts instead of forest and pasture. Societies spend a lot of time trying to modify the hydrologic cycle to gain some local advantage. For example, in the latter part of the last century "cloud-seeding" was the favoured way to make it rain on a local catchment, probably at the expense of rainfall in some distant and unknown place. Historians of colonialism have noted that often one of the first acts of colonial powers was to modify the hydrologic cycle to their advantage by building channels and dams.

THE ROLE OF SCIENCE IN HYDROLOGIC CYCLE MANAGEMENT

Historically, the development of water resources around the world was viewed as a triumph of applied science. This involved measurement of volumes and flow rates, developments of concepts of water energy and water quality, and applying these to natural systems. Under the leadership of engineer Ronald East,

Figure 1: The hydrologic cycle as viewed by the US Geological Survey. Source: USGS (Public Domain)



Flooding of the Hawkesbury River in Windsor, NSW, in July 2022 (Wes Warren, via Unsplash)

Victoria had a large program of dam building from about 1936 to 1975. These dams were viewed as temples of applied science. This enthusiasm then dimmed – possibly because we had a run of benign seasons until the 1990's. Economist Bruce Davidson in "Australia Wet or Dry" pointed out that we had gained a degree of hydrologic protection but argued that this wasn't worth the cost.3 And there was some "counting the cost" of unique environments lost to dams – of which Lake Pedder (Tasmania) is an example.

More recently, the hydrologic cycle is being viewed as a major part of the Earth's radiation balance and is being incorporated into Global Circulation Models. These have proven to be difficult to formulate and program, particularly at local levels. The advent of imagery and thermal measurement from satellites is creating new opportunities at local, national, and international levels. Controversial Russian work has suggested that volume changes of water in the hydrologic cycle creates winds which transport water far inland ("flying rivers", "rivers of rain").[4,5,6] The "bottom up" approach of scientists last century (based on observation and modelling of ground-based flows) has been replaced by a literally "top-down approach" involving global circulation and modelling. Difficulties include the training and equipment to participate, going from a global approach to what it means for a particular town or catchment, and issues of political water management that may emerge involving water vapour crossing international boundaries.

OUR CITIES BUFFER US FROM THE HYDROLOGIC CYCLE

In 1854, Dr John Snow was trying to work out why cholera was killing people in London. Through inspired research he realised that the water in a main London public tap was contaminated by sewage, and that this was responsible for the outbreak. It is hard to underestimate the importance of this in an age where theories of infection were vague at best. Cities around the world took note that a good water supply and sewerage system were necessary for good health. In Melbourne, this realisation ultimately led to the construction of the Yan Yean water supply in 1857, which would provide the city with an adequate water supply for the next few decades.

Melbourne's growth has hardly slowed down. From an 1857 population of 400,000 to a 2023 population of five million, the city has kept growing - and so too did the water supply projects. Having an inadequate water supply was not (and is not) an option for towns and cities. The large storage buffer created has substantially (but not entirely) made the vagaries of the hydrologic cycle irrelevant for most of us.

DO WE MANAGE THE HYDROLOGIC CYCLE?

The short answer is probably no, but we do manage aspects of it to gain a degree of protection. In particular:

1. We put a lot of work into storing water so that, should it choose not to rain for a short or long period we have enough to get us through
2. The volume of water stored may "take the peak" off high flows, thereby mitigating flooding.
3. Our larger river channels are usually capable of transmitting large flows. Such "bankers" can be very uncommon - so uncommon that they are often forgotten about in the planning process. This then gives a "blame game" when people build houses or businesses on this land within what is ultimately the high flow channel. We use mathematics to make errors of frequency (e.g., 1 in 100 years) but the error bars in such estimates are huge and often the assumptions implicit are tenuous. We often build earthen walls ("levees") to restrict the widths of the channels.

All things considered, the hydrologic cycle is something we still work around, not manage.

BUT THE HYDROLOGIC CYCLE STILL BITES US

Most Victorian residents can claim a few "degrees of separation" from the hydrologic cycle, but the daily news is as filled with "hydrocycle adventures" as ever. There is a certain inevitability of

"once in a hundred-years" events, earned by the fact that they have occurred, on average, once every hundred years for a certain period of time.

Flooding in the River Murray system is still being cleaned up,[7] towns in western NSW have run out of drinking water,[8] the town of Lismore in NSW is contemplating a very-expensive relocation,[9] the city of Brisbane's future is clouded by its flood vulnerability and the discovery that upstream dams can't guarantee immunity.[10] Victoria discovered that once flood-prone sites along the Maribyrnong River are still flood-prone,[11] and development along the river may have enhanced this tendency.[12] Flood insurance for houses in some areas have reached five figures and are viewed as "unaffordable".[13]

In the public comment there is at times an undertone of, "how can such things be allowed to occur in the modern age?". Some of us are not separated at all, and, arguably, the gap between comfort and various levels of disaster is not always great and, possibly, diminishing. We probably have an overstated view of our society's "cleverness".

OUR FUTURE LIVING WITH THE HYDROLOGIC CYCLE

Overall, we have done OK out of the hydrologic cycle. In Victoria we've been well fed (thanks partly to irrigated crops) and housed (mostly undisturbed by floods) and, as individuals, hardly need to pay it attention. It has created pretty landscapes and a valued biota well-adopted to coping with its short and long-term vagaries.

The question is, can this continue for the indefinite future? If we looked into the past as far as our records go back, we'd be tempted to say "Sure - why not? It has worked (in its hiccupping way) for recorded history; why should it falter in the next century?". Science shows us that the world climate is changing, and the experiences of the past are no longer the guaranteed guide to the future that they once might have been. We have a greater knowledge of the processes involved in managing the Earth's climate but still require greater understanding of the inherent instabilities. And if the issues of managing rivers that cross State or National boundaries have been complex, imagine trying to manage "flying rivers" of water vapour across these boundaries. We have benefitted from the application of science to its water resources. Commonly this involved increasing the amount of storage in some particular stream component.

We now have a more mature appreciation of the hydrologic cycle, its vagaries in statistical terms, and at least some of the social implications of it, but we are a long way from "understanding" the stop-go nature of it. This will be a major research area in the future with exciting but "difficult-to-use" tools becoming available. Full consideration of it involves the nature of the relationship between humans and the natural environment. For most of us we are fortunately remote from these difficult questions and the hydrologic cycle should continue to provide us with clean, safe places to live.

Dr. Leon Bren trained as a forester at the Victorian School of Forestry. After some years working in the field, he did a doctorate in the hydrology of small, forested streams. He worked as a lecturer in forestry, specialising in forest harvesting and forest hydrology at The University of Melbourne. Since then he has been a consultant and author of books on forest hydrology. He is currently writing an environmental history of Lake Corangamite in south-western Victoria.

Punt Road, Melbourne, during the Great Flood of July 1891 Source: State Library of Victoria (Public Domain)

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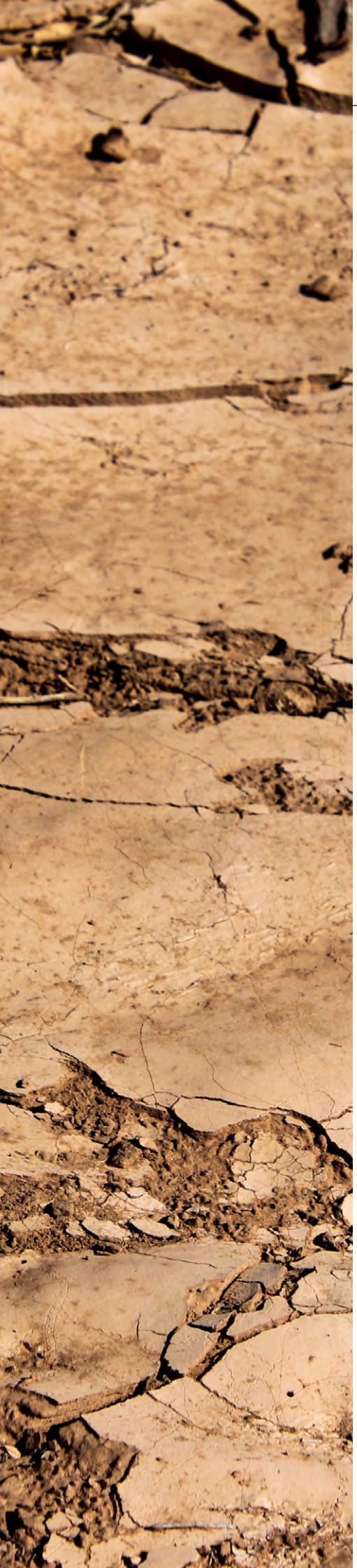

DRIVING ADAPTATION: CHANGING THE NARRATIVE OF WATER IN VICTORIA

By Lynette Smith

A lot must go right for us to have water for people and the environment here in Victoria. It's got to be the right amount, of the right quality, at the right time and place. It's something that many of us take for granted.

The systems and institutions that get that water to us—the infrastructure, governance, maintenance practices, and demand management—are largely invisible to us.

If we do think about water at all, that's where we often stop: infrastructure and operations. However, we also depend on factors that are even less visible, but just as material in their impact. These factors are the attitudes, norms of practice, habits, and biases that drive our decisions and behaviour relating to water.
It's often called the 'soft stuff', but it isn't. It's what makes us not leave the tap running when we brush our teeth. These factors motivate a farmer to manage chemical use, stock movements, and waste disposal, so that they don't damage the waterways. They are what shape the decisions of the manager of a paper plant who wants to use water more productively.

And it's not just the 'end users'. That 'soft stuff' also drives policy makers in the water sector to design programs that may or may not produce undesirable outcomes— such as externalising costs onto the environment or communities, and ignoring Indigenous water rights.

The problem for us here in Victoria, and for much of Australia, is that the 'soft stuff' we've got in our heads now is not suited to a sustainable way of life. It belongs to a way of life that assumes that water is there for the taking and that there will always be enough.

CHANGING WHAT WE THINK AND DO...BEFORE WE'RE FORCED TO

Even in the climate we've been used to for the past 200 years, our maladaptive behaviours have taken us into periods of extreme scarcity and to the brink of ecosystem collapse.

It's not to say that we did nothing. Households all over the country have repeatedly responded to the call to save water during periods of drought. In fact, most research over the decades have shown that Australians are on board with a strong norm of saving water in those circumstances.[1]

We should also mention the Murray-Darling Basin Plan here, brought into being during the Millennium Drought (1997 - 2009). This was a massive systemic response intended to re-balance the needs of the economy and the environment.

But with rainfall patterns already changing in each of Victoria's three climate zones,[2] and projections of less water overall,[3] we need to start the change before we're forced to— i.e., before we see an obvious reason to do it, and before it's clear what the best course of action is.

What we need is a transformation of everything that we take for granted—all the attitudes, norms, habits, and biases that drive our decisions and actions in relation to water and our way of life, whether we're a water user or a water planner.

That change is adaptation.

IT'S A COMMUNICATION PROBLEM

You might think that it will be 'no worries'. We'll get the messaging right, and roll out a marketing communications campaign that will convince people to 'value water'.

Unfortunately, our go-to technique is not the right one to use in this context. It's great when the context is stable and understood by everyone, and everyone knows what the required action is, but this is not how it's going to be as we adapt. No clever messaging is going to sort that out

for us, because it's baked into the marketing comms methodology.

An even bigger issue is that it maintains the attitudes, norms, biases, and habits that must change if we are to really adapt—by reinforcing, for example, the narrative of water as a commodity and us as consumers. The stakes are high. When a marketing campaign flatlines, it can trigger narratives of conflict with government, or its incompetence. We've seen the damage caused "in a number of failed water projects (where) consumer group campaigns against the project successfully subjugated official government marketing efforts".[4]

Even when a water project is delivered despite resistance, it can come at a heavy social cost. We saw this with the desalination plant in Wonthaggi, which was experienced by people there as an unjust imposition of the State government,[5] and is still tagged as a 'white elephant'.[6]

ARE WE STUCK?

The recent story of water in Victoria does have bright spots: a net zero emissions sector by 2035,7 and Water is Life, the roadmap for partnerships, legislation, and governance for managing waterways as living beings and using water to heal Country.[8] Both are examples of a conceptual and imaginative shift, which needs to become normal in our narrative of water.

But observers of the adaptation scene in Australia notice that we've arrived at an impasse, which they analyse as the inertia of 'climate capitalism'—an ideological position, which is invested in political and economic theories and practices that have brought us to where we are now. They also point out that until now there has been "little consensus on what a well-adapted future might look like".[9]

Could we come to a consensus—one that is strong enough to overcome the inertia—with water security right at the heart?

GETTING UNSTUCK: WHAT GENUINE COMMUNICATION ABOUT THE FUTURE OF WATER IN VICTORIA COULD DO FOR US

Coming to a consensus is an intrinsically communicative process, one that creates a rich context for the kind of change we need to accomplish individually and collectively.

For one thing, a consensus implies an equality of everyone at the table—greatly needed in a time of damaged social cohesion, where governments and other powerful organisations need to show us they are trustworthy. It's also an opportunity to question 'climate capitalism'—to make visible everything we take for granted about what we really want and need to live well and sustainably.

It gives us time to think about that 'soft stuff', and bring to the surface knowledge that is not available through current methods.

Critically, it would help us find a new common ground—space in which we can work cooperatively and collaboratively, resilient to the pressures of vested interests and 'fake news'.

This is communication in the proper sense of the word. It reduces uncertainty by sharing knowledge, building trust, and organising cooperative action to create collectively desired outcomes.
Making it happen: some thoughts from Euroa
Last year in Euroa, people got together to talk about the forces driving and stalling adaptation, with a focus on water.[10]

The workshop report shows that the citizens of Euroa understand the challenges of adaptation. They don't need a marketing campaign. Instead, they need—and expect—local and state government, and its agencies, to take the lead on change they can be part of.[11] For that, they—and all of us in Victoria—need "an appropriate governance structure to meet the adaptation challenges". That structure is a context in which people can come to a consensus about the future and collaborate to make it happen.[11]

But someone has to create that structure. And the people of Euroa are right: governments are the only actors with the social licence to do so. That governance structure is not a new channel for fake consultation. Nor can it be a way for policy makers or elected representatives to impose 'solutions'—as the Wonthaggi experience shows, that approach may deliver short-term gain, but with long-term pain.

Equality at the table is important. Governments have as much to discover about the path forward as the citizens do. That is the nature of adaptation. In these circumstances, the appropriate communication approach is deliberation, knowledge elicitation, foresight, social testing and collaboration, and, if people's perceived or actual interests are in conflict, negotiation and mediation.

Communication, in this sense, is a way to drive change and reduce the uncertainty that goes with it. It may require more investment than a marketing campaign, but it's in proportion with what we need to do. In short, it may be a way out of the impasse we find ourselves in.

Lynette Smith, director of gramma consulting, is a writer, analyst, and strategist focussed on using words and communication to its full capacity to get things done. She has worked for more than 20 years in the science-policy-society triangle, synthesising research, communicating science, and advising on strategies for change. With studies in linguistics and philosophy Lynette takes an empirical and ethical approach to these questions rather than stopping short at nudges, marketing techniques and knowledge transfer.

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(Ivan Bandura, via Unsplash)

OPPORTUNITIES FROM TREATING WASTEWATER WITH MICROALGAE

By Dr Morley Muse

Microalgae have been gaining attention as a sustainable, less energy-intensive method for wastewater treatment.

They can remove contaminants without the need for oxygen, making them a reduced energy treatment option compared to traditional systems that require aeration.[1] Additionally, following treatment the recovered microalgae can be used for the production of biogas and biodiesel.[2] This provides an effective means of mitigating current negative environmental impacts of wastewater discharge.

Treating wastewater with microalgae involves growing them in the effluent, where they consume compounds containing nitrogen and phosphorus, as well as heavy metals, pesticides, and particular toxins (depending on the species). Usually considered as waste, the microalgae view them as valuable nutrients, and effectively remove these pollutants from the water.

Once the microalgae have reached their maximum growth potential, they can be harvested and processed to extract valuable resources such as lipids, which can be used to produce biodiesel. In addition to biodiesel, microalgae waste can also be used to generate biogas via anaerobic digestion. Anaerobic digestion involves the breakdown of organic matter in the absence of oxygen, resulting in the production of 'biogas', which is made up of methane (CH4) and carbon dioxide (CO2). The terms 'biogas' and 'biodiesel' refer to products that have the same chemical components of natural gas and diesel respectively, but are produced from a 'renewable' source.

> Conventional wastewater treatment methods, such as activated sludge treatment, require significant energy inputs and can be expensive to operate and maintain.

The biogas can then be refined to produce 'biomethane' (i.e., methane from a renewable source), and CO2. The biomethane can then be used as a renewable energy source for electricity and heat production, while the CO2 can be re-bubbled as a carbon source, making the entire process carbon neutral.[3]

In addition to biogas, anaerobic digestion results in the production of other intermediate products, such as biohydrogen and volatile fatty acids (VFA).[4,5] VFAs can then be utilised across industries including energy, food, plastics, and pharmaceuticals, while biohydrogen can be used as an alternative fuel source. As biohydrogen can also be obtained from biogas, it means that it can be extracted from multiple points in the process of treating wastewater with microalgae.[6]
Conventional wastewater treatment methods, such as activated sludge treatment, require significant energy inputs and can be expensive to operate and maintain. In contrast, the use of microalgae-based wastewater treatment systems can reduce energy consumption and operating costs while also producing valuable resources.

Furthermore, the use of microalgae for wastewater treatment can help address the issue of nutrient pollution in waterways. Nutrient pollution from sources such as agricultural runoff and wastewater discharge can lead to harmful algal blooms (excessive growth of toxin-producing algae), which can have negative impacts on aquatic ecosystems and human health. By making use of microalgae's ability to remove nutrients from wastewater, the risk of nutrient pollution in waterways can be reduced.

Despite its promise, one of the major challenges of using microalgae for energy production is the fact that they are quite sturdy: when extracting lipids for biodiesel production, the cell wall of most microalgae resists digestion by microbes, and is therefore more energy-intensive to break down (Muse, 2021).

To resolve this, a pre-treatment process is required to disrupt the cell wall structure and improve degradation. Biological pre-treatment (using enzymes and bacteria) is the most energy-efficient option and can offer several benefits for microalgae breakdown during anaerobic digestion or lipid extraction for biodiesel. When compared to chemical pre-treatment, the benefits include lower cost, and greater yield of methane and lipids. In summary, extracting microalgae waste as a form of wastewater treatment offers a sustainable and cost-effective solution for mitigating the environmental impacts of wastewater discharge. The production of biogas, biohydrogen, VFAs, and biodiesel from microalgae waste provides opportunities for renewable energy generation and can help address issues such as nutrient pollution in waterways. The use of microalgae waste for wastewater treatment and energy production offers a range of benefits and opportunities for a more sustainable and resilient future.

Dr Morley Muse is a Chemical, Environmental and Renewable Energy Engineer with expertise in wastewater treatment. She is Director and Co-founder of iSTEM Consulting Pty Ltd, and a Board Director of Women in STEMM Australia.

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Barry McNeill (1937 - 2014), at an event held by friends, colleagues, and former students in 2013.

The event was held in the Royal Tasmanian Botanical Gardens at the 'Wombat' shelter, which is a prototype timber building designed and built by students from the School of Environmental Design in 1979-80. Barry was Director of the school within the then Tasmanian College of Advanced Education (TCAE), having established (from 1970) its radical educational approach that included 'self-assessed' learning, and 'learning by doing'.

Barry passed away in 2014, aged 76.

Photographer: Leigh Woolley FRAIA

1973

REFORMING URBAN GOVERNMENT

By Scott Reddiex MRSV

Another presentation made to the RSV's 1973 symposium, '*The Urban Environment and Life*', was the '*Environmental Design of Urban Areas*' by Barry McNeill. It begins with a definition:

"The word environment is widely used in the current upsurge of community awareness. I prefer to define environment in Buckminster Fuller's sense of 'everything that isn't you'. But perhaps I also should define environmental design. This is a general term used to describe those professions which intervene in the environment: i.e., design, architecture, planning and even civil engineering."

While these professions have a responsibility for that direct intervention in the environment, it remains the responsibility of governments and government departments to perform the high-level, comprehensive design of increasingly complex cities. This is where McNeill argues that the current systems of government are unsuitable for the task and need reform:

"Contrary to conventional belief our large cities have generally improved their quality over the past half century. The main physical problems are associated with air quality, transportation and the excessive spatial segregation of socio-economic groups usually to the disadvantage of the poor. But the planning and management of urban areas is the most important problem we are facing."

"There are relatively simple physical design approaches that could improve public transport, opportunities and the environmental quality of both living and working areas, but the key solutions lie in the reform of urban government and the creation of socio-political opportunities for lower socio-economic groups."

McNeill defines the 'urban crisis' as the problems of a society in transition from industrial to post-industrial culture, and that many problems stem from the style of thought and institutions that were appropriate in the past.

He goes on to suggest that the current model of government department is excellent for dealing with simple development problems (such as building a highway or railway), or with quantitative social issues (such as compulsory schooling, or building a public school). However, this 'single issue department' model cannot handle the coordination of complex issues like choosing between alternative mixes of transport, inter-relationships between alternative transport systems and land use, or trade-offs between building housing or providing credit for the poor.

The proposed solutions are, broadly, 1. functional regional government for urban areas with sophisticated planning procedures and the elimination or integration of the one-purpose agencies, and 2. considerable decentralisation to the point of local control over micro-environmental questions in living areas, and over the qualitative aspects of social services, e.g., schools and health centres. "And this means local control at a scale considerably less than present local government units, which are too small to deal with urban infrastructure questions and too big to deal with qualitative issues."

Barry McNeill
(21/11/1937 - 12/11/2014)

Barry McNeill was an architect, and in 1973 was the Director of the Department of Environmental Design at the Tasmanian College of Advanced Education (later part of the University of Tasmania).

He had commented in this piece that, *"Australian tertiary education is still producing professionals in separate departments, with little or no general education or appreciation of the urban system, and with a set of techniques or solutions rather than a problem-solving orientation"*. In response to this, he shaped the pedagogy of the School of Architecture & Design around the values of learning by making, self-direction and project-based learning, and multidisciplinarity.

From:
Proceedings of the Royal Society of Victoria, Volume 86 (New Series), 1974. Environmental Design of Urban Areas, by Barry McNeill.

RESEARCH INSTITUTE, MUSEUM, AND ANATOMY DEPARTMENT

The Veterinary Research Institute at the University of Melbourne, located on Flemington Road, Parkville.
Source: The University of Melbourne Veterinary School Prospectus, 1918.

1923

FUNDAMENTALS OF INFECTION AND IMMUNITY

By Scott Reddiex MRSV

On the 9th of August 1923, Prof Harold A. Woodruff presented a piece to the RSV by his colleague George G. Heslop at the University of Melbourne's Veterinary Research Institute, titled *'Further Studies in Contagious Bovine Pleuro-pneumonia. Experiments to demonstrate the occurrence of two distinct types of the virus in Victoria.'*

In 1922, there was a disease outbreak in a herd of dairy cows on a farm near Melbourne. The disease was a contagious pleuro-pneumonia (an infection of both the lung and the lining of the lungs), and blood samples were sent to the Veterinary Research Institute for testing and diagnosis.

What did testing of blood and other samples mean in 1922? The answer is much the same as it has meant since then, with the same principles applied in hospital pathology labs today.

Blood samples from infected animals were first submitted to an agglutination test, using a microbial culture generated from samples obtained during a previous outbreak on a nearby farm ('culture Y'). Should the blood samples contain antibodies specific to the microbe in the culture, they would clump together when mixed. The negative result informed Heslop that it wasn't exactly the same agent causing this particular outbreak, and the analysis continued.

A sample of the offending organism was obtained from the lungs of one infected animal from the current outbreak, and this sample was cultured in a specific media to produce 'culture X'.

Heslop remarked that both cultures X and Y had similar appearances, and produced similar results when subjected to the same biochemical tests. However, their point of difference remained how they responded to the antibody-containing sera from the infected animals.

"...suffice it to say that after numerous experiments and using over 30 different known positive sera, it became apparent that there were at least two distinct strains or types of the organism of contagious pleuro-pneumonia present in Victoria."

Drawing on the data from other outbreaks in the previous years, Heslop determined that most outbreaks in Victoria were caused by the 'type Y organism'.

The next step for Heslop was to determine how best to vaccinate the livestock against these infectious agents:

"Having established the fact that there are at least two distinct types of the organism of contagious pleuro-pneumonia present in Victoria, the question of prophylactic inoculation in the tail with culture or virus may have to be considered in the light of this knowledge."

"For instance, a prophylactic inoculation with culture or virus containing only type X organism may protect against type X organism, but not against type Y, and vice versa."

He notes that it would therefore be best to inoculate the herd using a culture derived from an infected animal on the same farm, instead of using one from another farm, as it may or may not be the same organism. The question remained: was one culture able to show cross-protection?

"Experiments are now being conducted at the Veterinary Research Institute, Melbourne University, to ascertain whether the organism of one type will protect only against its own type, or will protect against both types."

From:
Proceedings of the Royal Society of Victoria, Volume XXXVI (New Series), 1924. Article VII - Further Studies in Contagious Bovine Pleuro-pneumonia Experiments to demonstrate the occurrence of two distinct types of the virus in Victoria, by George G. Heslop.

The Yarra below the Falls. Melbourne., by Antoine Fauchery and Richard Daintree (c.1858). The photograph looks west from a point upstream of the Yarra Falls, which can be seen in the mid-ground. The waterfall was destroyed with dynamite in 1883, to mitigate flood risk and allow for uninterrupted travel along the river.

Source: State Library of Victoria (Public Domain)

1873

THE SECOND-BEST TIME TO FIX A PROBLEM

By Scott Reddiex MRSV

On the 18th of November 1873, Alexander K. Smith presented his piece to the Society on the 'Embankment above Prince's Bridge'.

The land now occupied by the City of Melbourne has always been prone to flooding, a fact well-known by First Peoples. Instead of heeding their repeated warnings, the European arrivals in the area opted to build a city on the banks of the Yarra, resulting in a city subject to repeated flooding.[1]

Smith's paper came in response to the establishment of an embankment on the south side of the Yarra, to the east of Princes Bridge. A civil engineer by trade, he argued that the construction of the embankment would do nothing to reduce the impact of flooding, and instead posed a greater risk to the nearby low-lying areas. These arguments he impressively supported by calculating the velocity and volume of water that would be expected during the next flood, based on data from a previous flood in December of 1863.

He proposed immediate action, and warned of the areas at risk:

"...it is not too late to take remedial steps to avoid to a great extent the disasters which it may cause by damming back the flood-waters upon Richmond and the low-lying lands adjacent to the city, but more particularly to those who have property on the low grounds of Emerald Hill [South Melbourne] and [Port Melbourne], should the embankment give way."

Employing their powers of hindsight, the authorities engaged engineers to review the risk after the embankment's construction:

"I am credibly informed that since the embankment was erected, the Commissioner has referred the subject to a board of engineers to report upon the probable effect of the embankment on floods, that the said board had sent in a report, in which the embankment as placed was condemned, and which further recommended that a considerable portion of it at both ends should be removed."

Validated, Smith concluded that, "It, therefore, appears that the primary objections I urged against its construction have now, after it has been made, been endorsed by a board of engineers. This recommendation comes too late to save the waste of public money; but if the difficulty be grappled with at once, it is not too late to avert the consequence of its presence."

Alexander Kennedy Smith (1824–1881) arrived in Melbourne from Scotland in 1854, and was a life-long member of the RSV from its inception. Unsurprisingly (given this particular piece), he served as a member of the Melbourne City Council for fifteen years, including time as mayor in 1875-76, before being elected to the Victorian Legislative Assembly 1877-1881.

From:
Transactions and Proceedings of the Royal Society of Victoria, Volume XI, 1874. Article IX - Embankment above Prince's Bridge, by A. K. Smith, C.E., &c.

References:
1. Finn, Edmund, The chronicles of early Melbourne, 1835 to 1852: Historical, anecdotal and personal, vol. 1, p. 211

The **Inspiring Australia strategy** was developed by the Australian Government to increase engagement and interest in the sciences. The **Inspiring Victoria** program is jointly funded by the Australian and Victorian governments with the Royal Society of Victoria.

Inspiring Victoria encourages involvement in STEM through initiatives (such as **National Science Week Victoria**) that are delivered by the RSV's program partners:

- Public Libraries Victoria
- Neighbourhood Houses Victoria
- Parliament of Victoria
- Museums Victoria
- Royal Botanic Gardens Victoria
- The Commissioner for Environmental Sustainability
- Questacon
- The Arthur Rylah Institute for Environmental Research.

WHAT ARE NEIGHBOURHOOD HOUSES?

Ms Brittany Prentice
Communications Specialist, Neighbourhood Houses Victoria

Neighbourhood Houses are places of connection, belonging, participation and inclusion. With over 400 locations across Victoria, these community-led & place-based centres have a significant and meaningful impact on the lives of many in Australia.

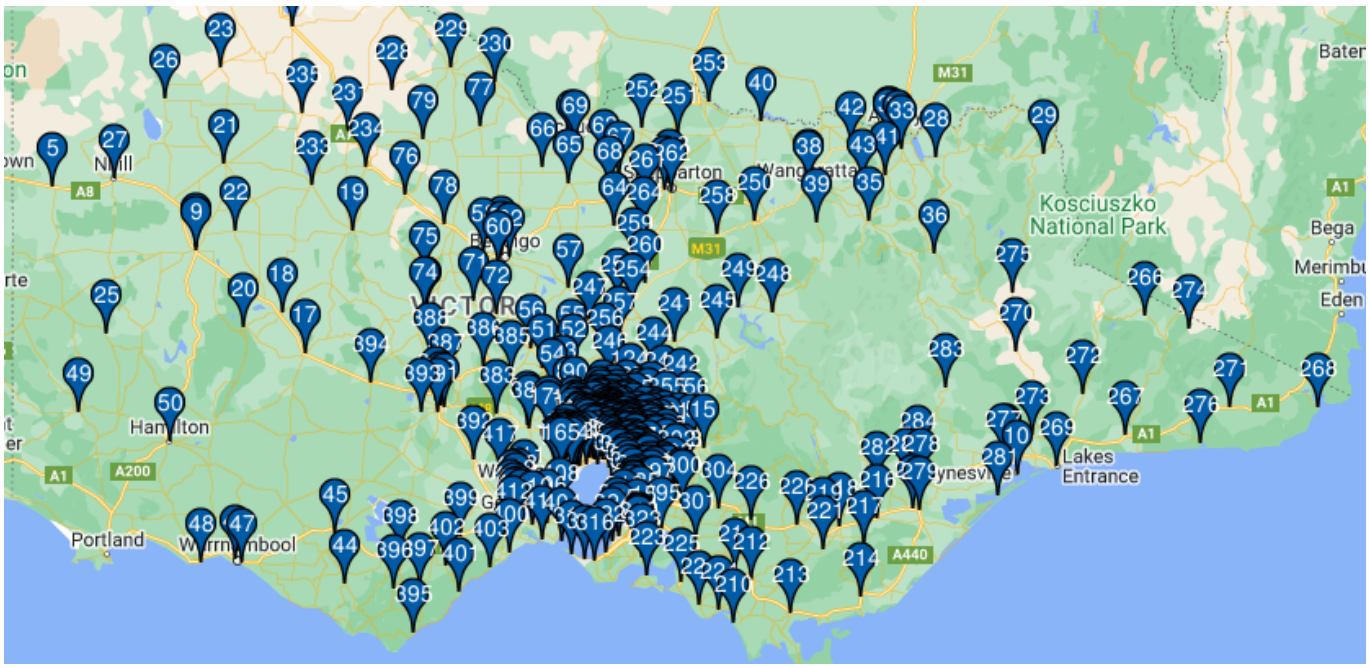
Born in the 1970s, Neighbourhood Houses grew from the grass roots out of local community need, particularly the isolation of women in the community, with a vision to bring people together and enhance the opportunities of people and communities.[1] There has always been an emphasis on providing a non-threatening environment for learning – something that is particularly aligned with the Inspiring Victoria initiative.

In 1986, the Victorian State Government introduced a funding program, recognising the value of these Houses. For every dollar of funding, Neighbourhood Houses create $7.26 in value through emergency relief, support services, social services, community lunches, classes, childcare, and more.

To this day, Neighbourhood Houses are community-based organisations – run by locals, for locals – so that funding can go to the programs that are most needed by their demographics. These Houses create the programs needed to fill the gaps in their community that might otherwise be overlooked.

Each Neighbourhood House is unique and independent. It's their greatest strength, but also what makes them so hard to summarise! They all share a mission to combat social isolation and loneliness by being accessible, non-threatening and inclusive spaces that welcome people from all walks of life. Everyone is invited, no matter their gender, age, race, sexuality, abilities, culture, or religion.

With a wide range of programs, there's room for all types of interests. You can take up a sewing class, improve your English, or learn to navigate your new phone. And one of the things we love to celebrate is a love of science at every stage of life. The highlight is National Science Week, when Neighbourhood Houses across Victoria deliver information sessions, workshops and science fairs to support their community learning about STEMM.



With over 400 Neighbourhood Houses in Victoria, there will likely be a few close to you.

In the face of climate change, the future of the planet depends on our collective actions. The extent to which sea levels will rise, temperatures will warm, and natural ecosystems will change, depend on what we do as a community. Supported by Inspiring Victoria grants, 20 Neighbourhood Houses across Victoria delivered events in 2021 to encourage communities to come together to showcase local initiatives and build a sustainable future as part of the National Science Week ACCLIMATISE program.[2]

Some Neighbourhood Houses invited members of their communities to learn how to compost and tend to worm farms, build bee hotels, or be citizen scientists in their backyard to care for wildlife. Others worked together to collect rubbish from around town and create art installations or new fabrics using their gathered upcycled materials. Other Neighbourhood Houses over the past two years have brought ever-advancing technology to their communities, running robotics and coding workshops or virtual reality sessions. Each House brings something unique to their community, but all of them individually work towards the common goal of sharing a love of science.

But you won't need to wait for Science Week to explore science in your local Neighbourhood House. There's plenty to see and learn year-round covering loads of topics, including some great water and waste programs:

Anglesea Community House runs an eWater System on site, helping community members create an Organic Certified disinfectant, cleaner and sanitiser.[3] This offers a more sustainable and less wasteful method of cleaning around the house for the community.

At Wedderburn Community House, you can learn to restore the creek on your bush property to embrace nature's productivity.[4] They're helping people learn about the importance of healthy waterways for the environment by controlling erosion, re-vegetation & encouraging wildlife. Caring for bodies of water, such as creeks, is a low cost and local way to help your bush home thrive and support the flora and fauna around you.

Or join Wyndham Community and Education Centre's Adult Migrant Education Program (AMEP) group for the 'Meet a Lifeguard' program with Life Saving Victoria, to help people learn water safety around oceans, creeks, rivers and more.[5] While many Australians might have had the opportunity to attend swimming lessons growing up, not all members of our diverse community have had the same chance or the need to learn about the risks of currents and tides.

There are plenty more ways to embrace science within your community. Each Neighbourhood House has a unique offering of activities and resources to cater to the needs of their community, from community gardens to children's care programs, cooking and casual social catch ups.

Find your local Neighbourhood House at **www.nhvic.org.au/find-a-neighbourhood-house**, and learn how they can help you embrace the spirit of science, sustainability, and community.

References:
1. History of Neighbourhood Houses www.nhvic.org.au/history
2. ACCLIMATISE inspiringvictoria.org.au/programs/national-science-week-victoria/acclimatise/
3. eWater System anglesea.org.au/community/ewater-systems/
4. Wedderburn Community House wedderburnch.org.au/courses/introduction-to-your-land-waterway-restoration-2023
5. Adult Migrant Education Program (AMEP) wyndhamcec.org.au/education-training/adult-migrant-english-program/

national science week

NATIONAL SCIENCE WEEK

National Science Week is Australia's annual celebration of science and technology.

Running each year in August, it features more than 1000 events around Australia, including those delivered by universities, schools, research institutions, libraries, museums and science centres.

Victoria has been turning up in numbers for many years to host events across the State - but there's been a recent downturn during the pandemic that we're keen to turn around.

SO - please help us to get Victoria fired up for National Science Week in 2023! We'd love to see more than 400 events happening right across the State this year, from Nelson to Lindsay Point to Corryong to Mallacoota and back again.

To get the ball rolling, we have seed grants available to help community organisations host events, particularly organisational members of Public Libraries Victoria and Neighbourhood Houses Victoria.

FUNDING AVAILABLE FOR YOUR NATIONAL SCIENCE WEEK EVENTS

Applications will open on 1 May 2023 for the National Science Week August 2023 grant round (up to $1000 ex. GST). These seed grants are designed to support individuals and organisations who wish to run public science events and activities within Victoria during National Science Week. Please follow the process set out online at **inspiringvictoria.org.au/programs/national-science-week-victoria/grants/**

Stuck for ideas? To help you get thinking, here are some of the activities supported in 2022:

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

The Ocean Grove & District Men's Shed presented a series of shows for Seniors on Friday 12th August, and another series for families on Saturday 13th August 2022, encouraging lifelong learning.

The aim of the shows was to promote positive attitudes towards science by participating in science activities, and highlighting the everyday accessibility of science in everyday life. Activity leaders helped to develop critical and creative thinking skills with participants, asking and answering questions, making predictions and drawing conclusions using scientific methods.

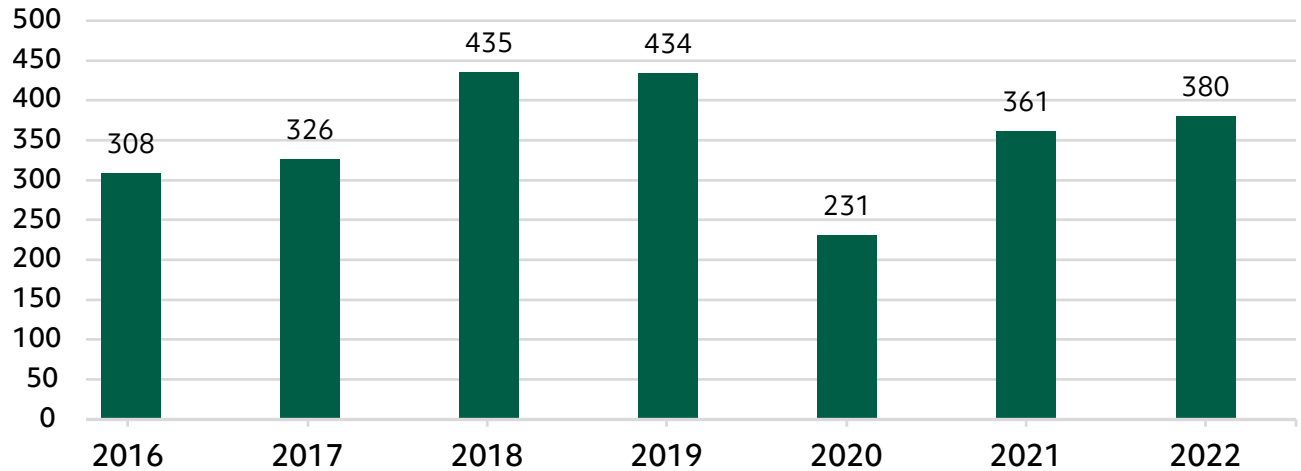
Attendance for these shows was 56 adults for Seniors Day, and 92 children and 49 adults for the Family Day.

HYCEL - HYDROGEN POWER AND CLEAN ENERGY – WARRNAMBOOL LIBRARY (WARRNAMBOOL)

The Warrnambool Library in partnership with Deakin University ran a very successful Science Week program this year. With the grant funds, the Library was able to purchase 3 hydrogen fuel cell cars. During Science Week the Library and Deakin University ran 3 sessions with children and youth aged 3-15. Warrnambool West Primary School brought their grade 5/6s (25 students), Warrnambool College brought a year 8 Science class (15 students), and the local home-schooling community attended a session (25 children of all ages).

The formal school group sessions had an activity that introduced hydrogen, the future of zero emissions energy and hydrogen powered vehicles. Delivered by Deakin University's Hycel team and assisted by library staff, participants made hydrogen with a tabletop electrolyser and experimented with toy hydrogen cars. The home school group completed the

Numbers of National Science Week Events Victoria (2016 - 2022)



following activities: making hydrogen and experimenting with the hydrogen cars, using Bee Bots to explore coding, building windmills from an electronics kit, and experimenting with Morse code using model telegraphs.

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

STEM Zone ran an engaging workshop for young scientists aged between 7 and 14 years. The sessions fitted into the theme for Science Week 2022 - "Glass, more than meets the eye" and students explored this through hands-on activities and investigations. They learned about how glass is made and how its properties determine its many uses. Activities included looking at the use of mirrors and creating optical illusions, exploring the effects of tools like lenses, a blown glass display, a mock stained-glass activity, and an opportunity to showcase their creativity!
The session literally finished off with a bang. The presenters showcased a glass-breaking experiment with different types of glass (normal, laminated and safety). The feedback indicated this was by far the favourite part of the session!

FROM PAST TO PRESENT – ISLAMIC MUSEUM OF AUSTRALIA (THORNBURY)

From Past to Present was an epic full-day event that brought many patrons into the Islamic Museum of Australia for the very first time.

Children loved the tactile experience of crushing and grinding natural pigments, including charcoal and sandstone, during the Hellenic Museum's presentation as part of the pigment mixing workshop. The tangible transformed into the chemical as participants moved into a new room to complete the calligraphy ink making activity.

Robofun's two workshops – Coding and Robotics – were completely sold out. Each participant created their own unique animation and worked together in teams to help the Edison robot navigate its way on the floor map.
Unfortunately, due to very poor weather, we were unable to go outdoors and stargaze for the astronomy workshop. Instead, we remained indoors for an immersive presentation and astrolabe-making activity.

Age groups included children up to 12 years and adolescents aged 13-17 years.

The majority of audience members identified as Muslim, from culturally and linguistically diverse backgrounds. We also had a group of around 12 Muslim teenagers travel with two teachers from Canberra to spend the day at the Museum, attending all the workshops on offer.

Audience numbers on the day (not including parents/guardians as spectators): 94. Estimated total audience numbers: 188.

GET INVOLVED

A wealth of event ideas and tips to help you make the most of National Science Week are available online from the national site: **scienceweek.net.au/get-involved/hold-an-event/**

CALL FOR SCIENTIFIC 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 **publish.csiro.au/rs**.

The Society invites contributions for the Proceedings from authors across the various disciplines of biological, physical and earth sciences, including multidisciplinary research, and on issues concerning technology and the applied sciences.

Contributions on topics that are relevant to Victoria and the south-eastern Australian region are encouraged. The journal also publishes Special Issues and themed collections of papers commissioned by the Council of the Royal Society of Victoria. It is published online in May and November, with two issues constituting a volume.

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.

The journal began in 1855 as an irregular publication under the title Transactions of the Philosophical Society of Victoria, the present name being adopted in 1889.

The journal began in 1855 as an irregular publication under the title Transactions of the Philosophical Society of Victoria, the present name being adopted in 1889. Since then, the journal has appeared on a regular basis, at first annually but varying from one, two or four parts per year. Since 1889, the parts issued each year were deemed to make up a volume. The online content extends back to Volume 118, Number 1, 2006.

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

Please note copies of the Proceedings 1854 to 2006 are freely available online at the State Library of Victoria website in their 'Digitised Collections.'

SOCIAL MEDIA

Follow the journal on social media using the hashtag *#ProceedingsRSV*

CURRENT GOVERNMENT CONSULTATIONS OF INTEREST TO VICTORIA'S SCIENCE COMMUNITY

*Projects open for consultation from **engage.vic.gov.au/project***

Victorian Murray Floodplain Restoration Inquiry and Advisory Committee.

Learn about the Standing Inquiry and Advisory Committee appointed to advise on the proposed Victorian Murray Floodplain Restoration Projects and their potential effects

Ongoing:
engage.vic.gov.au/VMFRP-SIAC

Hazelwood Mine Rehabilitation

Public comment is invited on the draft Scoping Requirements for the Hazelwood Mine Rehabilitation Project Environment Effects Statements (EES).

Consultation closes 10 May 2023:
engage.vic.gov.au/hazelwood-mine-rehabilitation-ees-project-draft-scoping-requirements

Offshore Wind Transmission In Gippsland and Portland

Have your say on the energy infrastructure needed to deliver renewable energy to Victorian homes and businesses across the state.

Consultation closes 14 May 2023:
engage.vic.gov.au/offshore-wind-transmission-in-gippsland-and-portland

Regional Drought Resilience Planning

Feedback is sought on regional drought resilience planning in Victoria

Consultation closes 15 May 2023:
engage.vic.gov.au/regional-drought-resilience-plans

Victoria's 30-year Infrastructure Strategy

Have your say on Victoria's 30-year infrastructure strategy which makes recommendations to Parliament on how to get the best use from our existing and new infrastructure.

Consultation closes 28 May 2023:
engage.vic.gov.au/victorias30yearinfrastructurestrategy

Government Land Standing Advisory Committee

Have your say on changes to planning provisions for surplus government land to be sold or land proposed to be acquired for priority projects by the Victorian Government.

Ongoing:
engage.vic.gov.au/glsac

PITCHING AND WRITING FOR SCIENCE VICTORIA

Science Victoria seeks the discussion and promotion of scientific topics of relevance to people living in the State of Victoria. We are particularly interested in new research, in-depth articles, or exploration of subjects where scientific work and thinking can directly address or deepen our understanding of environmental and socioeconomic challenges.

We welcome your pitches and pieces for news, features, opinion, and analysis articles on current scientific research in Victoria, recent scientific discoveries, related social and policy issues, technical innovations, and overviews of impactful research. We cover a broad range of topics around Science, Technology, Engineering, Mathematics, Medicine/health (STEMM) under an overarching theme of "science and society."

Science Victoria's articles are written in plain, non-academic language, pitched at an intelligent and naturally curious audience that does not necessarily hold subject-matter expertise. This is not a platform for scientific journal articles nor media pieces. For more information on what we're looking for, please read our article submission guidelines below.

HAVE AN IDEA FOR AN ARTICLE?
PITCH YOUR IDEA TO US!
Send your idea to **editor@sciencevictoria.org.au,** along with any questions you have regarding your pitch.

In your email, please outline:
- In one sentence, what is your key message? (No more than 50 words)
- Why should this key message be shared with the readers of Science Victoria? (No more than 100 words)
- Which style of article are you proposing to write? (See below for a guide to article types)

Article pitches can be submitted at any time, but please keep in mind the article submission deadlines for the next month's issue. Note that we may accept your pitch, but suggest it is more suitable for another style of article.

ARTICLE SUBMISSION
Once your pitch has been accepted, you can submit completed pieces that comply with the style guide below. Completed articles to be published in the next issue of Science Victoria must typically be submitted 2 weeks prior to the beginning of the next month.

All pieces will be reviewed prior to publishing and may be edited for length and clarity (although we will be sure not to alter the message or context of your work). We will also endeavour to fact-check and confirm any grey areas with you ahead of publishing in the interests of accuracy.

All published pieces will be accompanied by a by-line, and a short (<50 word) biography of the author (title, institution, qualifications, current projects, contact email) to be submitted with your piece.

Images and figures to accompany your piece are strongly encouraged, however please ensure that you only provide original images produced by yourself or those that already exist in the Public Domain.

Images must include details of the source and any relevant descriptions. If you do not provide any images, and any relevant descriptions. If you do not provide any images, we may include Public Domain or stock images that we deem suitable for visual communication of your content.

REFERENCES
References for all articles should use a modified APA 7th edition format: reference list in author-year format, with numbered in-text citations. Refer to articles in previous editions for examples, or contact **editor@ScienceVictoria.org.au**.

WRITING FOR SCIENCE VICTORIA: ARTICLE FORMATS

STYLE GUIDE

To successfully engage the largest audience, all pieces should have readability in mind.

Readability can be determined using a Flesch-Kincaid readability test, aiming for a score between 50-60. This score means that your piece should be easily understood by an educated 16-year-old (a year 10 student).

If drafting your piece in Microsoft Word, **you can easily view your document's readability statistics** at Home>Editor>Document Stats. Alternatively, you can use one of the many free online calculators.

FEATURE ARTICLES

Recommended word count (600 - 1,800)

Feature articles are more in-depth pieces on a specific topic related to STEMM. A key aspect of feature articles is the narrative – this isn't a journal article, so think about the story that your article is trying to tell.

Your audience is intelligent members of the general public, who share an enthusiasm for scientific topics, or who are members of the scientific community outside of your particular field.

Avoid using jargon, as it will quickly alienate anyone who isn't an expert in that field. Explaining one or two otherwise irreplaceable terms is fine.

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article.

Feature articles typically run between 600 and 1,800 words (including references). Use of sub-headings and figures to break up longer pieces is strongly encouraged.

Not quite sure about the tone for your piece? Have a look at articles published in previous editions of Science Victoria, or in other scientific magazines for a general audience, like The Conversation, Cosmos, New Scientist or Scientific American. A good litmus test is knowing that most of us have read a piece or been to a presentation that managed to make the most interesting topics incredibly boring. This is what you want to avoid.

LETTERS AND ARTICLES

Recommended word count (400 - 1,000)

Letters have minimal restrictions on style, structure, or subject matter. You are encouraged to submit your thoughts/questions/comments that broadly relate to STEMM in Victoria and/or the Royal Society of Victoria. Potential subject areas include responses to articles in previous editions of Science Victoria, seminars at scientific events, science-related issues and policies, or topics you'd like to see in future editions.

Where a specific question is asked, we will endeavour to have the appropriate person respond to your letter.

WHAT I'VE BEEN READING

Recommended word count (400 - 1,000)

This is a column for you to tell us about a book broadly relating to science that you've read. These pieces are typically between 400 – 1,000 words and include a summary of the book and its ideas, as well as your interpretations or conclusions.

Possible questions to consider when writing this column:

- Do you think the author was correct in any assumptions?
- Was the author's style of writing approachable?
- Did they do the subject matter justice?
- Who would you recommend this particular book to?
- What did it mean to you?
- What did you learn?

OPINION ARTICLES

Recommended word count (600 - 1,000)

In contrast to an unbiased news or feature article, an opinion piece conveys your informed opinion on, or experiences with a particular topic. This is where your expertise on a subject can shine. Clearly state your argument, outlining the details of the problem you are addressing, and build to a strong conclusion.

For greatest impact, your choice of topic should be one that is broadly relevant to STEMM-related fields in Victoria. Examples of possible topics include:

- how to address a climate-change related problem in Victoria, successes and failures common to STEMM engagement initiatives,
- changes in your particular field of expertise
- your experiences of a career in STEMM and thoughts on how to better support the next generation of researchers,
- existing STEMM-related studies or approaches that you believe could be applied in Victoria,
- ethical problems related to scientific projects or careers in STEMM.

Please reference primary sources/journal articles for any non-trivial scientific claims, or for publications that prompted your writing of the article.

Opinion pieces should aim to be 600-1000 words. For anything shorter, consider submitting it as a Letter instead. We welcome well-informed opinion articles from all authors, particularly from those with significant expertise in a given area. Articles may reference your own work; however these are not promotional fluff pieces.

NEWS AND ARTICLES

Recommended word count (400 - 1,000)

News Articles are for the discussion of current or recent news relating to science, with an emphasis on science in Victoria or news that impacts Victoria's scientific community.

These articles should be concise, avoid use of jargon and personal opinion, and be referenced as appropriate. News pieces should be between 400-1,000 words in length.

Reports could relate to funding announcements/grant outcomes, new STEMM-related projects, high-impact publications relevant to Victoria, successes of Victorian scientists, or relevant STEMM-related policy news.


THE ROYAL SOCIETY OF VICTORIA
Promotion and Advancement of Science

HOLD YOUR NEXT EVENT AT THE ROYAL SOCIETY OF VICTORIA

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!

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.

SERVICES AVAILABLE

We provide a number of services to ensure your event is a success. Some of the services we provide are:

- Event management
- Meeting venues
- Grants and awards administration
- Social media campaign management
- Broadcasting and video production
- Campaign management
- Recruitment of scientific panels
- Convening community engagement and deliberation processes where scientific work contributes to social, environmental, and economic impacts and benefits.

The Burke and Wills Room

Multi-functional space with adjoining kitchen.

Capacity:

Workshops	≤30 people
Dinners	≤60 people
Seminars, functions, catering, etc	≤80 people

The Von Mueller Room

Seminar room great for smaller meetings and seminars.

Capacity:

Meetings, seminars, etc	≤15 people

The Ellery Lecture Theatre

Raked seating great for lectures, presentations, and conferences.

Capacity:

Raked seating	≤110 people.

The Cudmore Library

A picturesque room great for larger meetings and seminars.

Capacity:

Meetings, seminars, etc	≤24 people

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

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 **rsv.org.au/support-the-rsv**

RSV 2023 FUNDRAISING CAMPAIGNS	RSV 2023 FUNDRAISING
The Area of Greatest Need, as identified by the Society's Council	$
Inspiring Victoria – Community Science Engagement Program	$
Science Awards & Prizes	$
Science History & Heritage	$
The Australian Science & Engineering Fair (AUSSEF)	$
Science for All - Citizen Science Programs	$
BioQuisitive Community Lab	$
The Phoenix School Program	$
The BrainSTEM Innovation Challenge	$
Australian Indigenous Astronomy	$
Science Victoria - Magazine and Web Content Production	$
TOTAL	**$**

Personal Details

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Science Victoria

The Royal Society of Victoria
8 La Trobe Street, Melbourne,
VIC 3000

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