Possible impossibles: The past, present and future of science in Victoria

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Executive Summary

For National Science Week 2020, the Parliament of Victoria in conjunction with the Royal Society of Victoria will present an online community forum centred around the theme, ‘Possible impossibles: how science can help create a better future’.

This paper highlights a small selection of the ‘impossibles’ made possible with science and technology in the state of Victoria:

Development of the flu treatment Zanamivir
Stopping influenza infections from spreading through the body

Development of socially aware robots
Improving the way robots interact with people

Discovery of the rotavirus
Saving thousands of children’s lives every year by preventing gastroenteritis

Creation of the Yume food marketplace and the KeepCup
Reducing waste from the commercial food sector and single-use coffee cups

Invention of atomic absorption spectroscopy
Allowing laboratories to rapidly identify more than 65 elements

Invention of the bionic ear and eye
Restoring the ability to hear running speech and the ability to see light and movement

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Exploration of COVID-19 nanobody therapy and saliva tests
Researching innovative new ways to test for and prevent COVID-19 infections

Possible impossible: Stopping influenza in its tracks

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is responsible for some of Australia's most well-known inventions (Wi-Fi!), including the development of the first drug to successfully treat influenza.[1] Called Zanamivir (but commercially known as Relenza), the anti-flu drug was developed in the 1980s and 1990s through a collaboration with the Victorian College of Pharmacy (now part of Monash University) and the Australian National University. As a typical Australian winter will see around 3,000 flu-related deaths, the development of Relenza is a breakthrough discovery.[2]

Relenza
Source: CSIRO (2019)

Leading the CSIRO's development of the drug was Dr Peter Colman. With his colleagues, Colman used x-ray crystallography to locate a region on the surface proteins of the flu virus that does not change in any of its strains. They developed a drug which 'locks' onto this section of the virus and stops the infection progressing.[3]

Relenza was the first in a new class of anti-viral agents called neuraminidase inhibitors and is one of the first examples of 'structure-based drug design', where the structure of the protein was used to guide the chemistry. Colman describes the moment that he had a breakthrough in a typical Victorian way— with a footy match going on in the background!

> One Saturday afternoon in 1982, after beating my way through the football traffic jam around Princes Park, I watched results come clanking back over the old-line printer. I saw what I wanted and realised my goal was achievable, not the result itself, but apparently the avenue to it. At exactly the moment as the Line Printer fell silent… a cheer went up from 30,000 people at Princes Park and I wondered was there anywhere else in the world that the inexorable advance of science would be so welcomed.[4]

Peter Colman, Mark von Itzein and Graeme Laver shared the Australia Prize for their achievement.[5]

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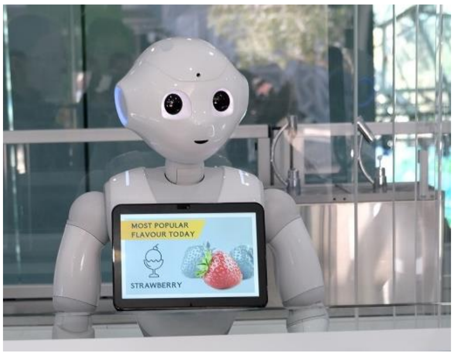
[1] Commonwealth Scientific and Industrial Research Organisation (date unknown) 'Our top ten inventions', CSIRO website.
[2] Commonwealth Scientific and Industrial Research Organisation (date unknown) 'Relenza - the first effective flu-fighter', CSIRO website.
[3] C. Ward (2011) 'Relenza' CSIROpedia website; Commonwealth Scientific and Industrial Research Organisation (date unknown) 'Relenza - the first effective flu-fighter', op. cit.
[4] Ward (2011) op. cit.
[5] ibid.

Possible impossible: Designing friendly robots

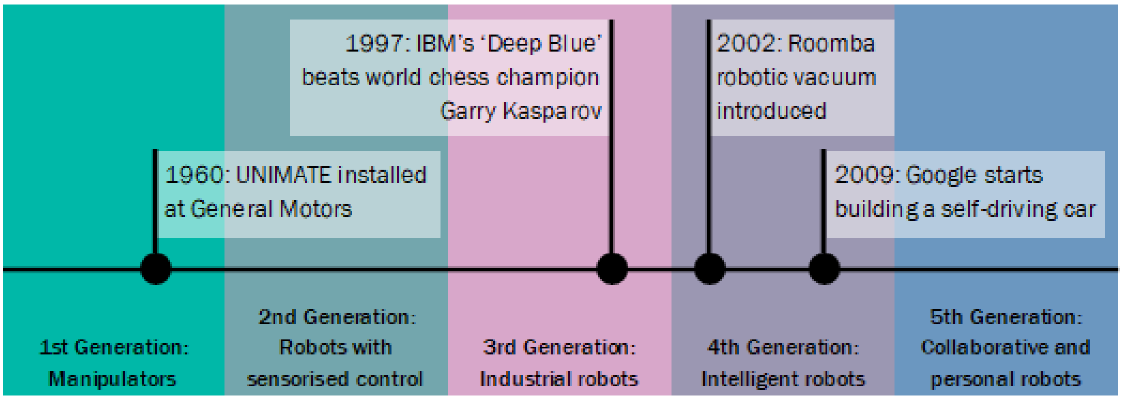
The Niska ice cream bar in Federation Square offers more than a cool treat on a hot Melbourne day. Customers also get to imagine a future where robots work alongside humans in everyday life.



Pepper the robot
Source: Niska (2019)

A human-like robot named Pepper greets customers and takes their orders, while a mechanical arm named Eka scoops the ice cream.[6] The bowtie-clad Tony, also a robot, is in charge of toppings as well as the vinyl turntable, acting as DJ for the team's impromptu dance parties.[7]

The robots at Niska showcase the evolution of robotics across the last 40 years. Roboticists have noted that the development of sensorised controls, such as those that allow Eka to determine how much ice cream is left in the carton, was the catalyst for the rise of industrial robots in the 1980s.[8] In the 2000s and 2010s, advances in artificial intelligence brought robots beyond factories and into fields ranging from hospitality to strategy games to autonomous navigation.[9] For example, Pepper's perception modules allow him to recognise and converse with customers in 15 languages.[10]



Milestones in robotics
Source: adapted from Zamalloa et al. (2017)

When robots' jobs were limited to mechanical tasks, it was straightforward to measure how well they performed. For example, Eka's job is to scoop ice cream into a dish. Her performance can be readily quantified—e.g. how often she scoops the right amount of ice cream and how quickly she does it. Roboticists can use objective measurements like these to compare robots and gauge developers' progress over time.

But do these tools still work when a robot's job isn't so simple? Does it matter how customers perceive a service robot like Pepper, or is it enough that he simply gets their orders right? Should Tony be judged by his hot fudge drizzling skills or the quality of his dance moves?

[6] Niska (date unknown) 'Meet our robot team', Niska website.
[7] ibid.
[8] I. Zamalloa et al. (2017) 'Dissecting robotics – historical overview and future perspectives', arXiv preprint arXiv:1704.08617, p. 2.
[9] ibid.
[10] SoftBank Robotics (date unknown) 'Pepper', SoftBank website.

To help bridge this gap, Professor Elizabeth Croft and her colleagues turned to the field of psychology. Drawing on methods used by psychologists to quantify subjective experiences, they developed a standardised measurement tool for human-robot interaction called the Godspeed questionnaire:[11]

Godspeed I: Anthropomorphism

Please rate your impression of the robot on these scales:

Fake	1	2	3	4	5	Natural
Machinelike	1	2	3	4	5	Humanlike
Unconscious	1	2	3	4	5	Conscious
Artificial	1	2	3	4	5	Lifelike
Moving rigidly	1	2	3	4	5	Moving elegantly

Godspeed II: Animacy

Please rate your impression of the robot on these scales:

Dead	1	2	3	4	5	Alive
Stagnant	1	2	3	4	5	Lively
Mechanical	1	2	3	4	5	Organic
Artificial	1	2	3	4	5	Lifelike
Inert	1	2	3	4	5	Interactive
Apathetic	1	2	3	4	5	Responsive

Godspeed III: Likeability

Please rate your impression of the robot on these scales:

Dislike	1	2	3	4	5	Like
Unfriendly	1	2	3	4	5	Friendly
Unkind	1	2	3	4	5	Kind
Unpleasant	1	2	3	4	5	Pleasant
Awful	1	2	3	4	5	Nice

Godspeed IV: Perceived Intelligence

Please rate your impression of the robot on these scales:

Incompetent	1	2	3	4	5	Competent
Ignorant	1	2	3	4	5	Knowledgeable
Irresponsible	1	2	3	4	5	Responsible
Unintelligent	1	2	3	4	5	Intelligent
Foolish	1	2	3	4	5	Sensible

Godspeed V: Perceived Safety

Please rate your emotional state on these scales:

Anxious	1	2	3	4	5	Relaxed
Agitated	1	2	3	4	5	Calm
Quiescent	1	2	3	4	5	Surprised

Source: Adapted from C. Bartneck et al. (2009)

[11] C. Bartneck et al. (2009) 'Measurement instruments for the anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety of robots', *International Journal of Social Robotics*, 1(1), p. 71.

While robotics engineers are interested to collect this kind of subjective data, the researchers report that they tend to devise their own unique questionnaires.[12] This poses two problems:

- There is no test of the questionnaire's validity or reliability; and
- There is no way to compare the results between different studies or over time.[13]

The Godspeed questionnaire solves both problems. Since its publication in 2009, the questionnaire has been translated into 12 languages[14] and has been cited more than 1,100 times.[15] Professor Croft has since joined the faculty at Monash University to continue her work in the field of human-robot interaction.[16] She hopes to continue her work toward making possible 'a robot in every home', simple enough so that anyone can program it.[17]

Possible impossible: Preventing rotavirus infections

Before Ruth Bishop discovered rotavirus, a highly contagious disease that causes severe gastroenteritis, around 10,000 Australian children under the age of five were hospitalised with severe vomiting and diarrhoea each year.[18] Professor Bishop began looking into the cause of 'gastro' at the Royal Children's Hospital in 1965 and, in 1973, Bishop, Geoffrey Davidson, Ian Holmes and Brian Ruck discovered what they named 'rotavirus'. Rota means wheel in Latin and was chosen because under electron microscopy the structure was wheel-like.[19]

After this discovery, studies showed that rotavirus was causing early childhood deaths on every continent and the World Health Organization supported a drive to develop a vaccine.[20] A vaccine developed in 1997 has worked well in Australia and Europe; however, the virus still kills an estimated 215,000 children under the age of five every year.[21] Researchers still believe it is possible to prevent rotavirus across the world, with recent discoveries by scientists at the Murdoch Children's Research Institute giving more hope that all children could be protected from this disease. In 2013, Professor Bishop was the first woman to be awarded the Florey Medal and renowned immunologist Sir Gus Nossal stated that her discovery of rotavirus is a 'great hallmark of Australian science'.[22]

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[12] Bartneck et al. (2009) op. cit., p. 72.
[13] ibid.
[14] C. Bartneck (2008) 'The Godspeed questionnaire series', Christoph Bartneck, Ph.D. website.
[15] Estimate retrieved from Google Scholar, 22 July 2020.
[16] Monash University (date unknown) 'Professor Elizabeth Croft', Monash University website.
[17] Inspiring Victoria (date unknown) 'Possible Impossibles with Professor Elizabeth Croft', Inspiring Victoria website.
[18] Department of Health (date unknown) 'Rotavirus', DoH website.
[19] R. Bishop (2009) Discovery of rotavirus: implications for child health, *Journal of Gastroenterology and Hepatology,* 24(3), p. 82.
[20] Bishop (2000) op. cit., p. 83.
[21] Murdoch Children's Research Institute (2018) 'Australian researchers successfully develop a rotavirus vaccine which could benefit millions of children', Research News, Murdoch Children's Research Institute website.
[22] Australian Institute of Policy and Science (date unknown) 'CSL Florey Medal', AIPS website; Murdoch Children's Research Institute (date unknown) '30 years of life-changing discoveries: Professor Ruth Bishop and Professor Graeme Barnes', Murdoch Children's Research Institute website.

Possible impossible: Reducing landfill waste

In 2017–18, it is estimated that 4.4 million tonnes of waste ended up in Australian landfill.[23] This includes organics, paper and cardboard, packaging glass, plastics and e-waste. The impact of this waste on the environment has concerned many Victorians and some, such as Katy Barfield and Abigail and Jamie Forsyth, developed innovative ways to reduce landfill.

Yume Food

Yume Food, founded in 2014 by Katy Barfield, aims to 'create a world without waste by facilitating the sale and donation of surplus food that may have otherwise been discarded'.[24] Barfield noticed the amount of food that was being discarded by the commercial food sector and decided to do something about it. Yume states that, each year, 4.1 million out of the 7.3 million tonnes of Australian food waste comes from the commercial food sector. Barfield developed an online marketplace which allows suppliers and buyers to connect and stop surplus food from ending up in landfill. Yume estimates that over the next five years, their estimated impact will be the equivalent to 20,140 cars off the road.[25]

KeepCups

KeepCup
Source: Freepik

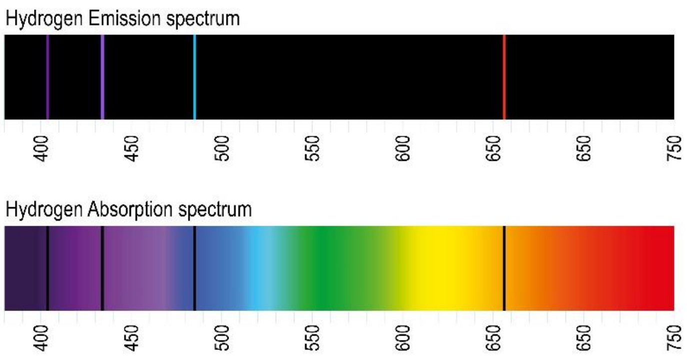
Melburnians are well-known for their love of coffee and picking up a takeaway coffee on the way to work is part of many people's routines. According to Sustainability Victoria, Australians throw out 2.7 million single-use disposable coffee cups every day. This adds up to one billion per year.[26] Melbourne café owners, brother and sister Abigail and Jamie Forsyth, noticed how many coffee cups were being used every day and created the first barista-standard reusable coffee cup.[27] In 2019, KeepCup estimated that its users have diverted billions of non-recyclable, single-use cups from landfill. In 2018, a lifecycle analysis of reusable cups showed that KeepCups have a lower environmental impact than a single use paper/polypropylene cup after 24 days (assuming one use a day).[28] After ten days, the KeepCup has a lower environmental impact than composting cups. Since then, the reusable coffee cup industry has boomed with many considering it a necessity when they leave the house.

[23] R Godfrey, J Trinh, B Grant & C Wardle (2019) 'Victorian waste flows', report prepared for Infrastructure Victoria, p. i.
[24] Yume (date unknown) 'About Yume Food', Yume website.
[25] ibid.
[26] Sustainability Victoria (date unknown) 'Eco-friendly alternatives to disposable coffee cups', Sustainability Victoria website.
[27] KeepCup (date unknown) 'The KeepCup story', KeepCup website.
[28] J. Bengtsson (2018) *Reusable coffee cups life cycle assessment and benchmark*, Manly, Edge Environmental, p. 23.

Possible impossible: Identifying elements with light

Craig Johnson was only five years old in 1968, when a can of petrol in his backyard caught fire. His clothes burnt in seconds and he was rushed to hospital. Doctors worked for weeks to treat his burns, but nearly lost hope when a mysterious complication arose. Craig had begun to have 'violent convulsions' that his doctors could not explain.[29]

Luckily for Craig, doctors at the Children's Medical Research Foundation in Sydney had access to an atomic absorption spectrophotometer, a device patented by Melbourne CSIRO physicist Sir Alan Walsh in 1954.[30] The analysis revealed Craig had a serious magnesium deficiency from his burns—and while the condition may have been difficult to diagnose, it was simple to treat. After the missing magnesium was replaced, the convulsions ceased and Craig had an otherwise 'uneventful recovery'.[31]



Examples of emission and absorption spectra
Source: Adobe Stock

Before Walsh's breakthrough, laboratories often relied on flame emission spectrometry to test for the presence of elements like magnesium. This method involves heating a sample in a flame or furnace to extremely high temperatures (1,700–3,700 °C), which causes some metallic elements to emit light at specific wavelengths.[32] Each element produces its own unique emission spectrum, like a brightly coloured elemental 'fingerprint'.

Unfortunately, even these temperatures are insufficient for all but eight elements.[33] Walsh's insight was that a broader range of elements (more than sixty-five in total) could be detected by measuring which wavelengths of light are *absorbed* by a sample, rather than which wavelengths are emitted.[34]

The impact of atomic absorption spectroscopy is difficult to overstate. It has applications across fields as diverse as agriculture, mineral exploration and food analysis.[35] In 1998, a former Commonwealth Minister for Science remarked, 'I don't know if there is a single significant laboratory anywhere in the world that doesn't have an atomic absorption spectrophotometer'.[36]

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29 (1968) 'Answer to the puzzle of a burnt boy', *Sydney Morning Herald*, 14 September, p. 6.
30 P. Hannaford (2000) 'Alan Walsh 1916–1998', *Historical Records of Australian Science*, 13(2).
31 (1968) 'Answer to the puzzle of a burnt boy', op. cit.
32 R. Twyman (2005) 'Atomic emission spectrometry', *Encyclopedia of Analytical Science*, 2nd edition, p. 195.
33 A. McKay (1976) *Surprise and enterprise – fifty years of science for Australia*, Melbourne, A.E. Keating, p. 6.
34 ibid.
35 P. Hannaford (2000) op. cit.
36 ibid.

Possible impossible: Restoring lost hearing and vision

When Graeme Clark successfully implanted a bionic ear, he forever changed the lives of many who had lost their hearing or were never previously able to hear. Rod Saunders, the first recipient of the implant, had lost his hearing after a car accident and had adapted to life without it, but Clark's successful implant allowed him to hear again.[37]

Cochlear implant
Source: Adobe Stock

Building on research into nerves in the ear cavity from France and the United States, Clark, a Professor of Otolaryngology at the University of Melbourne, implanted the first device in 1978.[38] Clark differed from other researchers, believing that implant recipients should hear running speech, not just environmental sounds; that the implant should be multi-channel, rather than a single electrode; and be totally imbedded in the skull and activated by radio signals.[39] Instead of amplifying sounds like a traditional hearing aid, cochlear implants directly stimulate any functioning auditory nerves in the inner ear. Some of the difficulties the team were facing were solved during a trip to the beach where Clark, using a seashell and some grass came up with an idea for how to insert wires into the delicate cochlea.[40]

Professor Clark founded the Bionic Ear Institute in 1986 (the name was changed to the Bionic Institute in 2011).[41] The Australian Cochlear Implant has allowed 350,000 people in over 120 countries to hear again.[42]

Victorians are also leading the race to develop the first Bionic Eye. So far, seven patients including Dianne Ashworth have had devices implanted. Ms. Ashworth, the first to undergo surgery to implant the device, described the first time it was turned on:

> I was waiting, waiting … I had these goggles on [to track her eye movement] and I didn't know what to expect. I don't know if anyone did … Then all of a sudden, I could see a little flash. It was like a little splinter … then that turned into splotches of black and white … remember when the first big image came, I thought, 'wow'… I was ecstatic that it worked, but I was also so happy for the team. It was something I could give to them after all the work they'd done. That made me happier than seeing.[43]

Bionic eye research has focused on helping patients with retinitis pigmentosa—an umbrella term for many inherited retinal diseases—achieve what researchers call 'sense of vision'. A 'sense of vision' means little flashes of light which can help patients detect edges, outlines and movement, not detailed

[37] J. Epstein (1989) *The story of the bionic ear*, South Yarra, Hyland House, p. 16.
[38] ibid., p. 23.
[39] ibid., p. 40.
[40] ibid., p. 41.
[41] Bionics Institute (date unknown) 'Our History', Bionics institute website.
[42] ibid.
[43] K. Hagen (2012) 'And the blind shall see- thanks to the bionic eye', *The Age,* 31 August.

vision.[44] An electrode array is implanted between the two back layers of the eye (suprachoroidal location), a location chosen as the implantation site that is relatively easy, safe, stable and reliable.[45] The 2012 device implanted in three patients used an external plug to connect electrodes to lab equipment, so it could only be used in a laboratory setting. The updated device used in the 2014 trial is fully implantable and portable, allowing recipients to use it at home.[46]

Much of this research was completed by Bionic Vision Australia, a consortium of some of Australia's leading universities and research institutes which was funded by the Australian Research Council between 2010 and 2016. The consortium included the Bionics Institute and the Centre for Eye Research Australia and technologies that were developed are now being commercialised by Bionic Vision Technologies Ltd.[47] Professor Anthony Burkitt was awarded the 2019 Victoria Prize for Science and Innovation, in recognition of his work in developing a bionic eye.[48]

Possible impossible: Determining the age of the Budj Bim eel traps

With his 2014 book, *Dark Emu*, writer and researcher Bruce Pascoe popularised the notion that pre-colonial Aboriginal Australians cultivated plants and animals for food. He catalogues dozens of accounts of Aboriginal agriculture and aquaculture, drawn primarily from the writings and diaries of 19th-century European colonists. This challenged the prevalent colonial depiction of Aboriginal Australians as hunter-gatherers.[49]

Among his findings were historical records of aquaculture across Victoria's western region. He cites the pastoralist James Dawson's 1881 account:

> Eels are prized by the Aborigines as an article of food above all other fish. They are captured in great numbers by building stone barriers across rapid streams, and diverting the current through an opening into a funnel-mouthed basket pipe, three or four feet long, two inches in diameter, and closed at the lower end. When the streams extend over the marshes in time of flood, clay embankments, two to three feet high, and sometimes three to four hundred yards in length, are built across them, and the current is confined to narrow openings in which the pipe baskets are placed. The eels, proceeding down the stream in the beginning of the winter floods, go headforemost into the pipes, and do not attempt to turn back.[50]

The escaped convict, William Buckley, observed similar harvesting systems at Lake Condah in 1836.[51] However, it wasn't until the winter of 1977 that uncharacteristically heavy rains revealed to archaeologists what the traditional owners of the land—the Gunditjmara—already knew: that a sophisticated network of artificial drainage channels and holding ponds had existed near Lake

[44] (2019) 'The future of Australia's bionic eye', Centre for Eye Research Australia website.
[45] Hagen (2012) op. cit.
[46] Centre for Eye Research Australia (2019) 'The future of Australia's bionic eye', Centre for Eye Research Australia website; Centre for Eye Research Australia (2014) 'National investment in the bionic eye takes it from the lab to the real world', Centre for Eye Research Australia website.
[47] Bionic Vision Australia (date unknown) 'About BVA', Bionic Vision Australia website.
[48] Veski (date unknown) 'Professor Anthony Burkitt', Veski website.
[49] B. Pascoe (2014) *Dark emu – black seeds: agriculture or accident?*, Broome, Magabala Books.
[50] J. Dawson (1981) *Australian Aborigines*, Netley, Griffin Press Limited, p. 94. (Original work published 1881).
[51] Pascoe (2014) op. cit., p. 58.

Condah.[52] Researchers soon began to collaborate with the Gunditjmara to support cultural knowledge of the eel traps with physical evidence.

Professor Lesley Head conducted one of the earliest attempts to estimate the age of the traps at Lake Condah in 1989.[53] She was able to compare the locations of surviving traps to historic water levels at the lake, to deduce when the traps might have been in use. The main form of evidence she used to reconstruct the history of the basin was pollen found in the lake sediments.[54] Because changes to a local climate affect how organisms in that ecosystem grow and reproduce, palaeoecologists can use indirect evidence found in pollen, tree growth, charcoal and oxygen isotopes to look back in time.[55] Head estimated that the lowest remaining traps at Lake Condah were most likely operable about 2,000 years ago.[56]

Lake sediment core with laminations
Source: Phil Higuera

More recently, a group of researchers from Monash University, led by Professor Ian McNiven, have used radiocarbon dating technology to establish the age of the Muldoons Trap Complex in the Lake Condah region.[57] Radiocarbon dating methods make use of the predictable way in which the radioactive isotope carbon-14 decays. Like clockwork, half of the carbon-14 in a sample will decay every 5,730 years, while the amount of stable isotope carbon-12 remains constant. By measuring the ratio of carbon-14 to carbon-12 in a sample, and comparing it against known atmospheric ratios over time, archaeologists can estimate an object's age—even if there are no other excavated objects nearby to use for reference.[58]

This technology revealed that charcoal fragments taken from a channel feature at Muldoons Trap Complex were at least 6,600 years old.[59] This estimate was cited in the dossier nominating the Budj Bim cultural landscape for inclusion on the UNESCO World Heritage list in 2017.[60] In 2019, Budj Bim was accepted onto the list. As observed by Denis Rose, project manager for the Gunditj Mirring Traditional Owners Aboriginal Corporation, this places Budj Bim alongside other cultural icons such as the Pyramids at Giza, Stonehenge and the Acropolis.[61]

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[52] I. McNiven (2017) 'The detective work behind the Budj Bim eel traps World Heritage bid', *The Conversation*, 8 February.
[53] ibid.
[54] L. Head (1989) 'Using palaeoecology to date Aboriginal fishtraps at Lake Condah, Victoria', *Archaeology in Oceania*, 24, p. 110.
[55] Carleton College Science Education Resource Center (2016) 'Paleoecology: a window into the past', SERC website.
[56] Head (1989) op. cit., p. 110.
[57] I. McNiven et al. (2012) 'Dating Aboriginal stone-walled fish traps at Lake Condah, southeast Australia', *Journal of Archaeological Science*, 39(2).
[58] R. Wood (2012) 'Explainer: what is radiocarbon dating and how does it work?', *The Conversation*, 28 November.
[59] McNiven et al. (2012) op. cit., p. 268.
[60] Commonwealth Department of the Environment and Energy (2017) *Budj Bim cultural landscape world heritage nomination*, Canberra, Department of the Environment and Energy.
[61] M. Neal (2019) 'Ancient Indigenous aquaculture site Budj Bim added to UNESCO World Heritage list', *ABC News*, 6 July.

Possible impossible: Ordinary Victorians contributing to scientific discoveries

Baron Ferdinand von Muller
Photographer: J. W. Lindt
Source: State Library of Victoria
(identifier H37475/24)

Citizen science is the 'practice of public participation and collaboration in scientific research to increase scientific knowledge'.[62] Since the 1800s, Victorians have enthusiastically contributed to a variety of citizen science projects. The first government botanist and director of the Royal Botanic Gardens, Baron Ferdinand von Mueller, established a network of citizen plant collectors across the state, who added to a research collection of specimens.[63]

The Victorian National Parks Association's 'ReefWatch' is a marine citizen science program which has run four projects: the Great Victorian Fish Count, Adopt a Sponge, PlateWatch and ReefCam.[64]

Adopt a Sponge came about during the redevelopment of the Blairgowrie Pier. Pier diving company Dive 2U organised for volunteers from the Victorian dive community to save more than 5,000 sponges and ascidians (sea squirts) which were otherwise going to go to landfill.[65] In a project never before attempted on this scale, the crew devised a method to remove sponges from the pier's timber panels and glue them to new panels. The care given to the marine life and the success of the rehoming has given scientists and researchers hope that during future structure upgrades, marine life will be able to be maintained.[66] Other citizen science accomplishments coordinated by ReefWatch include:

- Gaining protection for the western blue groper after confirmed sightings in coastal waters; and
- Discovering never-seen or rarely-seen-in-Victoria fish species, including the spotted grubfish, silver dory, short-nosed boarfish and spiny anglerfish.[67]

[62] National Geographic (date unknown) 'Citizen Science', Resource Library, Encyclopedic Entry, National Geographic website.
[63] Arthur Rylah Institute for Environmental Research (date unknown) *Citizen science: You and nature*, Melbourne, Department of Environment, Land, Water and Planning.
[64] Victorian National Parks Association (date unknown) 'Reef Watch', VNPA website.
[65] Victorian National Parks Association (date unknown) 'Adopt a Sponge', VNPA website.
[66] ibid.
[67] Victorian National Parks Association (date unknown) 'Reef Watch', op. cit.

Possible impossible: Innovating in the age of COVID-19

Alpaca
Source: Freepik

In 2020, medical researchers across the world are in a race to develop a vaccine to stop the spread of COVID-19, but East Gippsland might be one of the only places on Earth where the research takes place in a paddock! A team of researchers from the Walter and Eliza Hall Institute in Melbourne are studying a herd of Bairnsdale alpacas that have been immunised with a deactivated protein fragment from the SARS-CoV-2 virus (this does not harm the alpacas).[68]

Animals in the Camelidae family (which includes alpacas, camels and llamas) have an unusual immune system which produces two types of antibodies. One type is similar to human antibodies, but the other is much smaller—only 10 nanometres across, just wider than a strand of DNA. These nanobodies can attach to narrow 'crevices' on the surface of the virus, neutralising it in ways a human antibody can't.[69]

Extracting and purifying the nanobodies won't be easy, nor will disguising them as human cells so our immune systems won't perceive them as threats. The researchers don't expect to be first out the gate with a functioning vaccine but, if they are successful, nanobody therapy could become a powerful tool in the fight against COVID-19.[70]

Researchers at the Doherty Institute (named after Victoria's own Nobel Prize winner, Peter Doherty) are also assisting with the testing and treatment of COVID-19, including developing a saliva test.[71] Although a swab test is more accurate and is preferred, there are instances when saliva testing is a useful alternative—for example, when there are limited staff to collect swabs or a high number of tests required; when swabs and personal protective equipment (PPE) are in short supply; or when a nasal swab is difficult to conduct, such as on a child.[72] The Doherty Institute recently validated a COVID-19 nasal swab test developed by biotech company GeneWorks. This test will be incredibly useful in tracking new cases, as results can be processed in just 20 minutes![73] The Doherty Institute, with the University of Melbourne and the Royal Melbourne Hospital, is also involved in developing a vaccine for COVID-10 and was the first to grow COVID-19 in a laboratory outside of China.[74]

[68] Australian Nuclear Science and Technology Organisation (2020) 'Unique immune system of the alpaca being used in COVID-19 research', ANSTO website.
[69] L. Mannix (2020) 'Alpacas provide new hope for a COVID-19 cure', *The Age*, 10 August.
[70] ibid.
[71] Doherty Institute (2020) *Use of saliva as a diagnostic specimen for COVID-19*, media release, 25 June.
[72] D. Williamson, A. Cheng & S. Lewin (2020) 'Explainer: what's the new coronavirus saliva test, and how does it work?', *The Conversation,* 3 July.
[73] Doherty Institute (2020) ''Near-care' test that can detect COVID-19 in 20 minutes validated, Doherty Institute website.
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