Memory and Mind

Pam McKinlay
Editor

Memory and Mind

Pam McKinlay

INTRODUCTION – Art+Memory Project 2024

Memory and Mind is a collaborative interdisciplinary project, in which artists and scientists in conversation look at how the idea of memory is understood within different frameworks. Sentient beings, a term that is increasingly understood as at times applicable within and between species, generate and experience shifts in synaptic energy that form, erase and recreate flows of information in what we call memory. The artworks in Memory and Mind explore how changes of state have left their mark across the physiological, biochemical and geological fabric of the planet, from neural networks to earth and stone, from earth systems to living biology. Against this backdrop, the members of the Art+Science project 2024 explored the connections of what it is to live in a world in which being human is not the most important thing. The following essay interweaves the diverse ideas initially presented at the project's inception with the works that emerged from the process of conversation, creative discovery and reflection.

OUR GOLDILOCKS ZONE Planet Earth

Nature is a system in constant flux that creates and leaves traces with change. These traces become memories of those changes. Markers of past events recorded in wood and stone, or concentrated in various distributions of gaseous strata, can be measured and interpreted in our present.

Our planet's geology provides a record of earth systems and processes as it moves through shifts and feedback loops, of weather events, and occasionally even imprints of individual animal journeys along trails. Fossilised moa footprints were discovered and excavated at Kyeburn, Aotearoa New Zealand, in 2022 and are now housed at Tūhura Otago Museum.

Analogues of these footprints will be on display as well as a behind the scenes look at the conservation measures we take of cultural objects to ensure their preservation and ongoing contribution to testimony of shared memories in history, science and culture.

Gradual or traumatic geological transitions in stone and ice can be deciphered from sampled sedimentary cores. The cores

are a record of creatures great and small as they lived and died and the tectonic forces that then reshape our planet. Research on cores from the West Coast of Te Wai Pounamu the South Island of New Zealand examine Earth's geological history over millions of years and its relation to climate change in the Southern Alps. Faye Nelson's research looks at the paleomagnetic memory of events over the last 2 million years, including the time it takes Earth's magnetic field to "switch" poles, and the sensitivity of the Southern Alps to Glacial/Interglacial climate cycles. Physical memories of the Earth's molten core are revealed in ash and rocks thrown up from volcanic eruptions. Rachael Baxter's studies of microscopic shards of glass from the Hunga Tonga eruption of 2023 reveal moments in time of the conditions, heat and explosive power of the eruption event, providing physical memories of the formation of this undersea volcano.

TALKING AMONGST THEMSELVES

Plants represent most of life on Earth. The ability of plants to photosynthesise provides us with an essential bio-service of oxygen production, which is of overarching importance to human survival but of little consequence to plants. What can we learn from the relationships of other interconnected life forms in our wider environment? How do plants communicate with each other and across time?

Plants exhibit forms of learning, communication, defence and adaptation. They can use chemical signals above and below ground and symbiotic mycorrhizal networks below ground which play an important role in plant communication systems. Plants have their own means of keeping track of time, using temperature, such as coldness clocks to sense cyclical changes, and sunlight hours to determine seasons and flowering periods.[1] We see the accumulations of annual change in the residue of the seasonal shifts in tree rings. Trees grow outward, with each ring representing a year of growth, with thicker rings indicating favourable years for plant growth. In *How to Read a Tree,* Tristran Gooley gives examples of how the study of tree rings (dendrology) can be used to study climate, date archaeological discoveries, and analyse solar cycles. Changes in width in these tree rings can indicate anomalous years, such as extreme weather events.

Amid the growing and serious challenges of a changing climate, one of the most pressing questions for plant science is how the world can produce enough food for a growing population. Stresses caused by climate change and pollutants are predicted to diminish agricultural yields which feed the Earth's global populations. One main source of abiotic stress for crop plants is salt stress, due to uneven rainfall and inundation of coastal lands with seawater. This is the area of exploration in the preparation of botanical pigments and resulting silverpoint artworks by Katharine Allard in conversation with botanist David Burritt.

The interconnectedness of humans, plants and the environment are also emphasised in a collaboration by Becky Cameron with Heidi Dungey, recognizing and valuing the contributions of plants to urban

environments. The presence of plants in urban areas is crucial to maintaining balance and mitigating CO_2 emissions, yet the amount of vegetation in cities is often minimal, leading to disadvantages for humans, including overheating and increased pollution. Using roots as a metaphor for memory and whakapapa, Becky's cyanotypes explore the importance of intricate relationships between trees and ecological dynamics.

Two collaborative works by Gabby Malpas in collaboration with Susan Wardell and Janice Lord remember the loss of trees and habitat in an area of Central Otago since colonisation in a memorialisation of species now missing from the landscape, and also consider how the landscape retains impressions of trees that once were, even long after they have been removed.

Another piece by the Malpas and Wardell explores communal food memories as an aspect of community healing in the aftermath of the Christchurch earthquakes of 2011, when great swathes of the city were abandoned as Red Zones. Here in the absence of humans the gardens continued to grow and neighbourhood fruit trees are reminders of backyards that once were, and sites of homes long abandoned to the plants.

SENSORIUM

Animals rely on their sensory apparatus to make sense of their environment and communicate with others. Memory is embodied within organic connectomes, representing the neural networks underlying memory formation. Evolutionary pressures which shape genes are driven in context-dependent ways, influencing our behaviour and adaptation. Not only has our world been changing for millennia, but so have we within it. The human species lives in a narrow zone of planetary boundaries which describe some of the world's complex processes.[2] The experiences that shape our lives also shape our memories and shape and reshape the physical structures within our brains. Our perceptions then shape our *consciousness*.

For most of our species' time on earth, we have marked time by recognition of solar markers to understand seasonal change. In the past millennium, humans have lived through an accelerated pace of denaturation and through the process of urbanisation and removal of countryside from towns, we have become removed from environmental and lunisolar cues.[3] On top of this, notions of personal ownership have been at odds with traditions of the commons (whether land, air or water). Acts of enclosure across the globe have involved acquisitive actions for individuals and large conglomerates while extracting from the commons, contrasting with Indigenous cultural perspectives of interconnectedness and mutual responsibility.[4]

We can't see the forest when it is gone, clear-felled to make way for *growth* in the name of *progress*. We can't find the wilds of the forest when they are sidelined in the landscape by monocropping plantation species and native remnants removed from everyday language. Trees often have multiple names across cultures, highlighting the cultural significance and diverse meanings attributed to them.[5] Latin, the language used by Carolus Linnæus to identify species, was at that time shared by international communities. It is little used today and is unintelligible to most of the world's population. What's in a name is important because cultural traditions encompass knowledge in the way that they name things, for example, the tree *mahoe*. The name in te reo Māori, made up of "mā" and "hoe," also gives us clues as to its shape (paddle-shaped leaves – hoe) and traditional stories and uses.[6]

Human connections to forests were explored in the collective works of *Honohono* by Creative Impact Lab Ōtepoti Dunedin[7] of 2023-24. These digital works explore the losses caused by deforestation and the threats of climate change, through an Indigenous lens and the notion of sharing, wero and kiatiakitanga. The sharing of healing practices, interconnectedness and environmental responsibilities is now more than ever important in engaging community-driven processes to address equitable outcomes in adaptation to climate change.

MIND BODY

We are embodied. Where and how do we think and how do we feel? What is the mind-body connection? The brain is a system of neural connections, made up of collections of nerve bodies capable of computational processes. These don't only appear in the brain; for example, the neurotransmitter serotonin is produced by a collection of cells in the gut, as well as the brain stem. Much of our perception processing happens without our being aware of it. Despite our brain's constant processing of stimuli, most of our experience remains outside of conscious awareness as we navigate the unknown in uncontrolled events. The computational processes that run our bodies are called autonomic. Comic actor and auteur, Ken Campbell, put it succinctly when he said, "You are just one of the things your brain does, most of the time your brain is really in charge of you."[8]

In the construct called "theory of mind" the mind is understood as a product of all these processes within a social context that gives us a fluid view of our actions and responsibilities, giving a sense of agency and allowing us to communicate with others about rewards and dangers. We are never alone, not even in our minds. From our emotional responses to events, we create ideas of cause and effect often in connection to shared experiences. We don't just think about the world, we think about how it could be different, using recollections from the past projected onto future scenarios in a process called imagination. This requires the qualities we call empathy, curiosity and creativity.

In a series of paintings, and video, Sarah Shackleton in collaboration with Dave Bilkey explored the "where" tied to the notion of "when" of episodic memory in place cells in the hippocampus. Our present can be described as a bubble around us, filled with traces of our past experiences. A prevalent model of thinking is that we are individual *selves,* but if we look in the brain the *self* is nowhere to be seen. We are an elaborate illusion of histories of our continuous *selves,* shaped by narratives. Carlo Rovelli says, "We are stories, contained within the twenty complicated centimetres behind our eyes, lines drawn by traces left by the (re)mingling together of things in the world."[9] He goes on to say, "Our consciousness is unified by something (time) which we conventionally think of in terms as an order of time (past, present, future) with traces left by past experiences which orient us towards predicting future events." But, he asks, "Do we exist in time, or does time exist in us?"[10]

HOMO NARRANS

In Western classical rhetoric, *Memoria* was the term for aspects involving memory. From the Latin, *Memoria* can be translated as "memory". It was one of five canons in classical rhetoric concerned with the crafting and delivery of speeches and prose. Transference of memory was traditionally done by passing knowledge orally from person to person (story telling). The transference of memory and knowledge was also passed through creative acts such as carving, art and music. Traditional tattoo or moko transfers important genealogical connections. Heramaahina Eketone with Stu and Marama McDonald draw on the narrative that the first moko was the result of deep emotional and psychological trauma transferred from Papa to Ruaumoko and his reaction to that trauma.

The function of scientific research and exploration is to further knowledge. We are encouraged to explore, discover and share old and new knowledge of the world around us, as in the three baskets of knowledge in te ao Māori, known as Ngā Kete o te Wānanga. There are various traditions of this story with the protagonist (often Tane, sometimes Tāwhaki) climbing to the heavens to retrieve three baskets, or kete, of knowledge: te kete-tuatea (basket of light), te kete-tuauri (basket of darkness) and te kete-aronui (basket of pursuit). Renowned Māori scholar Māori Marsden has suggested that "the basket of light is present knowledge, the basket of darkness things unknown, and the basket of pursuit is the knowledge humans currently seek."[11] This story is represented in a tohu or design called *poutama* (stairway to heaven). Poutama has significant meaning with each step symbolising levels of attainment. Science communicator and teaching fellow Steve Ting's weaving of *Poutama* embodies not only the tohu or design but his own weaving journey.

OF WHALES AND BEES

Much of our study of animals in post-colonial western science has been gendered and based on the morals and the influence of Christianity and trade relationships. These influences often relegated non-human animals to have value only insofar as they could be commodified for human use, such as the use of whale oil in the first global oil rush and the early domestication and commodification of bees for honey production. In *Flight Behaviour,* Barbara Kingsolver writes that an animal is the sum of its behaviours, its community dynamics, and not just a physical body.[12] We have ignored much of the ways that we once understood the interconnectedness of the world, and therefore our understanding of animal perception and cognition.

Animals and plants are governed by the light and dark. In our everyday lives we can mark the passage of time by observing the positions of our star, moon and the Milky Way (our galaxy) relative to our position on earth. From these observations we can get a view onto the rest of the extra-terrestrial universe with the assistance of ocular, radio and gravitational lenses. The expanding space-scape reveals the universe's memories of births and deaths of interstellar systems and the evolution of small planetary bodies including in our own solar system. Early morning star gazers are sometimes rewarded for their dark-sky vigilance with sights of colourful aurora which are indicators of solar flares, flung deep into space interacting with the magnetosphere around our planet.

Creatures living far underwater are deeply affected by the aftermath of these solar storms. For example, sperm whales navigate the ocean using magnetic landmarks, unseeable by ourselves but necessary to marine life's navigation and perception.[13] Researchers propose that these magnetic features act as "thought barriers" to sperm whales. Strong solar storms can alter these invisible magnetic topographies, dissolving undersea mountain ranges and canyons, altering the whales' perception of the form of the sea floor and potentially disorienting them, leading to whale strandings. Vincent Chevillon travelled to New Zealand from France to investigate whale remains from the Strasbourg Museum most likely stranded on Farewell Spit, a sand strip that curves around Golden Bay at the northern end of Te Waipounamu (the South Island, New Zealand). The Department of Conservation (DOC) has been recording cetacean stranding data for the past 50 years, noting the location, date, space and number of individuals affected. [14] Working with DOC bio-diversity ranger Jim Fyfe and palaeontologist Sophie White, Vincent visited many of these sites. He shares a selection of these locations with us in the exhibition. The absence of the whales in the photographs is a poignant reminder of loss of life.

The family of bees serve as bioindicators of environmental conditions and ecosystem health, reflecting the impact of human actions on the natural world. They are another example of a creature with a wildly different sensory apparatus for perceiving the world. Bee memories are attached to emotional experiences, such as finding food or escaping danger.

Their brains are wired for cognition, exploration, prediction and efficient information storage. Although bees perceive the world through sound, touch, smell, and sight these are in ways that differ from humans. Bee vision is sensitive to ultraviolet light, and they have complex associations between scents and other sensory stimuli as they rapidly navigate on the wing to find nectar and pollen in a competitive environment, while avoiding predation. On top of these challenges, many flowers present complex floral-box puzzles for a bee to perform in order that the bee pollinates the flower in return for the sweet rewards of nectar. Bees possess cognitive maps and have complex memories of time and location, and they have the ability to learn and predict future events. Understanding bees' minds sheds light on their cognitive abilities and should inform conservation efforts to protect bee populations and the ecosystems they support. While the Western honeybee is not under threat due to domestication, other solitary species are at risk. Kueneman et al (2024) point out that the rallying cry to save the honeybee is to bee diversity as saving the chicken is to bird conservation.[15]

Not all bees are social bees, from the *Apis* family familiar to many as the honeybee. Of the estimated 20,000 species of bees, less than 10 percent are social, living in colonies with a highly defined and complex social order, presided over by a queen. More than 90 percent of bees are solitary bees, typically producing neither honey nor beeswax. In the artworks and site documentation by Pam McKinlay working with Jenny Jandt and Connal McLean, we learn that New Zealand has 28 species of native bee which are solitary bees. To reiterate, these are not social bees living in hives but are ground nesting or stem nesting solitary bees. *Ngaro huruhuru*, or native bees, have developed a broad range of sophisticated cognitive behaviours that facilitate learning the location of their nest site and navigating their environment while foraging. Habitat fragmentation and pesticide use associated with industrialised agriculture also pose threats to bee populations, particularly solitary pollinators.

CREATE, RECALL, RESET

In 2003 a project was initiated to map a mouse brain down to the cellular level. The Allen Mouse and Human Brain Atlases, sometimes called the Allen Brain Observatory, now contains an open-source reference atlas in comparative anatomy of sagittal planes for mice and human brains in developing embryos and adult specimens including a 3D reference space available as an online interactive viewer. This was the source of inspiration for Pam McKinlay's "Mouse Brain" sculpture.

Memory is story. Each time we bring a memory to mind, we reconstruct it. We take what we have in storage as a starting point and we piece together the event, often filling in the gaps as we go. That recollection – gap fillers included – then "sets" and becomes the memory in storage until the next retrieval, and so on. These recollections inform the way we constantly revisit and reinvent the past. The phrase "melting moments" hints at this transient nature of memory

or the process of memory formation and recall which Rachel Zajac likens to a jelly, able to be melted and reset but at each iteration of the jelly the memory is altered, distorted or degraded. Memories tend to be overwritten and gradually replaced upon subsequent recalls. This concept is explored in an interactive work by Manu Berry, Rachel Zajac and Michelle Elvy, with Cilla McQueen. In their installation, they explore, with visual and poetic representations, how memory is overlaid with each recollection, and how this informs the very grounding ideas of who we are.

COMING TO OUR SENSES - Smell

Smell is a chemical sense that is one of the oldest senses in terms of human evolution. Your nose can detect a vast number of odours due to over 400 types of scent receptors. These receptors, located in the olfactory epithelium, send signals to the olfactory bulb in the brain's temporal lobe, which is closely associated with emotions and memory. Smell triggers potent physical and mental responses due to its direct connection to these brain regions. Pam McKinlay reflects on Yusuf Cakmak's research on the direct perception route of volatile compounds taken from the olfactory bulb to the entorhinal cortex, which is the major interface between the hippocampus, a swan-like or sea-horse-like structure at the centre of our brain, and the trisynaptic neural system, which aids learning and remembering episodes (episodic memory).

The brain normally produces five different types of brain waves at different times. Of these, Gamma waves, the fastest brain oscillations, are associated with perception, consciousness and memory formation. Disturbances in gamma wave rhythms is linked to neuronal diversity and alterations in dynamic neural behaviour or structure. The resulting shifts in connectivity can affect memory and decision making such as in neuropsychiatric disorders. Introducing gamma oscillations from external sources, such as light and sound therapy, has potential to help mitigate various brain conditions, such as Alzheimer's disease and others.[16]

Research by Yusuf Cakmak builds on the relationships shown in the neural circuits between the biological sensory portals such as smell/nose, and the ear skin nerves with the olfactory neural network where non-invasive electrostimulation at a controlled frequency to the ear or nose interacts with the olfactory system and its extended connections with the hippocampus. This has the potential to create a non-invasive therapy, with the potential to improve memory formation memory storage, retrieval and loss, particularly in the hippocampus. This research is particularly relevant in the context of early stage dementia, where one of the first signs of memory loss occurs simultaneously with a weakening of the sense of smell. In response, Christine Keller worked with imagery of ears, noses and the hippocampus (a brain region involved in memory) to explore memory and sensory perception, weaving on a Jacquard loom.

Our olfactory memories are contextual. In multidisciplinary neuroscience studies, students are researching the interactions of olfactory memories, odour thresholds and perceptions categorised by language associations. Why are we transported or triggered emotionally by sound and smell associations from our memories – a karanga, a sonata, the smell of rain on hot earth? E M Davidson explores memory associations through poetic arrangement of words and photographs.

For some people a whiff of smoke out of doors will transport them back to pleasant memories of a family barbecue or campfire. For those caught up in devastating forest fires, this will create an adrenaline rush as they search for the source of the smoke. In years to come, as we are hit with increasing disasters, Pam McKinlay asks what will climate change smell like to you?

FUTURE MEMORIES

From the earliest neuro-anatomical mapping of the brain's neurons to cellular networks of connectomes which embody our memories, to the neural networks we are creating in AI, our memories define and will continuously re-define us and our behaviours. By 2041 we will see evidence of deep (machine) learning processes exhibiting continuous, dynamic and predictive associative capabilities. These developments raise new and often alarming questions about the nature of consciousness and the distinctions between an embodied person and generative AI, built on our collective memories. What is at the centre of AI beyond its function? AI is built back from purpose, not built forward from something that is within an ecological system. What is an AI rock or bee? And what happens when the power goes off?

Our brains are not ours alone; we are a node in a social organism entwined within our cultures which have a great influence on the stories we tell ourselves about our *selves,* and which affect our ways of being. Throughout this essay we have explored what we can learn from the more than human world of sensory perception, and reflected on our understandings of ourselves as human. Consciousness encompasses the capacity to feel, perceive and respond to stimuli. Our memories are the way our brain learns involving action, reaction, perception and adaptive behaviours with emotions playing a significant role in the shaping our responses and behaviours.

Pam McKinlay (Tangata Tiriti) has a background in applied science and history of art. As an artist she works in collaboration with other artists locally and nationally, in community outreach and education projects around the theme of climate change, sustainability and biodiversity. Her practice is concerned with the connections between new ideas and deep knowledge – the process and practice of making and the process and practice of connecting with the communities in which she lives. She is the convenor and curator of the Art+Science project based in Ōtepoti Dunedin, New Zealand.

1 Tristan Gooley, *How to Read a Tree*, (Sceptre, 2023) 214.

2 Stockholm Resilience Centre, Planetary Boundaries, https://www.stockholmresilience.org/research/ planetary-boundaries/the-nine-planetary-boundaries.html

3 Robert Hannah, *Time in Antiquity*, (Routledge 2009), 120-121.

4 Tyson Yunkaporta, *Right Story, Wrong Story: Adventure in Indigenous Thinking*, (Text Publishing, 2023), 85.

5 Tristan Gooley, 4.

6 Te mara reo, The language garden, https://www.temarareo.org/TMR-Mahoe.html

7 *Honohono* is a collection of works by artists in the Creative Impact Lab Ōtepoti Dunedin (2023), a Leonardo international exchange supported by the U.S. Embassy in Wellington and hosted by Tūhura Otago Museum.

8 Ken Campbell in *Brainspotting*, BBC4, Investigates Consciousness, the Self and the Mind.

9 Carlo Rovelli, *The Order of Time* (Penguin2019) 163.

10 Carlo Rovelli, *The Order of Time* (Penguin2019) 2.

11 Ranginui as knowledge and life, Te Ara from Elsden Best, https://teara.govt.nz/en/ranginui-the-sky/page-2

12 Barbara Kingsolver, *Flight Behaviour*, (Harper Collins, 2012) 317.

13 Rebecca Giggs, *Fathoms: The World In The Whale*, (Scribe, 2020), 206- 207.

14 Vincent Chevillon, "What Grows On Whale Remains?" *Scope (Art&Design)* 24, 2023, 98 https://doi.org/10.34074/scop.1024022

15 Jordan G Kueneman, Cassidy N Dobler, Bryan N Danforth, "Harnessing community science to conserve and study ground-nesting bee aggregations," *Frontiers in Ecology and Evolution*, 11, 2024, DOI=10.3389/fevo.2023.1347447, https://www.frontiersin.org/articles/10.3389/fevo.2023.1347447

16 *Allens Brain Map*, https://portal.brain-map.org/

Memory + Mind

Dunedin Community Gallery
26 Princes Street, Dunedin

8-20 JULY, 2024
Daily: 10am-3pm

Memory and Mind

Curated by Pam McKinlay and Katharine Allard

Kane Fleury, Shannah Rhynard-Geil, Sophie White, Locke Unhold, Paulina Barry
Faye Nelson
Rachael Baxter
David J Burritt, Katharine Allard
Heidi Dungey, Becky Cameron
Janice Lord, Susan Wardell, Gabby Malpas
Susan Wardell, Gabby Malpas
Paulina Barry, Fiona Clements, Craig Cliff, Virginia M Gautusa, Savannah Kerekere, Pam McKinlay, Aislinn Mirsch, Ellen Murray, Isaiah Okeroa, Hayley Walmsley
David Bilkey, Sarah Shackleton
Stu and Marama McDonald, Heramaahina Eketone
Steve Ting
Sophie White, Vincent Chevillon
Jenny Jandt, Connal McLean, Pam McKinlay
Pam McKinlay
Rachel Zajac, Manu Berry, Michelle Elvy
Yusuf Cakmak, Christine Keller, E M Davidson, Pam McKinlay

8 – 20 July, 2024
Dunedin Community Gallery
NZ (Int.) Nano-Science Festival

Moa Footprints

14

Kane Fleury
Shannah Rhynard-Geil
Sophie White
Locke Unhold
Paulina Barry

2019 was an incredible year for footprint research in Aotearoa. A tractor driver by the name of Michael Johnston had discovered a moa trackway in the Kyeburn River. With the help from Tūhura Otago Museum, the University of Otago's Department of Geology, Kāti Huirapa Rūnaka ki Puketeraki and Rūnaka o Ōtākou we diverted the river and excavated 6 of the 8 footprints discovered.

Once these footprints had arrived at the museum a slow process, under controlled conditions observed by the conservator (Shannah Rhynard-Geil) was undertaken to dry the clay-based footprints and the scientific team got to work decoding the secrets of the footprints to understand the history, significance and movement characteristics of the moa that left those footprints.

It took 5 years to learn that these footprints were approximately 3.6 million years old. It was made by a moa from a relative of the heavy-footed moa *(Pachyornis spp.)* that was 85 kg and was traveling at a speed of 2.6 kmh−1. The entire trackway took less than 3 seconds to make. On the clay slab in the 3D imagery taken we discovered another footprint left by a second kind of moa that was only left as a faint impression. This footprint was considerably bigger than the trackway and this was made by a relative to the South Island Giant moa *(Dinornis spp.)*. These footprints are the second oldest moa fossils in existence and the oldest that can be identified reliably. This is the best evidence that exists showing that by 3.6MYA some species of moa had reached their enigmatic size.

This entire project has captured the imagination of the world, making this a truly unique fossil project that has incredible public enthusiasm behind it.

Now that the research is complete the team turned their minds to jacketing the prints and have been working with Sophie White from Otago University Geology Department and Locke Unhold from the Otago Polytechnic. They have been creating imitation footprints from clay to test different methods for the long-term preservation of these unique treasures to trial methods of making plaster jackets that will ensure that the clay blocks containing the footprints last several more lifetimes. Once jacketed they will go on display at Tūhura Otago Museum near the incredible moa skeletons already on display.

Illustration by Paulina Barry.

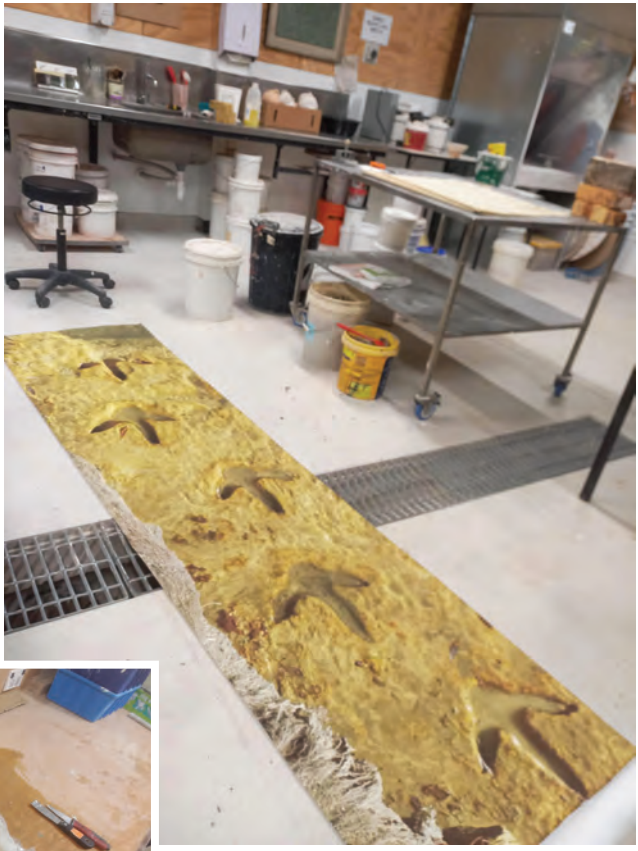
Ewan Fordyce and Marcus Richards extracting the footprints.
Photograph: Ian Griffin.

Michael Johnston and a moa footprint.

Paulina Barry is from the Puget Sound, now based in Dunedin, Aotearoa New Zealand. Her works are place and community-based, focusing on bio-heritage and restoration of the human/nature connection.

Kane Fleury is of Te Ātiawa (Taranaki) descent and works as the Natural Science Curator at Tūhura Otago Museum. He is passionate about all things in the natural world and the human interactions with these. He is particularly fond of moa and pondering the fates of extinct animals.

Shannah Rhynard-Geil trained as an Objects Conservator at Durham University and is currently the Conservation Manager at Tūhura Otago Museum, specializing in the care and conservation of archaeological and social history collections. Natural Science is a new field for Shannah, but she is enjoying applying her conservation background to large objects like the moa footprints and assisting in the investigation of their story.

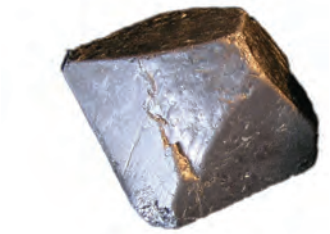


Sophie White works as the Palaeontology Lab manager and collections technician at the University of Otago Department of Geology, with ancestral fossil whales from the limestone valleys of the Waitaki. With a background in landscape archaeology, whale strandings and recoveries, natural materials and the making of taonga tūturu, Sophie (Te Ātiawa, Manukorihi) also works around Te Waipounamu with makers and practitioners exploring traditional pathways and resources with communities.

Locke Jean-Luc Unhold is the technical teacher and Glaze Technology lecturer at the Dunedin School of Art. He has a deep passion for the intersections of art and science, utilising geology and chemistry within his craft practice. His works range from colourful, cartoon-like mugs to sculptural eldritch creations. He is currently undertaking his MVA at the Dunedin School of Art.

Memories of the geologic past

Faye Nelson



Magnetic memory can refer to storage of data on magnetised media, or magnetic remanence – natural storage of magnetisation. Both these magnetic memories rely on quantum mechanical properties of electrons within ferromagnetic minerals. Magnetic remanence that retains a record of Earth's past magnetic field (the basis of my field, paleomagnetism) is an example of rate-independent hysteresis: there is persistent memory of the past magnetism after the transient magnetism has ceased to exist.

I use ferromagnetic minerals, such as magnetite (Fe_3O_4), to study the memory of Earth's magnetic field, including past magnetic pole reversals. These records can be tied to the geologic timescale and used to provide chronology. I also use the physical properties of the magnetic recorder minerals as proxies, or clues, about past climate and environment. This magnetic memory contributes to a collective record of paleoclimate – what happened where, and when – and provides an opportunity to reflect on events that predate human memory, hopefully prompting good future decisions.

Hysteresis, or persistent memory, is also found in climate and other environmental systems. Jeltsch-Thommes et al[1] found that it is far more effective to not emit carbon than it is to remove carbon from the system because of memory (hysteresis) in the system. We cannot assume climate systems will forget as fast as they react.

1 Aurich Jeltsch-Thömmes, Thomas F. Stocker, and Fortunat Joos. "Hysteresis of the Earth system under positive and negative CO2 emissions." *Environmental Research Letters* 15.12 (2020): 124026.

Magnetic memory

Faye Nelson

Marine sediments are cored or drilled using drill pipes off research vessels. These cores are then subsampled for paleomagnetic research, using either plastic cubes or plastic u-channels. These subsamples are magnetically "cleaned", or demagnetised, by being subjected to an alternating electric current in a low-field environment, peeling off successive layers of "soft" memories to reveal the magnetic memory locked-in when the sediment settled on the sea floor. Some years ago, an experimental glass u-channel was commissioned to allow thermal demagnetisation of marine sediments as well (heat and plastic don't mix). The experiment failed; however, I have repurposed the glass u-channel for a synthetic sedimentary record.

Recently I started experimenting with synthetic core records as a geo-education tool. Both kinetic sand (beach sand, cornstarch, and baby oil in a 5-3-1 ratio) and magnetite sand (colloquially known as black sand) are incredibly fun to touch and manipulate. The black sand from the Arrow River is part of the Earth system which carries terrestrial minerals from the Southern Alps to the oceans. The alternating light and dark layers in this piece represent the interglacial and glacial periods, respectively, or the normal and reversed magnetic polarity chrons of the Magnetic Polarity Time Scale.

Faye Nelson graduated from the University of Otago with a PhD in Geology in 2011. Faye provides training and support for research in the Paleomagnetic Research Facility.

Ashen memories: fire frozen in time

22

Rachael Baxter

Rachael Baxter is a PhD student at the Geology Department, at the University of Otago.

I study volcanoes and the rocks and ash created by both recent and ancient eruptions. In geology we work with the time capsules of our planets' stories, the rocks which hold the oldest memories and from these we can unravel the stories of shifting times on our planet, both sudden and gradual changes.

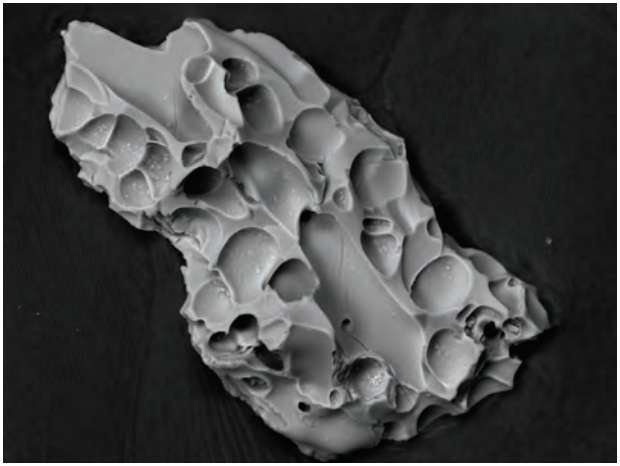
In studying geology, I get to be in awe of the natural world around me, constantly blending my scientific training to understand the geological history around me, with my artistic affinity to share with others the awe-inspiring places, shapes, rocks, colours, textures, and glass particles I study, and try to communicate the stories I learn as vividly as they form for me through scientific study.

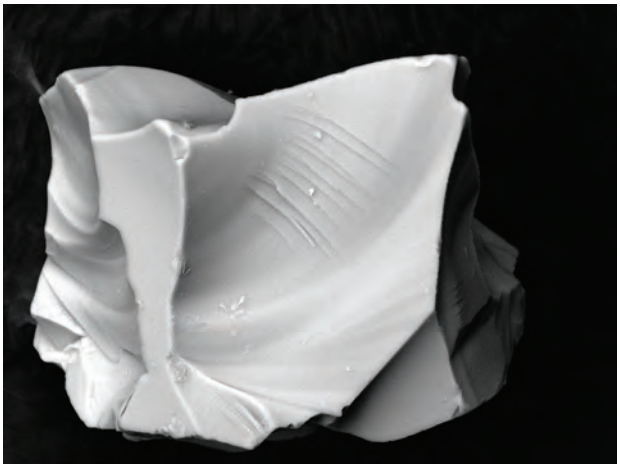
There are two key aspects of volcanoes that I study. I work to uncover the architecture of volcanic plumbing systems, why these are arranged the way they are, and how magma moves through this system before eruption. I also study what happens during an eruption by analysing glass volcanic ash grains. Using these tiny glass fragments, we try to interpret what drives some of these violent explosions and the sequence of events leading up to these far-reaching events.

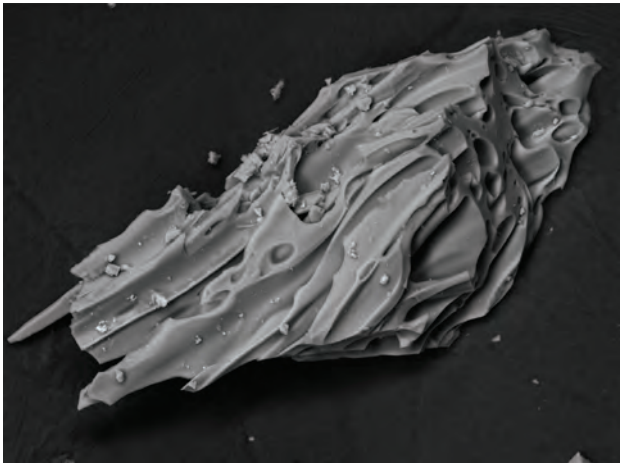
Volcanic ash particles are made of glass, which was magma frozen and fragmented during volcanic explosions. These ash grains capture and hold the memory of what processes occur during a volcanic eruption.

These images of tiny ash particles were captured using a Scanning Electron Microscope (SEM), allowing us to see micro-scale details of these glass shards. With images like these, we study the shape, surface texture and fracture patterns on volcanic ash particles from recent and ancient events, to understand what processes drive eruptions.

These images compare a few ash grains from the subaerial 1883 Krakatau eruption in Indonesia (top), the deep submarine 2012 Havre eruption on the Kermadec Arc (bottom), and the 2022 Hunga Tonga eruption (middle), a shallow submarine eruption within the Kingdom of Tonga which broke many records and challenges how we think about how such drastic eruptions can occur.





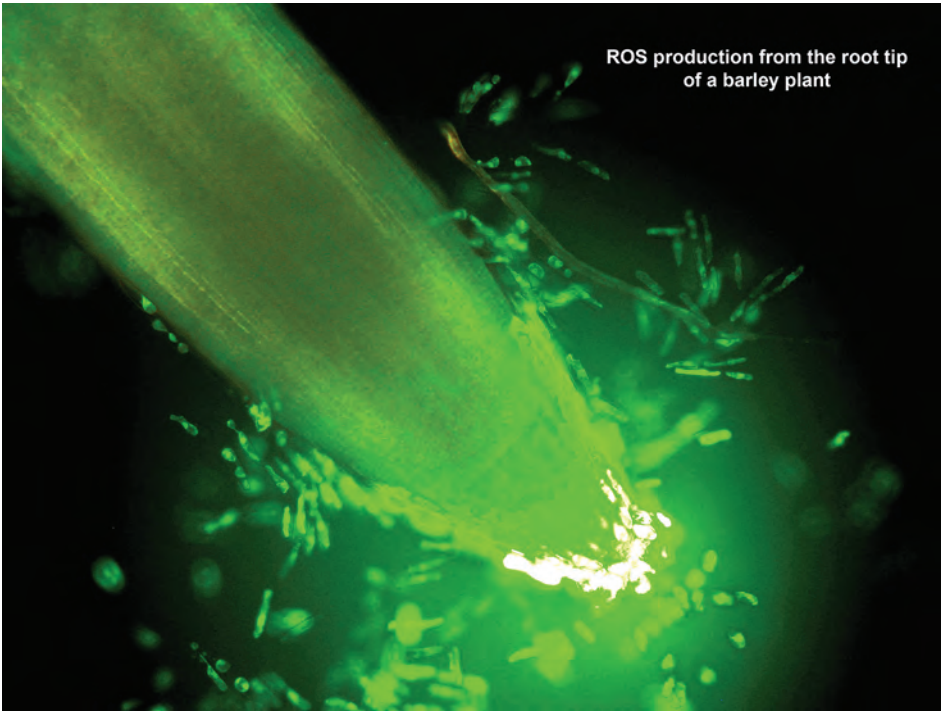


Plant Stress

David J Burritt

My research is focused on answering fundamental questions associated with how organisms survive under environmental stress and when exposed to toxins and other pollutants, both increasing global problems. One of my main areas of interest is the role reactive oxygen species (ROS) play in stress responses. While oxygen is important for life is can also be harmful, as some forms of oxygen are highly reactive. ROS are small highly reactive oxygen containing molecules formed as a by-product of the normal metabolism of oxygen in cells. However, under conditions of stress, which can be caused by pollutants or adverse environmental conditions, ROS levels can increase past the point that they can be neutralized. Oxidative damage occurs and an organism is said to be under oxidative stress. I investigate the importance of ROS production and oxidative stress in plants and other organisms exposed to pollutants and a range of other environmental stressors. Other related research areas include investigating and developing tissue culture techniques that can be used to efficiently clone commercially important plants and to store valuable germplasm at ultra-low temperatures, using a technique called cryopreservation. Plants and seaweeds (macroalgae) contain a wide range of bioactive molecules of potential valuable to the food, wine and pharmaceutical industries. I also investigate effective ways of extracting these bioactive molecules and the ability of these molecules to improve the quality of foods and to protect human cells from stress-induced damage.

David J Burritt
Katharine Allard



Reactive Oxygen Species (bright green fluorescence)
produced from the root tip of a Barley seedling under stress.

Associate Professor **David J Burritt's** research is focused on answering fundamental questions associated with how organisms survive under environmental stress and when exposed to toxins and other pollutants, both increasing global problems.

Katharine Allard

Planting Memory

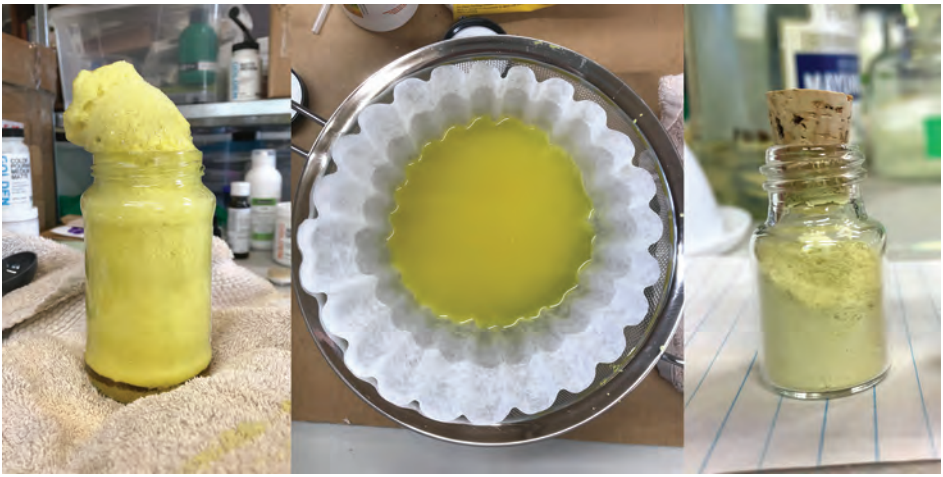
David J Burritt
Katharine Allard

One of the most pressing questions for plant science is 'how will the world produce enough nutritious food with a growing population and a changing climate?'.[1] Ever larger areas of land are being used for primary food crops, but as crops undergo increasing stress caused by climate change, yield is predicted to diminish. One main source of abiotic stress for crop plants is salt stress, due to 'uneven rainfall, inundation of coastal lands with seawater, poor-quality water for irrigation due to groundwater depletion and degradation of high-salt rocks'.[2]

When a plant retains a memory of stressful conditions, it can acclimatise and respond more quickly and effectively to a recurrence, yet 'in some circumstances it may be advantageous for plants to learn to forget'.[3] Holding on to a memory through myriad physiological, biochemical and metabolic changes uses a lot of resource that could be used for growth. 'Better, perhaps, to let those negative experiences go, instead of always preparing for the worst'.[4]

The works *reset* and *forget* are based on observational drawings of a range of commercial and heritage home-grown *Phaseolus vulgaris* grown under normal conditions and in salt-stress situations. The beans are also used as a medium in the work by extracting chlorophyll from soaked and salted bean leaves. The chlorophyll dye is transformed into an insoluble pigment using alum to bind the dye to soda ash in a laking process. The resulting bright yellow pigment then forms the basis of a homemade watercolour paint.

Chlorophyll as a colourant is known to fade with exposure to UV light, but this 'defect' is used to advantage as the transient properties of the plant pigment reflect the forgetting/resetting aspect of plant memory. Botanical drawing in silverpoint (drawing with a silver wire on prepared paper) is used to depict healthy bean plants. The works also include illustrations of stressed plants using the watercolour paint made from the plant pigments. This salt-stressed state will fade and eventually disappear, leaving just the non-stressed plant drawings.



Making chlorophyll paint.

1 New Phytologist (2023), issue 238, *Viewpoints: One hundred important questions facing plant science: an international perspective.* Armstrong et al.

2 Cells (2020) 9; 2492, Review: *Enhancing Salt Tolerance of Plants: from Metabolic Reprogramming to exogenous chemical treatments and molecular approaches.* Patel et al.

3 Science Advances (2016) Review: Botany; *Reconsidering Plant Memory: Intersections between stress recovery, RNA turnover, and epigenetics.* Crisp et al.

4 https://www.atlasobscura.com/articles/plant-memory-hidden-vernalization. Accessed 16/10/23

After 20 years of art practice including photography, public art, teaching, curating and art management, **Katharine Allard** has fallen in love with metalpoint drawing. This delicate medium uses a silver wire (or other metal) to draw on specially prepared paper. Katharine's work is informed by historic and new art materials, traditional and contemporary botanical drawing, experiments in her home studio and current scientific research.

Everything is connected

Heidi Dungey
Becky Cameron

Heidi Dungey

My research specialises in tree breeding and genetic resource characterisation for forestry species including exotic and native tree species and using genetics to understand which trees are native to an area, and which trees are planted, or introduced from elsewhere. Some recent work has looked at building partnerships and connections to improve the success and long-term sustainability of indigenous forests for their standing forest benefits. This includes seed, nursery propagation, site preparation and establishment in the field.

In our conversations Becky Cameron and I talked a lot about connections of native trees to sites, the importance of microbes and community structure and the potential for climate change to disrupt this. Establishing new indigenous forests might mean new connections and new types of forests.

Heidi Dungey, *Everything is connected,* drawing.

Heidi Dungey research specialises in tree breeding and genetic resource characterisation for forestry species including exotic and native tree species and using genetics to understand which trees are native to an area, and which trees are planted, or introduced from elsewhere. Some recent work has looked at building partnerships and connections to improve the success and long-term sustainability of indigenous forests for their standing forest benefits. This includes seed, nursery propagation, site preparation and establishment in the field.

Memories of a future forest

Heidi Dungey
Becky Cameron

Becky Cameron

One strand of Heidi Dungey's work is using forest genetics to trace the whakapapa of a forest and its trees to guide present day management and restoration. My project seeks to trace the ecological history of where I live, to understand what was lost and has been forgotten, in order to inform a future where a new forest ecology and community can be created.

As Kapukataumahaka became Pine Hill, the original podocarp-broadleaf forest with its towering trees was felled and replaced by paddocks, housing, and *Pinus radiata* plantations. I have explored remnants of this rimu forest and studied the native plants that have self-seeded in my garden, looking for signs of what was and what could be. I've made drawings of what I've found and of nursery seedlings that are to be planted out by my local community group, the shoots of a new ecosystem and a new community.

For this work I have used cyanotype to record the silhouettes of the trees and other plants and grasses that make up my present day altered environment. I have drawn over this base layer of present-day vegetation to create panels that reflect what was once there but is now only a faint memory, along with a forest that might one day grow, evolve, and help reestablish the links between a community and its trees, creating new memories and connections.

Becky Cameron has been exhibiting in group and solo shows since 2008 and holds an MA with Distinction from Dunedin School of Art. Her drawing based practice explores landscape, memory, belonging and home.

Everything is connected.
Cyanotype with mixed media on paper, 700x1000mm.

Shadow Green as Moon

Ātārangi karera enanga marama

Nurturing tree memories

This art installation explores the memories of trees, in response to extensive deforestation in the South Island over the last 800 years, and with a focus on the Central Otago region.

It was created by the Sydney-based New Zealand artist Gabby Malpas, in discussion with botanist Janice Lord, and anthropologist/poet Susan Wardell.

32

Janice Lord
Susan Wardell
Gabby Malpas

Janice Lord is a botanist with interests in the evolution, ecology and conservation of New Zealand's unique plants, and how they interact with pollinators, seed dispersers and microbial mutualisms. She is an associate professor at the University of Otago, where she is the curator of the Otago Regional Herbarium.

Susan Wardell (she/her) is Pākehā, trained in social anthropology, and communication studies. She is currently a Senior Lecturer at the University of Otago. As well as academic writing, she writes across a range of different creatives genres – gaining awards for essays and creative prose, poetry, flash fiction, and most recently, children's literature. Her first picture book for children, The Lighthouse Princess, was selected for the 2021 Storylines Gavin Bishop Award for Illustration.

Gabby Malpas (she/her) is an alumni the Dunedin School of Art. Gabby considers and challenges the western tradition of Chinoiserie with her own narrative in paintings and ceramics. The resulting, joyful and celebratory works have stories that draw you in for a closer look. A proud maximalist, Gabby currently lives and works on unceded lands of the Gadigal people, of the Eora Nation in Sydney, Australia.

Beech forest surviving in gullies, Blue Mountains, Otago.

Janice Lord
Susan Wardell
Gabby Malpas

About the science

Janice Lord
Susan Wardell

Aotearoa New Zealand was once predominantly forested, but anthropogenic fire caused substantial deforestation especially in drier eastern part of the South Island. In the central Otago region, 99.3% of the native forests and shrublands that existed 1000 years ago had been cleared by 2002. The composition of these forests and shrublands can be reconstructed from the remaining remnant woody vegetation along with buried logs and pollen extracted from sediments.

Tall Tōtara and Matai with bird-dispersed fruits, and Beech forest hosting their specialist mistletoes would have occupied the richer soils, with drought tolerant Kanuka, bird-pollinated Kōwhai, tree daisies and other shrubs on drier rocky slopes. Faunal remains such as subfossil bones also provide evidence of a diversity of birds and reptiles in the region prior to human arrival.

These lost ecosystems would have also harboured an array of species that left no trace: insects, mosses, and lichens, some of which almost certainly went locally or totally extinct when the forests disappeared.

Top: Remnant Kahikatea, Catlins, Otago - the high branching recalls a lost understorey.

Bottom: Isolated Kōwhai and Ribbonwood, Goodwood, Otago, that host the rare mistletoe *Tupeia*.

Janice Lord
Susan Wardell
Gabby Malpas

About the art

Gabby Malpas

The landscape holds the memories of trees; in depressions, hollows, and absences, that mark where individual trees and whole forests, once were. The ceramic vessels in this installation - which are formed of clay (in connection with earth) - present these shapes as a physical memory of loss. At the same time, they are a way of lovingly holding the memories of precious native species, as taonga.

The idea for the bowls was also connected to the use of incantation bowls in ancient cultures. These were often buried within house walls and floors as protective items. Here, combined with lines of poetry written by Ōtepoti writer and poet Susan Wardell, they invite a prayer of remembering, but also perhaps of protection for remaining forests. As part of this invitation to speak the memories, some of the vessels bear the names of particular tree and bird species that occupied the forests in the Central Otago region. Just as each lost, threatened, or relocated species, is unique, the bowls are intentionally diverse in shape, form, and size, treated with a variety of glaze treatments including porcelain, stoneware, buff and dark clays with celadon, clear and tin glazes. Cobalt oxide, the traditional mineral of Iran responsible for the enduring blue and white ceramics loved globally, and gold lustre.

Hanging above, the garlands are hand-painted watercolour paintings, reproduced on transparent material; gesturing towards the intangible memories of rich ecosystems that once occupied these regions. The species represented are Kōwhai, Red Beech, and Mistletoe. Their abundant foliage, and lush joyful colours, stand in contrast the disappearing, ghostly transparency… as a call to let the memories impassion us towards the type of future invested in regrowth, renewal, and rejuvenation, of this sort of vibrant ecology.


MIRO
FINGERS
SIFTING
CLOUD

Memories Red, Green, and Eaten

Food histories in Otautahi's quake zone

Susan Wardell
Gabby Malpas

About the science

Susan Wardell

As an anthropologist, Susan Wardell's work has focused on the social aftermath of the Canterbury earthquakes. This has included attention to the different ways people enact memory and memorialisation in the physical landscape, including in the Red Zone.

Christchurch is invested in its identity as the 'garden city', and some of the areas most effected by the quakes have a rich history in relation to food. This was established in precolonial times, through Mahinga Kai (seasonal foraging) by Kai Tahu, through a native wetland ecology. After European settlement, around 1850, the area became the site of the city's first botanical garden and first plant nursery, and William "Cabbage" Wilson built a legacy on market gardening in the Avon Loop before becoming the city's first mayor

In the period after the quakes, a large part of the badly damaged Eastern suburbs was cordoned off as a 'Red Zone'. This left gardens and fruit trees in many former suburbs, ripe with unharvested fruit, through the autumn. Amidst widespread city grief and recovery, unofficial practices or foraging led to new traditions such as making 'red zone jam' or 'red zone pies'. 'Red-zoning' in fact, become a synonym for foraging. Later, government efforts to clear 8,000 damaged houses, and establish a 'green zone', proceeded with a policy to leave heritage fruit trees in place. An app was eventually created to map the locations of 1,763 catalogued trees fruit and nut trees, to aid the public in foraging. Successful community efforts establish gardens in these area – for example, the Kaiapoi food forest – also came to inform council policy. Proposals to continue to preserve heritage fruit trees, alongside replanting of indigenous wetlands species, show links between past practices, current ones, and speculative future ones.

Susan Wardell
Gabby Malpas

About the art

Gabby Malpas

Practices of foraging, growing, cooking, and eating, are a very intimate, bodily way, to be entangled with the landscape. They are also a way to be connected to others, since food is integral to cultural identity, and both knowledge and traditions about food can be transferred intergenerationally. Food can, therefore, hold memories. The sensuous experience of eating it can trigger nostalgia, and a sense of connection; but may also involve memories of loss, and disruption, to livelihoods or identities, as part of complex social histories including settlement, migration, and in this case, natural disaster.

These watercolour paintings represent some of the types of food grown and harvested in this region of Canterbury. The twelve species shown include: lettuce, apricots, feijoa, pears, apple, tomato, crabapple, radish, loquat, greengage/bullace plum, strawberry tree, and dandelion.

Can eating be a way of remembering? What role does gardening have in social repair? The sensory vibrance of these images allows us to ask questions about how food entangles us with the past, and with the future, within specific local landscapes.

Honohono

Creative Impact Lab Ōtepoti Dunedin (2023)

42

Paulina Barry
Fiona Clements
Craig Cliff
Virginia M Gautusa
Savannah Kerekere
Pam McKinlay
Aislinn Mirsch
Ellen Murray
Isaiah Okeroa
Hayley Walmsley

Honohono, is a project by the Creative Impact Lab Ōtepoti Dunedin (2023), a Leonardo International Exchange supported by the U.S. Embassy in Wellington and hosted by Tūhura Otago Museum.

As climate change increasingly threatens humankind with extinction, unforeseen and large-scale ecological phenomena and changes have been, and are, manifesting themselves with increasing intensity.

Connecting climate change to memory is perhaps a counter-intuitive starting point, we have been taught to think that climate change is all about future catastrophe. Looking at climate change through an Indigenous lens offers valuable perspectives and solutions for climate resilience, emphasising sustainable living and a deep respect for nature. Traditional ecological knowledge is a form of collective memory that encompasses observations, practices, and spiritual beliefs tied to the land.

Links between memory, climate change, and Indigenous thinking centers on the deep interconnection between environment, cultural memory, and traditional knowledge where communities have long relied on an intimate knowledge of natural surroundings, for survival and cultural identity.

The collection of digital works in Honohono highlights the potential of fostering connection, transformation, and dialogue across temporal and spatial boundaries and celebrates the harmonious convergence of tradition and innovation, heritage and process.

Te Waihanga o Honohono (video)
Isaiah Okeroa | Fiona (Fi) Clements | Aislinn Mirsch | Creative Impact Lab Team

Through this short video, the viewer is taken on a journey floating through spaces of the past, present, and future. Guided by Te Ao Māori, this video documents and focuses on the collaborative endeavour behind the creation of a woven structured piece in Waitati, Aotearoa. Performing with Taonga pūoro in Te Taiao, this process facilitates the transformative connection between tangata and whenua, a sacred hononga that demands acknowledgment and reverence. The dynamic and expressive nature of this piece elicits a range of reflective emotions, inviting the viewer to immerse themselves and contemplate the deeper intricacies within this cultural practice.

Rotoscoping Film — *Hayley Walmsley*

A meditative reminder to look at the small details, this is a love letter to nature.

The wairua of these special spaces becomes apparent through tracing: Making the invisible, visible. This work condenses significant time into an animation that celebrates this place that we inhabit.

Rotoscoping Film — *Paulina Barry*

Walking within the foggy atmosphere on a low tide, it's easy to become disoriented. We are drawn towards defined shapes, but upon closer observation, we realise we expected something other than expected. The tidal flats are a liminal space. Layers of intertidal creatures decaying into mud, juxtaposed with bright flowers, and seabirds on world journeys.

Telegram *Craig Cliff*

A telegraph message was an urgent means of communication in the twentieth century, sent by an electrical telegraph operator or telegrapher using Morse code (or a printing telegraph operator using plain text). The decoded message was printed on a strip of ticker tape and cut and pasted to a brown cablegram page for delivery in person or by telephone. The video plays with the multiple meanings of "stop" in a telegram, incorporating the different perspectives and contradictions present in climate discourse, culminating in a united message to Papatūānuku Mother Earth: a plea for forgiveness and commitment to do better.

Forest Guardians *Pam McKinlay*

The *Forest Guardians* video is an exploration of ideas around kith and kin and our collective relationships to the environment in a response to the ClimLab workshops and site encounters. Text responses from ClimLab collaborator Craig Cliff.

Titiwai *Craig Cliff*

Glow worms walk a similar knife-edge between hope and despair, incorporating elements of chant, autobiography, cut-up and erasure poetry, while also speaking to the group's collaborative woven portal

Elemental Armour — *Savannah Kerekere*

Small sculptures which personified elements of Whenua, ngā Awa, Ahi, Moana are overlaid with AR. Energy levels are being depleted by corporate takeovers and commercial interests in our water ways. Frayed forests are cut through. The forest fires sweep through unchallenged, in the drying landscapes.

Welcome to New Zealand — *Ellen Murray | Fiona (Fi) Clements*

Welcome to New Zealand parodies New Zealand's tourism ads, highlighting stark ecological realities and promoting local climate action, with humour and wit. The NZ Pure ads promise a truly breathtaking landscape – winding coastlines, rolling green hills, towering mountains. But behind those beautiful images and that signature Kiwi humour and charm, the landscape bears the scars of anthropogenic climate change. Native plants and animals are endangered or at risk. The air is polluted. The coastline is eroding, the sea levels rising and the glaciers melting. Transmission of location-specific mātauranga Māori and tikanga practice is disrupted. This parody brings these two truths – Aotearoa's natural beauty and the accelerating effects of climate change.

Climate Change Through Homelessness *Virginia M Gautusa*

A black & white documentary photography series where the artist explores - Climate Change Through Homelessness. This was a great opportunity for the artist to put out the sentence "Climate change has affected our…" for the participants to write their responses on cardboard, and later captured through her lens.

Paulina Barry: Paulina Barry is from the Puget Sound, now based in Dunedin, Aotearoa New Zealand. Her works are place and community-based, focusing on bio-heritage and restoration of the human/nature connection.

Fiona Clements (Waitaha, Kāti Māmoe, Kāi Tahu) Fiona is proud to be a Takatāpui Māori business owner, co-creating and transforming lives through connection to Papatūānuku. Fiona is director of Ōtepoti/Dunedin's Res. Awesome.

Craig Cliff (Tangata Tiriti) In addition to bringing climate mahi into his artistic practice, Craig currently leads the Net Carbon Zero Programme at the University of Otago.

Virginia M Gautusa is a 44-year-old Samoan born, Dunedin-based visual artist/entrepreneur.

Savannah Kerekere (Rongowhakaata) Self-taught multimedia artist based in Ōtepoti. Savannah's work is heavily influenced by her Maori heritage and often explores our connection to the elements – ngā huanga.

Pam McKinlay (Tangata Tiriti) is a weaver and curator of the art+science project based in Ōtepoti Dunedin, New Zealand. Her practice is concerned with the connections between new ideas and deep knowledge.

Aislinn Mirsch is a German American science communicator, now based in Ōtepoti Dunedin. They favour artistic connection through the creation of audio stories and immersive soundscapes.

Ellen Murray is a writer and photographer. Her travel writing and creative nonfiction celebrate place-based narratives and traverse themes of trauma and grief.

Isaiah Okeroa is based in Ōtepoti, Isaiah's work centres on Moving image and Sound as mediums for exploring Māoritanga, Spirituality, Takatāpuitanga, Whanaungatanga, Taonga Pūoro and Mahi Raranga.

Hayley Walmsley is of Ngati Kura, and Nga Puhi descent. Growing up in Te Taitokerau – Northland, New Zealand, She was taught that the sand, dirt and stones are literally the blood and bones of our ancestors and this, in part is why we have such a call to take care of the environment and the life it supports.

The contours of memory for places past

David Bilkey
Sarah Shackleton

David Bilkey, Professor of Psychology, University of Otago. His general research area is systems neuroscience.

Sarah Shackleton is a visual artist, born in Dunedin but has been living and working in Zaragoza, Spain, since 1991.

David Bilkey

Memory serves as the scaffolding upon which our identities and experiences are built. While we often think of memory as being somewhat like a video recording of our experience, that we can play back at some later point in time, the reality is much more complex. First of all, memory isn't a single process. Rather, it involves a complex, coordinated interplay of activity in many parts of the brain, where new memories are built by overlaying portions of your current experience onto traces of those had previously. So, for the memories of the 'what, where, and when' type that we call episodic, they are a combination of what actually happened, shaped by what we expected to happen given our memory for similar events, and what we have learned since that time.

In my own research I'm particularly interested in the 'where' of episodic memory. That is, spatial memory, and the question of how we remember places and our journeys between them. I study how these memories are stored in a part of the brain called the hippocampus where neurons called 'place cells' are found. Individual place cells fire electrical impulses when you are in a particular location, such that over a population of these cells the activity can represent the whole of a larger environment. These place cells are connected, and store memories by changing the strength of these interconnections. Important questions relate to how the information encoded in these cells is used by the brain to plan and navigate journeys through the environment. Also, how do these cells store information about journeys so that you can navigate back to some location in the future? How do the cells encode and store the sequential nature of that journey, and what happens when that sequential process is broken as might occur in some psychiatric disorders?

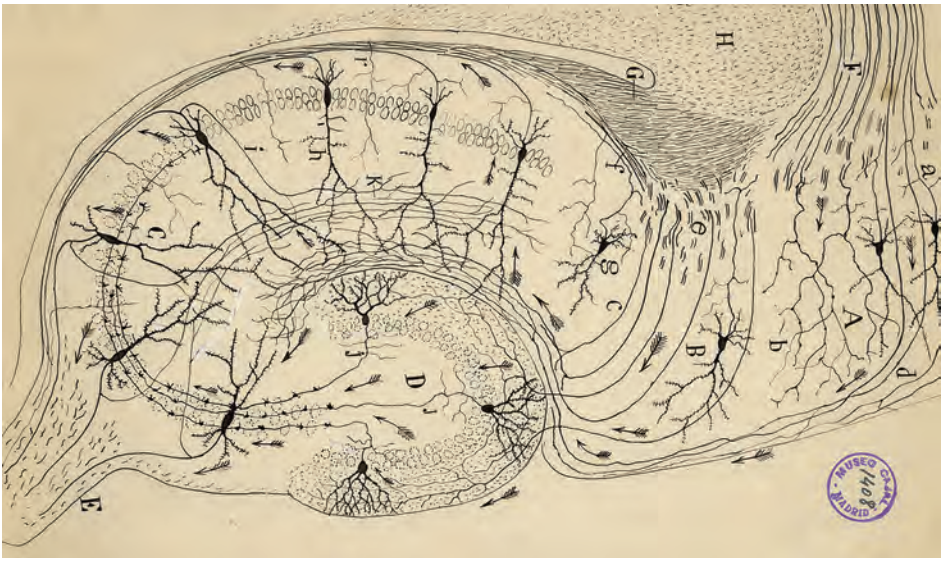
Sarah Shackleton

Memory drives the creative process. As you draw a line across a surface it becomes an extension of your mind and snippets of memory stored in your hippocampus are made visible. Through a process of sequential drawing, overlaying, repetition, recording and remembering I have tried to unlock my unconscious memory.

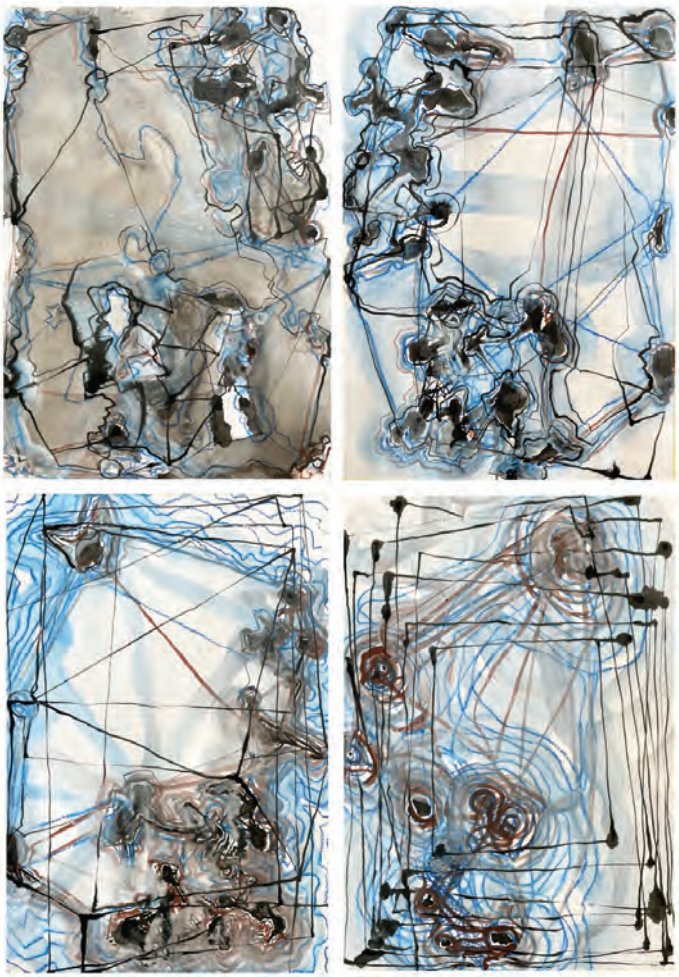
The drawings exhibited in "Art and Memory" have evolved out of a process of memory and recollection. While doing these drawings I recalled the intricate drawings of the Spanish neuroscientist Ramón y Cajal (1852 - 1934), whose intricate drawings reveal the complex nature of the hippocampus.

In my conversations with David Bilkey, we talked about the sequential process of memory. This led me to consider how this could relate to my working process in drawing. The four sets of four drawings included in the exhibition belong to a series of ten sequential drawings which were done almost as a memory ritual. I chose to work in sets of four at random. The first drawing extended to the next, through a process of stamping, which meant the image transferred is a reflection of the first. This drawing process continued back and forth until a number of layers had been built up. The last drawing in the series was then transferred to a new paper to start a new series. The final drawing bears only a little resemblance to the first sketch. It is the memory of a new reality.

In much the same way as drawing, walking stimulates memory through the rhythmic action of stepping. I have integrated video recordings of walking into this work. In these video sequences, David Bilkey collaborated by providing video recordings of walks in New Zealand. Juxtaposed with recordings of my walks in Spain, these images intertwine in a grid like pattern of memory on the screen.



A cross section through the Hippocampus as drawn by the Spanish Neuroanatomist Ramón y Cajal.
https://doorofperception.com/2022/12/santiago-ramon-y-cajal-the-beautiful-brain/



Tracking Memory 4: Phase precession Ink and watercolor on paper, 95x74cm.

The contours of memory for places past

This image references the concept of place cells and the 'place fields' they produce. Place fields are regions where a place cell is active and in academic studies, they are usually mapped onto a 2D surface like a map, that represents the whole environment. This surface then has a third dimension where 'hills' represent regions where the cells fire at a higher rate. These regions can be displayed by blobs of colour or by contour lines. The lines also reflect back to Cajal's beautiful drawings of cells in the hippocampus and their connections. They also talk to trajectories through space and the way that these can overlay each other, reflecting how the representation of a journey is both a 'now' experience and recall event for previous similar experiences.

Tracking Memory 10: Neural networks Mixed media and collage on paper, 95x74cm.

Fragments of a Neural Network

The place fields of hippocampal place cells are usually represented in a grid that divides the environment up into smaller squares. This can be thought of as a coarse map of the environment with place cell activity overlaid. An individual cell's firing rate is then represented in a color code with hotter colors representing firing rate. A hint to this idea can be seen in this drawing. Furthermore, the weaving at the top right speaks to the interconnectedness of cells in the CA3 region of the hippocampus which have a dense reciprocal connectivity. This connectivity is sometimes drawn in academic papers as a two-dimensional grid and modelled in computer simulations in much the same way. The piece also references the fragmented nature of memory and how it is composed of pieces of our experience, not necessarily all acquired at the same time.

Tracking Memory 8: 217 Steps Ink and watercolor on paper, 95x74cm.

Tracking memory

Cajal's drawing used letters to sequentially label the different parts of his drawings. Here sequences are shown in numbers, with each line reflecting a series of steps taken on a journey. This talks to our usual means of locomotion and to recent findings that the hippocampus might be involved in the fine details of movement, including monitoring individual steps. The rhythmic nature of these steps also links to the brain wave oscillations that are important for memory formation and recall. A brain wave called theta activity, which oscillates at around 8 times per second, is critical. Theta activity is the result of synchronized, repetitive input to the place cells of the hippocampus.

Tracking Memory 6: Mysterious butterflies of the soul, 95x74cm.

Mysterious butterflies of the soul

Here the place fields have become more distributed and abstract, displaying both the underlying trajectories and also echoing the physical structure of place cells and their dendrites. Dendrites are the branch-like structures that manage the connectivity between neurons. The layering process of memory is also evident with older memories being less distinct and forming a background for more recent episodes.

He aha te kai? He mamae te kai!

What is my sustenance? Pain is my sustenance!

56

Stu and Marama McDonald Heramaahina Eketone

The Ahipoutu Collective

Dr **Marama McDonald**
(Ngāti Kauwhata, Rangitāne)
Māori Health Researcher.

Stu McDonald (Ngāiterangi, Ngāti Ranginui, Ngāti Pukenga, Ngā Rauru, Ngāti Rehua)
Tohunga moko, Artist, Educator.

Heramaahina Eketone
(Ngāti Maniapoto, Waikato)
Artist, moko apprentice, Educator.

This ipu-waatea is made from glazed porcelain showing Papatuuaanuku as the carved moko kauae attached by the umbilical cord (rauru - at the mothers end) moving into the iho and finally connecting to her son Ruuaumoko by the pito. The pigment used to colour the cord is whenua collected from 'the kainga' in Matapihi.

As Ruuaumoko is the atua of moko, Papatuuaanuku was the first being to receive the taonga from her son's reaction to a series of traumatic events. It is only fitting that these two be represented in this, made for purpose, piece.

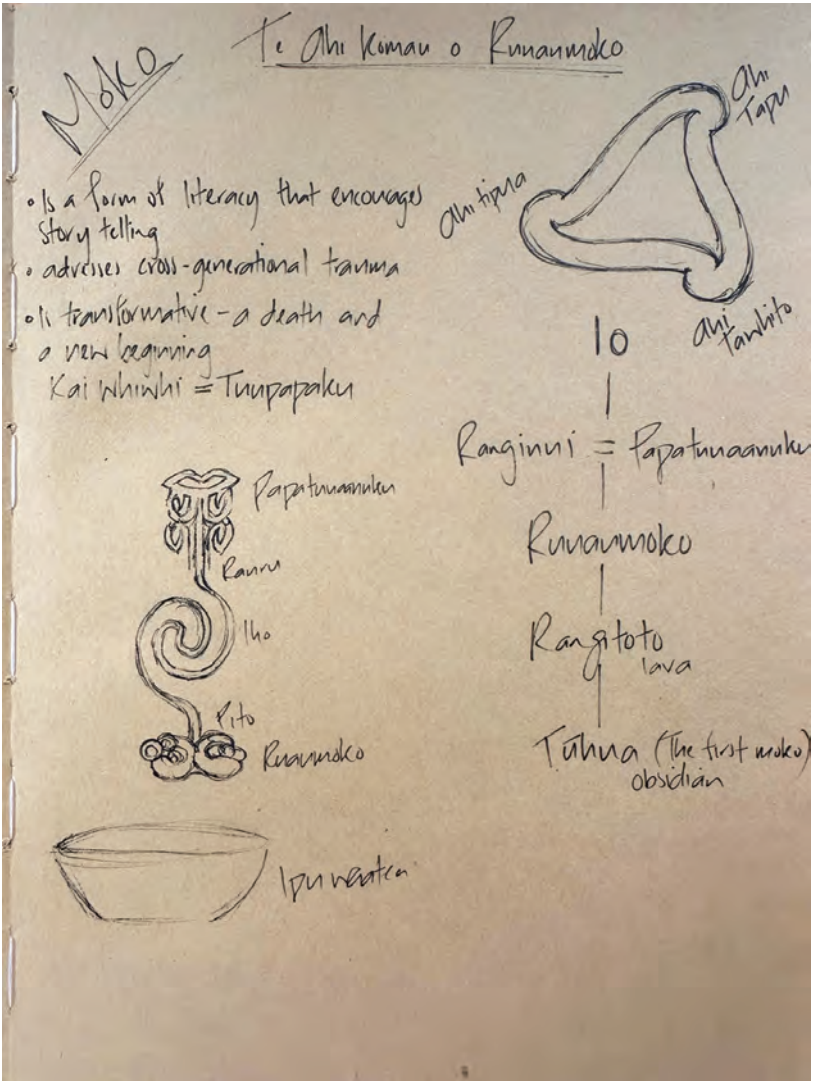
This ipu is specifically made to support removing the 'extension of Tapu' in order to come back to a state of equalibrium after moko has been received.

Once the karakia is performed by the practitioner and the first incision is made, both kai-whiwhi (receiver of moko) and Kai-taa (artist) enter into a new state of Tapu.

Prior to the practical application of the moko, there has been an exchange of information and memory between the kai-whiwhi and Kai-taa where whakawhanaungatanga is practiced by sharing reasons for the decision to receive moko - this can include whakapapa, stories, psychological and spiritual mamae etc.

The process of receiving moko gives the Kai-whiwhi opportunity to release what needs to be released while at the same time aroha (along with the ink) is being packed in through waiata, the company of loved ones and touch by whaanau and the kai-taa. The transference of memory is applied through moko, where the skin is pierced, precious toto is shed and is exchanged with ink.

Once the moko is complete it is time to come back to a balanced normal state.



There are many ways to bring the kai-whiwhi back to te ao maarama/normality post-moko, including but not limited to cooked kai, salt water (including tears), wai maaori (fresh water) etc. The kai-whiwhi are encouraged to partake in their favourite food or favourite beverage, as an opportunity to celebrate the transformation. A death/ ending of the old self and a birth/ beginning of the new present self.

Through pain, we experience and know life.

Through grief, we experience and know love.

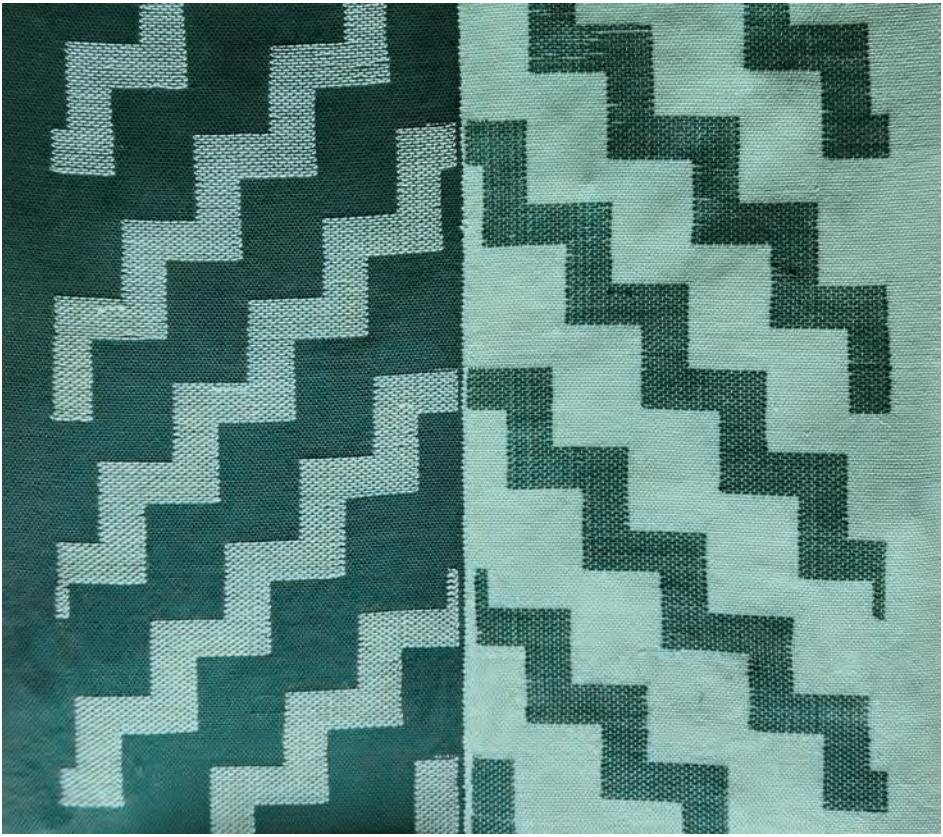
Therefore we live by the words - He aha te kai? He mamae te kai.

Poutama

My weaving piece has been greatly influenced by the tukutuku patterns found on the wall panels of marae around Aotearoa. Their sharp-edged geometric shapes have always fascinated me and I found their repetition calming and introspective. The particular design I took influence from is called Poutama. One of the interpretations of Poutama is that the steps represent the upward journey of learning and achievement. As someone who has spent over 10 years in the Tertiary education system, I still find joy in seeing students achieve their goals and dreams so this shape holds special importance to me. I hope it can inspire those that view it.

Steve Ting

The weaving technique I used was developed by Theo Moorman and outlined in her book 'Weaving as an Artform' and was an attempt to create a quicker alternative to traditional tapestry methods. The technique allows a weaver to use a 4 shaft loom to weave a plain weave background and then to 'trap' a design of their choosing via thin warp threads. While this technique is considered 'less intensive' than traditional tapestry I can confidently say that this piece was incredibly time-consuming (mostly because of my ongoing inability to plan out how long my final pieces will be) and somewhat infuriating (try dealing with 8 weaving shuttles at once!).



Born and raised in the cosmopolitan metropolis of Hamilton, New Zealand, **Steve Ting** is a former marine biologist who traded in his wetsuit for a career in sharing his love of science and the natural world with the people around him. Now a passionate science communicator and visual artist, Steve has put his restless mind to good work by exploring various crafts in his spare time. Several years ago, Christine Keller showed him how to use a loom, and he was instantly hooked, creating fabrics that have been used for hats, scarves, and other items of clothing. In addition to his love of textiles, he is also a bone carver, photographer, and digital fabricator. His work is often inspired by his Chinese culture, history, and the marine world (he is a big seaweed fan).

He rerenga hei mahara: Strandings and connections

Sophie White

Ki tai ki uta, ka uru mai te tipua ē. Whales come to our shores in their thousands, both in their lives and in their deaths, in ongoing cycles of nature. Internationally our islands are known as a major marine mammal confluence with over 50 species around our coastlines, and histories of many large and incredibly rare encounters and strandings. To the whales our islands are part of aeons old pathways in the ocean and their worlds. Spending time at sea and along our coasts, we share in their lives; learning and observing, and connecting between our environments.

Places of strandings evoke strong waves of memory. Travelling and walking these remote beaches again with Vincent opened memories we hold of events, especially of the Arnoux's beaked whales Tangimoana at Sandy Point and Hine Reti at Ōmaui, in Murihiku Southland. These were significant life moments and complex events, marked by the recollection of a 10pm summer sunset + moon rise with a scarlet arc of blood carried to the sea's horizon, and years later when finding and recovering them again in the sand, a teal aurora over Tihaka. My involvement in whale strandings began young growing up in the top of the South Island and witnessing hundreds at a time come to their life's end. Calmly and respectfully with care, moving their bodies up onto the spit, letting them rest in the sand to feed the dunes, or in the bay to feed the waters around them and continue the cycle. Traditional harvesting acknowledges their deep value and significance, providing sustenance and vital materials, and connecting with kin. This natural cycle of life and death and seeing the changes between deeply influences my work, and grounds my relationships within the natural world.

Sophie White
Vincent Chevillon

Time and tide: Pilot whale stranding – Onetahua / Farewell Spit. Photograph: Sophie White.

The Arnoux's beaked whale found in the ceiling spaces of the zoological collections at the Université de Strasbourg revealed an incredible life story, tracking its place of stranding back to Golden Bay in 1905 through handwritten collectors' notes, newspapers, and intense serendipitous research, creating an intricately linked mind map across the sea. This elusive large beaked whale species has a strong connection with France; it was named from a skull collected in Akaroa on a French Pacific voyage, described by the zoologist and anatomist Georges Louis Duvernoy in 1851, now in the Muséum National d'Histoire Naturelle. Southern whales and relationships continued to link across the world, and a century later led us to rediscover their paths through walking these coasts and trawling international archives, connecting back into memoirs and photographs into seascapes.

Finding again these places of stranding and journeys of memories, they connect the whale with its place and remembrance of its life and death. The connections between sea and land across time humble us in honouring our responsibilities and care of our natural world, in awe inspiring moments.

Sophie White, Palaeontology Lab Manager and Collections -
Department of Geology, University of Otago.

Sunset on the flats: Pilot whale stranding – Onetahua / Farewell Spit.
Photograph: Sophie White.

What grows on whale remains

Sophie White
Vincent Chevillon

Initially trained in earth sciences, **Vincent Chevillon** went on to study art and in 2010 joined the post-diploma class of the Beaux-arts de Paris, La Seine. Since 2014, he has taught space and volume at the Haute Ecole des Arts du Rhin (HEAR) in Strasbourg, bringing together different fields of study, including anthropology, geophysics and iconology.

Since 2013, he has been developing a participatory encyclopedic platform called Archipels with the support of several organisations (FNAGP, SCAM, Espace Khiasma, Dicream, Medialab SciencePO Paris). His work is in several public collections.

See further
www.vincentchevillon.com

Vincent Chevillon

Between February and September 2023, on the coast of Aotearoa, New Zealand, with the help of a GPS and a register established by the Department of Conservation (DOC), I visited sites where stranded cetaceans had been found.

158 sites were visited.

At each rendezvous, I took a photograph.

Each image is associated with a caption that states the date the image was taken, the date it was beached, locates the individual geographically, assigns a species, sex, size and sometimes information about the encounter.

Through a digital diary that was published daily, Sophie White followed and advised me, sending me documentation, comments and observations.

Joining these sites was a ritual, connecting them was an astonishing way of the cross, the empathetic experience of a stranger at the edge of worlds.

What remains... an archipelago of images, punctuated by the transformation of landscapes and light according to latitude, different times of day, the sequence of seasons, temperature...

Images in which the off-camera is not limited by the frame, but extended by the caption, by the ocean and the smoldering skies, by the soil that harbours strata after strata of the territory's memories.

Spaces that bear witness to human and industrial activity, but also to a much deeper history that will outlive us all.

27.09.1994 - 29.05.2023
Brighton Rocks
Long: -45,9439 / Lat: 170,3373
Orcinus orca
Male
258 cm
Euthanised

Very young calf still had umbilical cord. no sign of adult orca at sea. Newborn animal stranded ~1100, refloated in pontoons. Considering surf, age of animal and absence of other orca, we decided to euthanase. Teeth not yet erupted. Whale distinctly yellowish. Usual grey blaze behind dorsal fin very indistinct.

11.01.1950 - 05.06.2023
Shag Point
Long: -45,4602 / Lat: 170,8156
Physeter macrocephalus
Male
1500 cm
Beach cast

Pam McKinlay

NZ Native Bees

Jenny Jandt
Connal McLean
Pam McKinlay

New Zealand is home to 28 species of ngaro huruhuru (native bees) that belong to three genera– *Leioproctus, Lasioglossum,* and *Hylaeus.* Unlike honeybees, ngaro huruhuru do not have hives or produce honey. Each female has her own nest where she lives a solitary life. On her own, she constructs a nest in the ground, under bare, undisturbed clay soils, in hollow stems of dead plant material, or in holes drilled by other insects.

Ngaro huruhuru have developed a broad range of sophisticated cognitive behaviours that facilitate learning the location of their nest site and navigating their environment while foraging. This means that changes in the environment (e.g., shifts in weather, introducing or removing plants, applying pesticides to the soil, or in my case, digging into the soil) require real-time problem-solving innovations to respond appropriately and avoid getting lost. Moreover, competition from other foragers in the environment, e.g., honey bees and bumble bees, can impact the types of flowers and times of the day that ngaro huruhuru can forage.

This Art+Memory collaboration is a PSP project BEE Creative, in which we will be carrying out a series of workshops across Dunedin schools and communities, sharing knowledge of native bees and their value with the community.

BEE Creative will also create community artwork banners representing aspirational floribundance for native bees. Each banner will feature a NZ native bee. The complete set will be photographed and used as the basis for a calendar and include a brief text of bee-trivia on each native bee portrait. Each month will have a tie-into the native bee-life cycle and what the bees are doing or not doing in that month.

Jenny Jandt is Senior Lecturer at the University of Otago, New Zealand where she studies behavioural ecology and evolutionary biology of social insect colonies.

Connal McLean completed a Master of Science with Distinction in Zoology at the University of Otago, where his research assessed the cognitive ability, foraging behaviour, and colony phenotypes of bumble bees raised in environments that featured differing degrees of floral complexity and biodiveristy. His background is in Biological Psychology, and he holds certifications in Science Communication, Medical Entomology, and Horticulture.

Pam McKinlay gardens at the North East Valley Community Garden.

NZ native bee, *Hylaeus* (masked bee) on flowering coriander. Photograph: Pam McKinlay.

Wild Bees Crossing

Pam McKinlay

I accidentally dug into a solitary bee community last year at the North East Valley Community garden. I dropped my tools and ran screaming from the "bees" like a big girls-blouse. One trip around the sun later and I have formed an alliance with the bee people. On the people side there is Jenny Jandt bee guru, Zoology Department and Anthony Harris should-be-national-treasure, Honorary Curator Entomology Collection Tūhura Otago Museum. There is Connal McLean recent graduate from Jenny Jandt's "Bee Lab" working on identifying foraging sources of native bees by examining pollen at Te Papa. On the bee side there are communities representing three genera living in our community garden. I wait, I watch. Finally, they come out of the ground and are summer flying.

'We are all related,' says Anthony Harris when I visit. We are kith and kin. Anthony gives me a sheath of hand-written pages he has prepared from our previous correspondence including some valuable diagrams of bee tunnels so I can imagine their goings on under the earth. I also learn about the "pollen pudding" in which the young bee embryo develops.

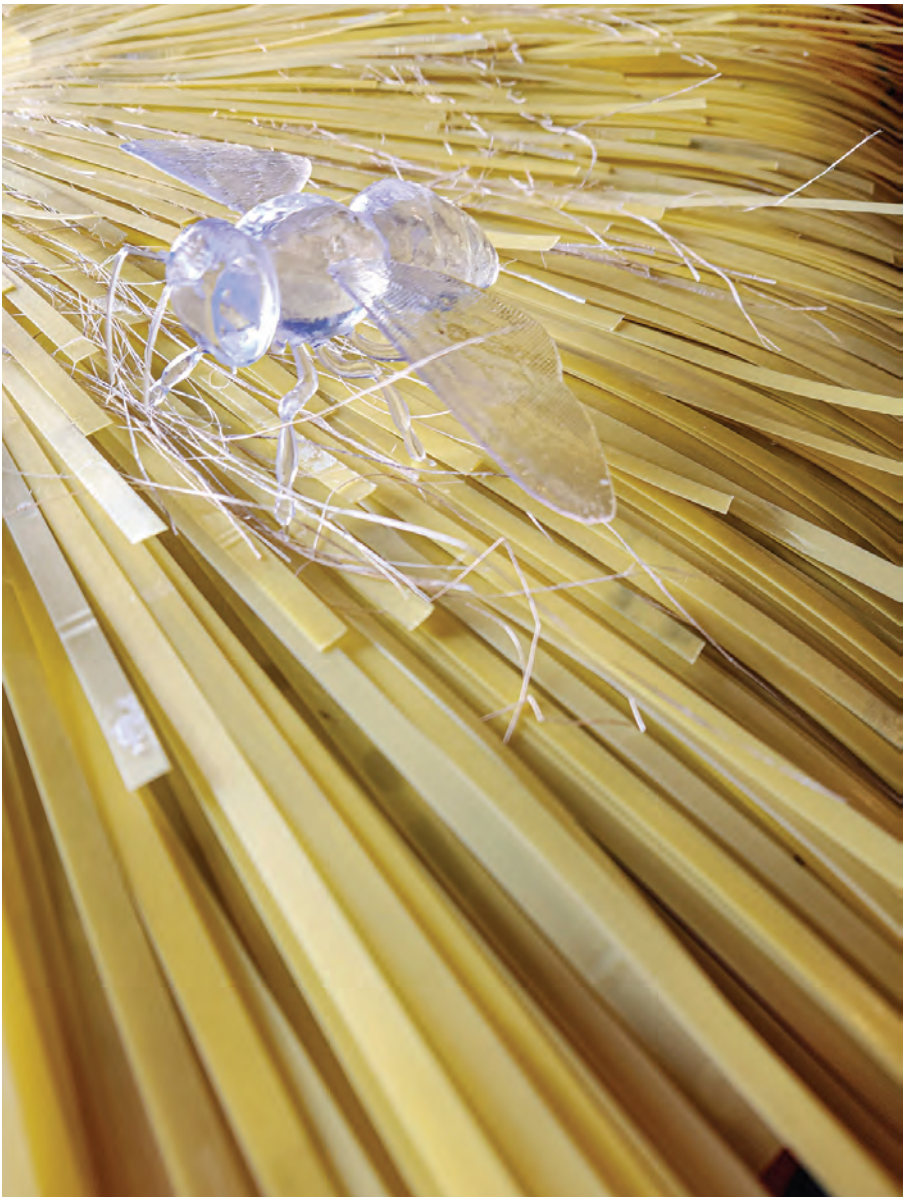
Kith and kin is our connection to our environment, with the notion that kith (our knowledge) comes from our being in a relationship with the land and kin that we are all related. Kin denotes the great trees, the birds and the smallest insects that inhabit the forest and the spirit that imbues all. Kith is the scientific and spiritual knowledge of all water and wellsprings, of the calls of birds we hear of shifting winds and dangers coming. Scientists at the ICCP tell us we have five years of useful consciousness in which to heal our ngahere.

Will the bees know about the changing climate and adapt to the new phenology, will the flowers they need be flowering when they emerge for their truly short flying season.

We tend the garden beds and leave aside the scraggy flowering vegetables as bee food. We leave the early spring daisies and dandelions as food sources for early emerging bees. We let the feverfew, coriander and celery run riot, the bees favour the wide open umbrels of these flowers best. They look like Queen's Lace to me. Who wouldn't plant vegetables just for their gorgeous flowers?

Above: BEE Creative - NZ native bee *Leioproctus*.
Screen printed bees developed from artists research photographs.

Left: BEE Creative – NZ native bee *Lasioglossum,* 2024, 1x1m.
Screen printed bees developed from artists research photographs, textile collage.



Ngaro Huruhuru on dandelion, 2024.
With thanks to William Early for 3D printing. 3D model designed by Creazilla.com.
1.8m diameter. Upcycled plastic strapping, LED flat-light, 3D printed bee (Dental resin).

NEVee Bee Movie, 3mins.
Youtube link for NEV BEE MOVIE
https://www.youtube.com/watch?v=bS_SaZTZKlQ

Mouse Brain

Pam McKinlay

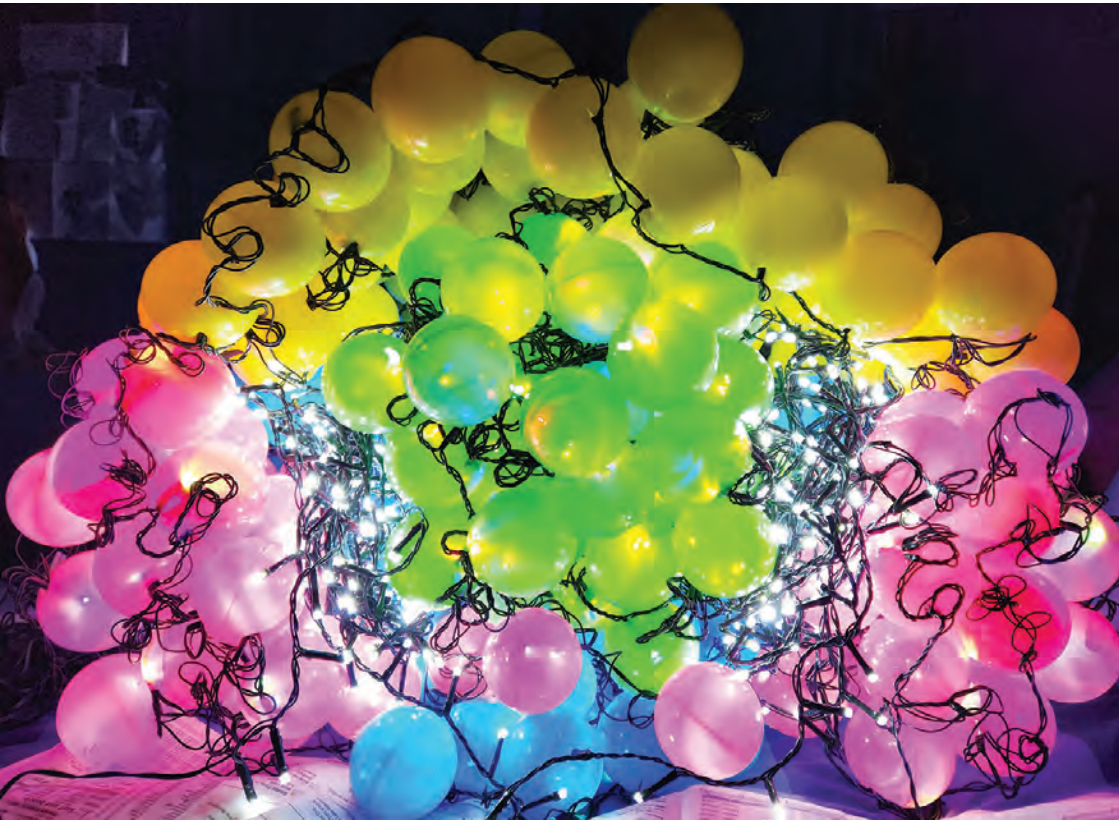
As part of the Art+Memory project I had the pleasure of several conversations with Yusuf Cakmak about neuroanatomy and a tour of the Anatomy Museum. Later, David Bilkey introduced me to the Allen Brain Atlas, a neuroscience project to map a mouse brain down to the cellular level.

This intriguing website is sometimes called the Allen Brain Observatory. Amongst its pages, it contains an open-source reference atlas in comparative anatomy of sagittal planes for mice and human brains in developing embryos and adult specimens including a 3D reference space available as an online interactive viewer.

A scroll through the pages reveals detailed analysis of various brain cell types, their form function/s and how they connect. Cell structure informs function, neuronal diversity and dynamic neural behaviour including memory and decision making. Alterations in connectivity and structure can result in neuropsychiatric disorders such as depression, ADHD, or addiction.

Further mapping of genetic geography of the brain, in the Atlas, reveals the brain has in common distinctive structures of patterning across individuals. Variation in neural signal behaviour, which shows up in functional imaging, can reveal onset or diagnosis of neurodevelopmental dis-orders such as autism spectrum disorder and schizophrenia.

The mouse brain sculpture is a prototype. It was designed as a fun way to conceptulise the interconnectedness of the brain's regions with sensory inputs and higher function reasoning that comes from learning and consciousness. As the Exhibition is taking place in the Science Festival it was also deliberately designed to appeal to a younger audience, who would be familiar with the plastic balls from indoor, "ball-pits," used in the light sculpture.



Inner structure of the 'firing neurons' in the *Mouse Brain* (prototype), 2024.
Light sculpture, coloured plastic balls, LED lights, Arduino. Still from light sequences.
With thanks to Ken Wyber, Matias Lotitto, Matt Sutton.

Pyramidal cell drawing screenprinted on tissue paper, by Santiago Ramón y Cajal 1905. Pyramidal neurons are found in multiple brain regions related to higher order cognitive processing, including the prefrontal cortex (PFC) and hippocampus.

Pam McKinlay has exhibited regularly in the Art+Science Project and touring exhibitions as well as New Zealand (Int.) Science Festival and New Zealand Festival of Naure. She was a finalist in the NZ Textile Arts Awards 2023. Her writing has appeared in Scope: Contemporary Research Topics (Art&Design), Junctures: The Journal for Thematic Dialogue, Down in Edin and has a chapter in press in Craft- the Hand of the Creator, Celebration and Revival (Springer).

Points of light: ‘How do I remember what I remember?’

Rachel Zajac
Manu Berry
Michelle Elvy

Our memories make us who we are. They attach us to our past, and guide our present and our future. We piece together episodic memories (‘I remember when…’) and semantic memories (‘I know that…’) to form our autobiographical memory: the story of our life.

Each time we bring a memory to mind, that memory ‘un-sets’, allowing it to be altered after the fact. The new memory sets again and the process repeats. Over time, we can experience many layers of memory iteration, even without awareness. Our memories, therefore, are likely to contain a combination of accurate details and details that have been altered or otherwise reshaped. This concept is explored in this interactive work by Rachel Zajac, Manu Berry and Michelle Elvy.

They begin with memories from poet Cilla McQueen, who takes her starting point from one school photograph from childhood. The project asks questions about how we recall our Self from an earlier time, and how that Self changes each time we go back. It looks at the specificity of memory and the fragments of people and things, ideas and light. From a science view, memory is non-linear, imperfect and fragile. From an artistic view, memory is depicted in this installation through the layered images from silkscreen, colours flooding

Rachel Zajac is a Professor of Psychology at the University of Otago, where she also trained as a clinical psychologist. Rachel’s research focuses on how people remember events in their past. She is a passionate communicator of science, and has won multiple local and national awards for tertiary teaching. Rachel is frequently called on to advise police investigators, clinicians, judges, and lawyers on methods for eliciting and evaluating memories. In her spare time, she is an aspiring artist.

through. From the poetic view, words make sense of images, milky and fluid, or pointed and sharp: 'words spun in strings from a cloud of images'. This collaboration portrays these ideas via wallpaper, with suggestions of the organic realms of frosty mornings and Dunedin's magical trees, the cityscape of Belleknowes houses on hills, trolleys and trains, pathways to school, library stairwells. Specificity of the bumblebee telephone, Peter Pan collars and cups full of tea weave in and out, in pointillistic impressions, as do parents' gold-nibbed pens and dahlias in rows. The collaboration builds a story of memory, and participants will be able to peel back layers and engage in points of discovery.

In many ways, this might be a visual interpretation of the hinting at a future poet, drawing on image and language from the Cilla McQueen herself – 'memory around which words gather'. With an eye on artistic and poetic interpretation, the project represents the science of layered memory, from the domestic realm of a small girl to the imaginary space of sky and flight.

Manu Berry is a printmaker at Bellamys Gallery in Macandrew Bay. He works in a variety of print mediums, and has enjoyed collaborating with musicians, academics and writers, extending his practice to fit each project. He especially loves working with poets, and the process of translation from word to image that compels him to engage more deeply with their work. He has worked with Cilla McQueen before, producing black and white woodcuts for a volume of her poems, and he is excited to be collaborating with her in this new format.

Michelle Elvy is a writer and editor in Ōtepoti Dunedin. Her poetry, fiction and creative nonfiction examines intersections in our natural world, often drawing on themes of memory, time and historical resonance, and rhythms of the sea, from her life aboard her sailboat. Her books include a small novel *the everrumble,* a short story collection *the other side of better,* and many anthologies, most recently *A Kind of Shelter: Whakaruru-taha* (Massey University Press, 2023), which she co-edited with Witi Ihimaera.

Pathfinding for Smell

Yusuf Cakmak

The olfactory (Smell) system is one of our senses that accompanies the memory coding of episodic events along with the merged perception of other senses. On the other hand, the olfactory system has direct neural links with deeper brain structures, including the entorhinal cortex that relays to the hippocampus, which helps memory consolidation with its tripartite synaptic organisation. The olfactory nerve has the earliest signs of neurodegenerative diseases like Alzheimer's and Parkinson's. Covid and aging have also been found to disrupt olfactory perception.

Numerous different but invasive approaches have been used to stimulate the olfactory nerve through electrical stimulation to improve its activity/function. On the other hand, we aimed to non-invasively stimulate the olfactory nerve to improve its function. In this context, we designed a novel wearable olfactory nerve stimulator as glass. The digital modelling of direct current electrical fields demonstrated

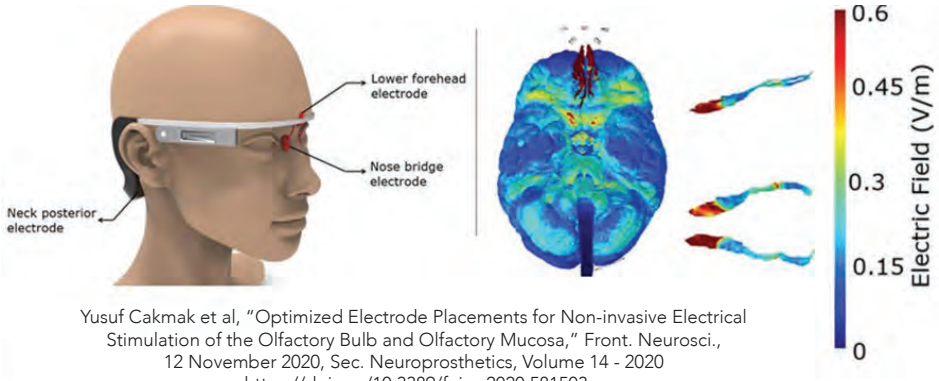
Yusuf Cakmak
Christine Keller
E M Davidson
Pam McKinlay

that our wearable stimulator's optimal electrode configuration can stimulate the olfactory nerve and hippocampal region. It is known that direct current can decrease the threshold of peripheral nerves. In this context, the aim of targeting the olfactory nerve with direct current is to decrease the threshold of its response to volatile compounds.

We also trialled an indirect way of stimulating the olfactory nerve with an alternative current and explored how the olfactory nerve function can be improved. This approach is based on the documented functional connectivity between the cranial nerves (Vagus nerve and Olfactory nerve in our case). Our results also demonstrated that olfactory system function can also be improved with auricular (ear) vagal nerve stimulation. We also demonstrated that the olfactory system response to our alternative current stimulation is frequency-specific.

Our lab's research explores neural pathways to develop non-invasive therapeutic stimulators, including the olfactory system/network. Our direct and indirect non-invasive approaches to olfactory systems aim to develop wearable systems for point-of-care technologies that can be helpful, especially for early dementia and memory loss.

In this project, I worked with two textile artists: Pam Mckinlay and Christine Keller. I had been flourishing my lectures with the anecdotes of the hundred-year-old discussions between the artist Gustav Klimt and anatomist Emil Zuckerkandl for years, and I mirrored the joy of Emil Zuckerkandl in the moments that I spent with Pam and Christine and how they perceived and interpreted our research with their artistic perspectives and skills.



Yusuf Cakmak et al, "Optimized Electrode Placements for Non-invasive Electrical Stimulation of the Olfactory Bulb and Olfactory Mucosa," Front. Neurosci., 12 November 2020, Sec. Neuroprosthetics, Volume 14 - 2020 https://doi.org/10.3389/fnins.2020.581503

Associate Professor **Yusuf Ozgur Cakmak** (MD, PhD) is a researcher in applied anatomy for non-invasive wearable neuromodulation and remote health monitoring using nearable devices. A/Prof. Cakmak leads point-of-care technologies theme for Centre for Bioengineering at the University of Otago, where he holds an Associate Professor position at the Department of Anatomy. Cakmak holds over ten international patents and has founded spinoff companies specializing in wearable neuromodulation and mobile phone-based diagnostics in the US. He is also a member of Interventional Technologies theme at NZ Consortium for Medical Device Technologies and provides invited expert opinions to numerous governmental grants, including NIH (US), ERC (EU), and MRFF (Australia). Cakmak's research is supported by Health Research Council New Zealand and New Zealand Medical Technologies Centre of Research Excellence grants.

Yusuf Cakmak
Christine Keller
E M Davidson
Pam McKinlay

Christine Keller

The smell of Ribes Sanguineum

When looking at Yusuf's work, I became interested in the connection between memory, the sense of smell, and the ear he is researching on. The distribution of an electric current to the ear (e. g. with a wearable device) interacts with the olfactory system that perceives odours and relays it to the deep brain regions that forms the memory. This connection is important in the context of early stage dementia and Alzheimer's disease, when one of the first signs of memory loss is when the sense of smell weakens.

Lately walking in my neighbourhood, I have passed by a flowering current *(Ribes Sanguineum)*. It is very distinct smell, which reminds many of cat's pee, but which never fails to transport me directly into my childhood in the garden behind our house. In this memory, I am hunting for easter eggs. The cherry, apple and forsythia trees are in flower. It is spring and I can hear a blackbird calling. I am using this imagery as an example of the memories a particular scent or smell can trigger.

My research for this show is my first project in Jacquard weaving since 2007. Jacquard weaving is a passion of mine since the mid-1990s, but the equipment is rare and expensive and I haven't had the opportunity to use a Jacquard loom since I was a post-graduate student. In November 2023, I was able to buy one of only three TC2 Thread Controllers in New Zealand for my private studio. While my memories are rich and colourful, my abilities on my new tool are still limited. I hope you enjoy these prototypes from the new loom.

The smell of Ribes Sanguineum, a series with six woven panels.

Christine Keller is a German New Zealand master weaver. She uses her art to tell contemporary stories about science, environment, community, power and value.

The scents of my home land

E M Davidson

To paraphrase L. P Hartley, the past is a homeland to which you cannot return. The past becomes ever more indistinct and suppositional as you journey from it, though it is possible albeit briefly, to be transported by a word, a sound, a taste, or a scent, often these memories surface when least expected.

In this work I am playing with the idea that scents can unlock connections to memories forgotten. Photography being an imperfect medium for the communication of scent, I can only build the remainder of this triangle of association and see where it leads.

Yusuf Cakmak
Christine Keller
E M Davidson
Pam McKinlay

Swimming togs forgotten
in a school bag

Boiling cabbage

Electrical smoke

Service station forecourt

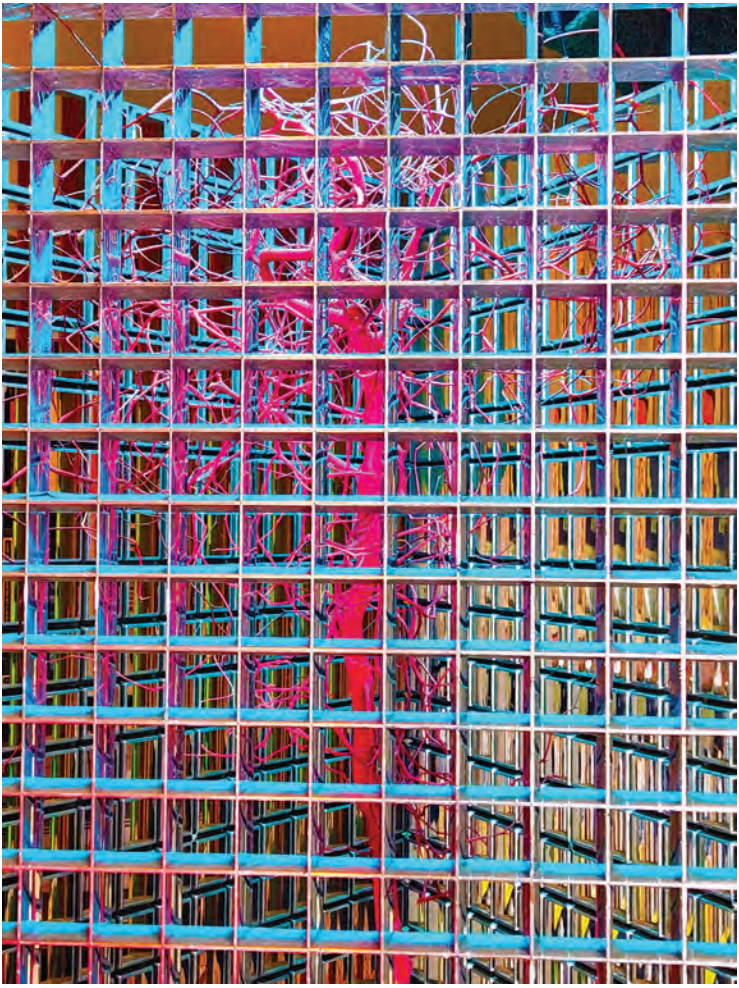
Rain on a hot road

What does Climate Change Smell like?

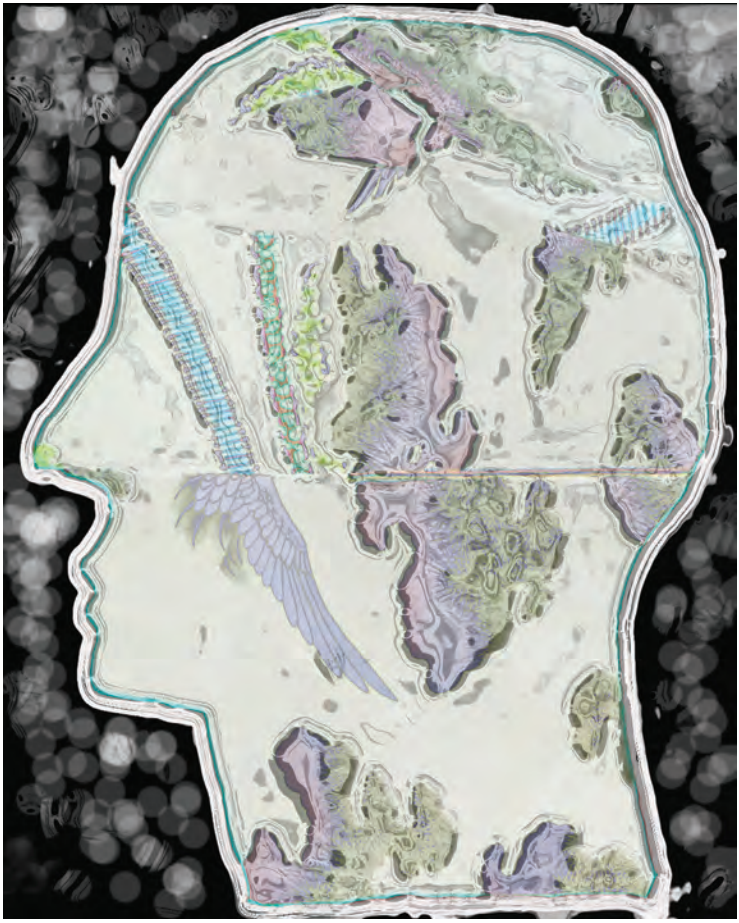
Yusuf Cakmak
Christine Keller
E M Davidson
Pam McKinlay

Pam McKinlay

Continuing with pioneering work of Cajal into the trisynaptic circuit or trisynaptic loop in the hippocampus, this work explores ideas around the porosity of this neural system and the perception route of the volatile compounds from the olfactory bulb to the hippocampus, a swan like structure at the centre of our brain. Day after day our neurons remodel themselves in response to environmental cues, ensuring that the brain adapts and operate over our lifetime. Advances in neuroanatomical mapping have built on the work of Santiago Ramón y Cajal to precisely observe and map the neural circuits to better understand how memories are stored, retrieved, and lost in the distributed temporal spatial grid where we store, access and recreate our memories.



Sleeping swans, forest branches, roses and tuna sandwiches, 2024.
With thanks to Joanna Wernham and Brendon Monson.
Triangular sculpture, LED light, branch.



What does Climate Change Smell like?
Light box, 2024. 1170x570mm.

This image was an artistic response to patterns of spiking behaviour in areas of the human brain related to smell. Inspiration for the inner layering of the images came from the (MICrONS) program which map neural dynamics in the Allen Brain Observatory.

Our olfactory memories are contextual. For some people, a whiff of smoke out of doors will transport them back to pleasant memories of a family barbeque or camp fire. For those caught up in devastating forest fires, this will create an adrenaline rush as they search for the source of the smoke. In years to come as we are hit with increasing disasters, will we carry collective memories of what Climate Change smells like?

What does Climate Change smell like to you?

A River Flows Through Me III.
Light box, 2024. 1170x570mm.

How have we learnt about smell and what are our memory associations with this sense? How do our memories prepare us for the future?

Our sensory interactions with the world are layered and filtered in our brain to become a story in our minds eye.

A photomontage inspired by Ramón y Cajal histology drawings has been overlaid with photographs of melting ice and glacier fed rivers and lakes. Onto this image-base overlapping pathways were drawn in ink.

Contacts

Katharine Allard	katharine.allard@gmail.com
Paulina Barry	paulinabarry13@gmail.com
Rachel Baxter	r.j.mbaxter@gmail.com
Manu Berry	manuberryprints@gmail.com
David Bilkey	david.bilkey@otago.ac.nz
David Burritt	david.burritt@otago.ac.nz
Yusuf Cakmak	yusuf.cakmak@otago.ac.nz
Becky Cameron	beckycameronart@gmail.com
Vincent Chevillon	vchevillon@gmail.com
Fiona Clements	senorita.awesumo@gmail.com
Craig Cliff	thecraigcliff@gmail.com
EM Davidson	emilymdavidson@hotmail.com
Heidi Dungey	heidi.dungey@scionresearch.com
Heramaahina Eketone	heramaahina.eketone@icloud.com
Michelle Elvy	michelle.elvy@gmail.com
Kane Fleury	kane.fleury@otagomuseum.nz
Virginia M Gautusa	iamvirginiamau@gmail.com
Jenny Jandt	jenny.jandt@otago.ac.nz
Christine Keller	christine@christinekeller.co.nz

Contacts

Savannah Kerekere	savannahk2828@gmail.com
Janice Lord	janice.lord@otago.ac.nz
Stu and Marama McDonald	ahipoutu@gmail.com
Pam McKinlay	pam.mckinlay@op.ac.nz
Connal McLean	connal.mclean@tepapa.govt.nz
Gabby Malpas	gabby@gabbymalpas.com
Aislinn Mirsch	mirai260@student.otago.ac.nz
Ellen Murray	ellenmurrayb@gmail.com
Faye Nelson	faye.nelson@otago.ac.nz
Isaiah Okeroa	isaiahokeroa@gmail.com
Shannah Rhynard-Geil	shannah.rhynard-geil@otagomuseum.nz
Sarah Shackleton	sarahshackleton62@gmail.com
Steve Ting	steve.ting@otago.ac.nz
Locke Unhold	locke.unhold@op.ac.nz
Hayley Walmsley	hayleyrwalmsley@gmail.com
Susan Wardell	susan.wardell@otago.ac.nz
Sophie White	sophie.white@otago.ac.nz
Rachel Zajac	rachelz@psy.otago.ac.nz

Acknowledgements

Thank you to all those who have helped to make this Art+Science Project possible with funding and support in kind from: the Dunedin School of Art and Otago Polytechnic Te Pūkenga, University of Otago, Scion, Dunedin City Council and Creative New Zealand, Curious Minds Participatory Science Platform, Tūhura Otago Museum, Stitch Kitchen, New Zealand (Int.) Science Festival. With thanks also to Jenny Rock, Bridie Lonie and Michelle Elvy for comments, suggestions and proof reading of texts.

Many of the artworks in the exhibition are available for sale. Please contact the artists directly regarding their works.

Memory and Mind
Published by Pamphlaterre Publications, 2024

ISBN 978-0-473-71508-3 Paperback
ISBN 978-0-473-71509-0 E-Pub

Type layout by Joanna Wernham
Printed by Uniprint, Dunedin New Zealand

Pamphlaterre Publications
Pam McKinlay
Dunedin, New Zealand
pamphlaterrepress@gmail.com