Unsettling epigenetics: contested understandings of trauma and evidence in settler colonial Australia

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October 2023

Thesis submitted for the degree of Doctor of Philosophy in Sociology, Criminology, and Gender Studies (School of Social Sciences)
The University of Adelaide

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Abstract

This thesis examines how the search for biological evidence of intergenerational trauma through environmental epigenetics has become a highly contested space within Indigenous health research in settler colonial Australia. Intergenerational trauma is a popular model for understanding how colonial and racist policies have had, and continue to have, long-lasting and multi-generational impacts on the health and wellbeing of Indigenous peoples. Environmental epigenetics is a field of post-genomic science in which genetic expression is understood to be plastic and changeable due to exposures to environmental factors such as nutrition, stress, and trauma, and it has been linked to intergenerational trauma within Indigenous health spaces. The possibility of epigenetic inheritance of trauma across generations has captured the imagination of many researchers, scientists, and health workers.

Conducting qualitative research during COVID-19, including interviews with Indigenous and non-Indigenous health workers, researchers, lab scientists and social workers, archival research, ethnographic fieldwork at scientific conferences both in-person and online, and fieldwork on remote Indigenous lands in South Australia, the thesis explores how evidence of trauma through epigenetics is produced, enacted, and performed in different evidentiary spaces. Drawing on key theoretical contributions from Science & Technology Studies and medical anthropology, the thesis demonstrates that the allure of epigenetics lies in its capacity to validate existing Indigenous knowledges on intergenerational trauma within a molecular frame. However, this same aspect is also what concerns many participants, as it positions molecular evidence of intergenerational harm as more legitimate than other forms of knowledge and evidence. Additionally, epigenetic models of trauma risk perpetuating a deficit-based model of Indigenous health by continually ascribing ‘damage’ to Indigenous bodies at a molecular level. The thesis links these tensions surrounding intergenerational trauma and the role of science in producing evidence of harm to the tensions present in the 1984-85 Royal Commission into British Nuclear Tests in Australia, a Royal Commission that sought to bring to light the ongoing, intergenerational impacts of the British nuclear testing program that occurred in South Australia in the 1950s-60s. By placing contemporary environmental epigenomics into conversation with historical radiation exposure from nuclear testing, the thesis demonstrates how concepts such as porosity, inheritance, trauma, and the privileging of the biological have long been intertwined in matters of evidence production and hierarchies of knowledge when it comes to Indigenous health in the settler colonial state of Australia. By drawing attention to these overlapping fields, this thesis seeks to critique and unsettle how biological ‘evidence’ of intergenerational trauma is imagined, produced, circulated, and contested within Indigenous health contexts in Australia.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint award of this degree.

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I acknowledge the support I have received for my research through the provision of an Australian Government Training Scholarship.

Signed Dated 11 October 2023

Henrietta Byrne

Acknowledgements

This research took place on Kaurna land, Yankunytjatjara land, and Ngunnawal and Ngambri land. I acknowledge the elders past and present of the lands I worked on.

I acknowledge and thank the participants of this research, without whose generosity this work would not exist. I particularly acknowledge Karina for inviting me to spend time on her country.

This research was supported by an Australian Government Research Training Program Scholarship and an Australian Research Council Discovery Project, no. DP190102071. I am thankful for additional financial support from the Australian Academy of Science Moran Award for History of Science Research, and the Karen Halley Trust fund for students of Gender Studies.

This work was guided, shaped, and developed in collaboration with many scholars to whom I am so grateful. Thank you to my principal supervisor, Professor Megan Warin, for modelling what feminist mentorship and care can look like. Thank you for inspiring me to work beyond what I thought possible, for believing in my ideas and pushing me to believe in them too. Your careful and generous supervision has left an indelible mark on this work and on my development as a scholar. I am honoured to be your student.

To my co-supervisors, Associate Professor Georgina Drew, and Associate Professor Bastien Llamas, thank you for being a part of this work and for lending your expertise and knowledge in your disciplines of Anthropology and Life Sciences to this project. We were truly an interdisciplinary team, and it was a joy to work with you.

As a member of a Discovery Project team, I had the privilege to learn from Professor Emma Kowal and Associate Professor Maurizo Meloni. Particular thanks to Emma Kowal for reading an early version of this thesis. Thank you to the Advisory Committee of the Discovery Project for their guidance and for holding us accountable – Prof Kerry Arabena, Prof Alex Brown, Prof Jeff Craig, A/Prof Stephanie Gilbert, A/Prof Glenn Pearson, Dr Greg Pratt, A/Prof Kym Rae, A/Prof Rick W. A. Smith, and Dr Mark Wenitong.

I am most grateful to the Discovery Project for connecting me with Dr Jaya Keaney, a scholar whose intellectual force and genuine commitment to collaboration has been inspiring to me. Researching together, writing together, and talking ideas through on zoom calls and phone calls at all hours has been crucial to this work. I am so proud to have found a collaborator, mentor, and close friend in Jaya.

For answering questions and pointing me towards important insights, I also thank Emerita Professor Margaret Allen, Dr Maggie Brady, Dr Jenni Caruso, Dr David Denborough, Tom Gara, Professor Vivienne Moore, and Cheryl White. Thank you to the TopEnd STS reading group and Deakin ECR epigenetics writing group for sharing thoughts and comments on early versions of my research.

Thank you to my department at the University of Adelaide, particularly my office mates Lily Atkinson, Matt Barlow, Carina Craft, Tarmia Klass, and Nat Thomas. Without having Pallavi Laxmikanth by my side I am not entirely sure I would have navigated writing a PhD during a pandemic (or at all) – thank you Pallavi for your unwavering solidarity, clearheaded advice on how to keep writing, and your friendship, which has been a true blessing.

Thank you to my community of friends for looking after me in the stressful times and helping me to find joy and rest in between – Reade Allison, Matilda Copeland and Alison Coppe (and baby Roma), Hugo Cronin, Robert Farquharson, Maddie Goldsmith, Ariane Jaccarini, Sara Perri, Elliott Papazahariakis, Lukas Papagiannis, Camilla Trenery, and Seb Tonkin. I am especially grateful to Natalie Carfora for help formatting this document. Thank you to Maddie Sarre and Jessica Black for keeping me afloat, always listening, challenging me, and inspiring me. I am most myself when I am sat on a beach somewhere on the South Australian coast with you both, talking things through.

Lastly, thank you to my family – to my mum Linda Foreman and dad Daniel Byrne for their unconditional love, support, enthusiasm, and encouragement, and to my sister Sophie Byrne for answering my calls and knowing how I feel and what I need to say before I even do. Thank you for everything.

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Introduction — 'Nuclear is gonna be in our family forever': open bodies and closed borders on sacred and scarred country

There is something extra special about arriving at a new camp at night. Having spent a few days in Coober Pedy and Oodnadatta, we (myself and three female linguists) decided to take the scenic route through the Painted Desert west to Wallatinna, so we arrived well after sunset. At the turn off to Wallatinna Station, we met our colleague Karina, a Yankunytjatjara-Anangu woman, and followed her Toyota down the dark track until she pulled up at *tjamu*'s camp (grandfather's camp). Karina set up the fire while we set up our camp, and when she was satisfied that we had everything we needed, she left us to it and drove up the track to the homestead, her Wallatinna home. And so I got into my swag that night not quite knowing where I was, but knowing it was sacred country.

The next morning, I had a proper look at *tjamu*'s camp. An old bed frame, a shovel with a smooth carved wooden handle, pannikins and tins and a billy all hooked on a tree ready to use. A big pile of *waru* (firewood) and a worn fire pit. With the red dirt warming up by the minute as the sun settled in, we got ready to make our way up to the homestead, still not entirely confident where that might be, and heard shouts from Karina's six year-old, May, and barks from one of their dogs, Bailey, who had come down to help us out. We all piled into the Toyota – Bailey running alongside the car – and we followed her directions to the homestead. Karina was out checking some tracks, so May became our tour guide for the morning. She showed us the important bits of the huge property; the old cars (including Karina's old yellow one that I had heard stories about) and a massive Country Fire Service truck from Streaky Bay, the Walla windmill, the small patch of lawn which acted as a sort of backyard within a backyard. May took us in the direction of the few other houses in the area – Russ (who later introduced himself to me as a 'Mintabie refugee') over there, Uncle Lionel over there.[1] She then asked us if we wanted to go meet poppa. It was about 8:30am, and one of my colleagues wondered if maybe we should wait a bit before making introductions, but May didn't seem worried and just told us to follow her. As we walked further out towards the horizon it became clear that we were being led to a small graveyard, and not to a house. May opened the low wire gate that marked the graveyard

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[1] Mintabie is a remote former township that was closed by the South Australian government in late 2019.

and introduced us to her poppa, Mr Yami Lester. She didn't let the dogs in, as she said they stand on the grave. Some flowers in a small vase had fallen over and May asked me to go stand them back up. As I did I glanced at the tombstone. *Yami Lester OAM, 1941-2017. Always and forever a stockman*.

Wallatinna Station is about 1,100km from Adelaide, just west of Marla, and one of the first Anangu Pitjantjara Yankunytjatjara (APY) communities off the Stuart Highway if you're coming up from the south.[2] About 200km south-west from Wallatinna is Emu Field. At Emu Field there is another tombstone of sorts (see figure 1). This one reads *Test Site. Totem 1. A British atomic weapon was test exploded here on 15 Oct 1953* and *Test Site. Totem II. A British atomic weapon was test exploded here on 27 Oct 1953.*

Figure 1: Obelisk at Operation Totem test site with inscription of test dates. Photo reproduced from Trove, Monument Australia.

Back at Wallatinna station after our tour from May, we met up with Karina and went for a drive to the sand dunes where her father Yami was living and working on that day in 1953. The old *wiltjas* (shelters) are still standing – low wooden structures nestled in amongst the red dunes.

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[2] The APY Lands are a local government area (LGA) for and governed by Aboriginal people. The LGA was established in the early 1980s with the passing of the *Anangu Pitjantjatjara Yankunytjatjara Land Rights Act 1981*.

Karina sat down in front of one of the *wiltja* and gestured up to the sky, referencing the ‘black mist’ that Yami and other Yankunytjatjara men, women, and children saw rolling in from the west. She talked about how this mist then fell down, and how it ‘scarred up’ the country and the people. She told us the stories she was told as a young girl, talked of how the women dug holes in the dunes to try and protect their children from this mysterious silent rain – digging deeper into the earth, placing the kids deeper into the ground where it should’ve been safe, but of course it wasn’t anymore.

From the 1980s onwards, when activism led to a Royal Commission into British Nuclear testing, the story of the ‘Black Mist’ and what happened in South Australia in the 1950s has become better known. Yami lost his eyesight due to the atomic fallout of that first Totem test, and spent his entire life fighting for justice and recognition of the harms of nuclear testing, intersecting this fight with the fight for land rights. Listening to Karina talk about the scars on her country and people some sixty years later, I found myself wanting to know more about how she reckons with this legacy. Down at the sand dunes she described the black mist as a dusty, dark ash, settling on everything in sight. She evoked for me an image that she was often told about – of the pastoralist’s orange trees which were coated in black dust, and then, the next day, of women waking up to find that all the fruit had been eaten up by atomic acid. Shrivelled black oranges lay on the ground. Up at the homestead, there are *punu* (plants) everywhere; the linguists had travelled there to film Karina describe these native plants in Yankunytjatjara. As we walk around the homestead looking for plants, we walk past one of these large citrus trees. The fruit isn’t quite ripe, but it’s there, and I stop to have a look. I think about this tree bearing nuclear fruit and feel almost fearful of it. But then I think about Karina’s six-year-old daughter picking and peeling oranges on her grandfather’s country, and playing amongst all the other *punu*, and I feel silly for associating risk with the tree. How does Karina, who tells me that ‘nuclear is gonna be in [her] family forever’ make sense of being on the ‘damaged’ land of her ancestors? How does she keep her family connected to their sacred land while holding the stories of its scars? How does she feel when she looks at that citrus tree? How do those legacies of harm and exposure seep into the present, and what about the future?

British nuclear testing in South Australia

Before reckoning with those questions, it is first necessary to briefly lay out how Emu Field and other parts of the Great Victoria Desert came to be sites of nuclear testing. In the late 1940s, the British Government sought to find a suitable location in which to test explode nuclear materials. Due to the secrecy and tension in the British-American relationship at the time, Britain's first choice of a site in the US was rejected, and so attention focused on Australia. The first tests occurred in the Montebello Islands in the North West of the continent in 1952, followed by testing at Emu Field and Maralinga in South Australia. The 'relentless Cold War fever of the fifties' was such that Robert Menzies, Prime Minister of Australia at the time, agreed to Britain's proposal to test nuclear weapons with a surprising level of enthusiasm (Milliken, 1986: xiv). The notion that the entire Australian desert was empty land was crucial to Menzies' belief that Australia was well placed to host Britain's testing program. Indeed, he famously said in 1953 that 'no conceivable injury to life, limb or property could emerge from the tests conducted in the vast spaces in the centre of Australia…with all our natural advantages for this purpose' (Milliken, 1986: 58). These 'vast spaces' of course include the Anangu Pitjantjatjara Yankunytjatjara Lands on which I was travelling with Karina and her daughter. Emu Field was chosen because of its remoteness and was abandoned for this reason too. After the Totem 1 and Totem 2 tests in 1953, testing at Emu Field ceased, with officials citing too many complications in accessing water and transporting materials. The remainder (and bulk) of the testing program took place at Maralinga, some 200km south of Emu (the 'Field' is mostly dropped when you are out there, in the field). The test series at Maralinga ran until 1963, as the Maralinga location was considered remote enough to be 'safe' for the general Australian population, but not too remote to function, as was the case with Emu. At both locations, surveyors were employed to carve roads through the desert and to install weather stations – to create entire military communities out of so-called baron lands. The traces of these roads and these constructions (both literal and metaphorical) are still present in the country today.

Borders, roads, and boundaries

In many ways, when I went to visit Karina at Wallatinna Station, what we spoke about were boundaries – keeping things out and negotiating what happens when they get in. Borders, boundaries, and the slippages that occur when trying to contain space, land, contamination, bodies, are crucial to the story of nuclear testing in South Australia, and to this thesis.

Considerations of borders had already come up in the very process of getting to Wallatinna. I have travelled in the North of South Australia before, but I had not been to the APY Lands for a research trip. This particular trip came together in a very last-minute way. I was visiting my colleagues at the Mobile Language Team, an Aboriginal language centre I used to work at, as I do quite often, and they were in the middle of one of those classic fieldwork conversations which goes along the lines of ‘hang on, who is actually going to drive?’ It became clear that they needed another person to help with the drive north, and since I happened to be in the room and talking with Karina, it was settled. We then had about two weeks to organise the details. To enter any community group on the Anangu Pitjantjatjara Yankunytjatjara Lands (as a non-resident, and especially as a researcher), a permit request needs to be approved by the APY Council. This is the first border I started to think about. Due to COVID-19 considerations, we also completed two health checks (self-reported symptom questionnaires) which added to the sense of really needing to demonstrate that ‘going in’ to the Lands was necessary, and which added another good reason to keep city folk ‘out’. To submit a request for a permit we each supplied an application form, Risk Management form, Health Record form, and a national police check. We listed the three communities to which we were requesting entry – Wallatinna, Mimili, and Iwantja (Indulkana) – and provided a short description of our intended activities in the Lands (linguistic and anthropological research with an Anangu colleague). Karina herself sits on the board which approves such requests, and so in a matter of a couple of days our applications were approved, and we were sent PDFs of the permits to print out and put on the dashboard of the Toyota. We were ‘in’.

Given the context of COVID-19, where state borders in Australia suddenly became visible and tangible realities, as opposed to mostly unmarked roads, the feeling of ‘getting in’ was a slight thrill. The border of the APY Lands cuts across three state borders (SA, NT and WA), borders which dissolve as dirt roads take over. Turning off the Stuart Highway at the main entry road to the APY Lands, it really does feel like you are crossing an invisible but powerful line. The first time we saw a brightly coloured ‘APY Lands’ sign, we all felt excited. The more senior linguist of the group who had been working in the field for over five years was especially giddy. ‘Finally, I’ve finally made it to the APY Lands! People are always surprised when I say I haven’t been yet.’ As an anthropologist, the uneasiness of celebrating the crossing of a border which was explicitly constructed to make self-determination and self-governance as much of a reality as possible, stopped me from expressing my excitement quite so outwardly. But I was excited, and it was beautiful country we were in. The roads which take me to Coober Pedy or to Oodnadatta have become familiar, and though they are remote and dusty, they don't feel like the roads in the APY Lands. The mythology of this place precedes it. There is a certain reverence here. The roads are dustier, the dirt is redder, the remoteness is somehow remoter, and there is a heightened sense of having *made it somewhere* 'we' wouldn't usually travel. Having travelled up and in to the APY Lands, it was possible to see this land as an example of self-governance, a place where Anangu had control over their sovereign border. But of course, this was not always the case, as became increasingly clear when we started to talk about the Emu Field nuclear testing. The boundless, remote, and seemingly empty central desert was specifically chosen as a site to launch the first mainland nuclear tests in Australia because it was far away from 'civilisation'. The same characteristics which give the APY Lands their capacity to enforce a certain boundary from settler intervention now are what drew the British and Australian governments to so severely intervene on the land in the 1950s. Then, nuclear fallout made its way into the lands, and I got in to talk about how this 'getting in' was being felt some sixty years later.

Porosity and permeability

When scholars in science and technology studies talk about borders and boundaries, they also talk about the lack of such things: about porosity. Porous and permeable bodies have been the site of anthropological inquiry for a long time. In her work in Melanesia, Marilyn Strathern discussed the concept of the 'dividual' person as opposed to the individual (1988). The idea that the body is not bounded has more recently been taken up in work on feminist new materialisms, and in the field of post-genomics, where concepts such as the microbiome and epigenetics seek to problematise the singular, non-porous self. Broadly, this work can be housed under the study of entanglements; 'to be is to be related' (Mol, 2002: 54). The defined and bounded categories of Western enlightenment are finally being challenged by this turn towards entanglement, and often these entanglements – between bodies, microbiota, chemicals, other bodies – are discussed in ways which highlight the freeing or liberating potential of the extended and fluid self. This celebration of 'the postmodern collapse of distinctions between inside and out' (Roberts, 2017: 594) is heralded as a revolutionary opportunity to live 'with' and live better – as Elizabeth Roberts writes, to live 'in mutuality with each other on and with this planet' (2017: 596).

However, as Roberts also notes, the permeability of one's body is not always an opportunity for excitement; oftentimes it is a burden which needs to be highly managed in order to ensure survival. In considering how residents of a *mala fama*, a 'working class neighbourhood of bad reputation' in Mexico City, navigate and construct boundaries in an environment of violence, Roberts demonstrates how a desire to enforce boundaries for survival complicates the 'recent embrace of entanglement' in social sciences (2017: 594). She highlights the fact that certain bodies are exposed to more toxins and more social harms than other bodies, and that this needs to be foregrounded in discussions of permeability. Similarly, in his recent ethnographic film *The Body Won't Close: Bahian Tales of Danger and Vulnerability*, Mattijs van de Port explores how Bahian men seek to 'close' their bodies from dangers that they face – from knives and bullets, but also from everyday forms of violence that seek to infiltrate their lives – lives which are lived in a context of poverty, crime, and racial tension (2021). Through ritual, recital, and bathing with certain herbs, men in Bahia (the fourth largest state in Brazil) reject the notion of the porous body by seeking to make themselves literally impenetrable. In the opening monologue of the film, van de Port recounts how an interlocutor cautioned him that 'the world is a dangerous place, and open bodies are vulnerable'. Here in Bahia, one 'cannot be like a wide-open field', one must be separate and solid, 'like a fortress' (van de Port, 2021). There is an understanding here, both in Bahia and Mexico City, that in situations of ongoing harm and violence, the body as porous is a complicated concept. Or, as Roberts rather succinctly puts it, 'certain groups of people are and have always been entangled in shit' (Roberts, 2017: 596). In her work, Vanessa Agard-Jones also considers how the challenging manifestations of permeability or porosity impact certain bodies more than others, namely women of colour in Martinique, referring to the 'chemical kinship' that certain peoples must navigate in their everyday lives (Agard-Jones, 2017).

In the APY Lands, Karina too highlights the anxiety (as opposed to an idea of post-modern liberation) that the porous body engenders when it comes to radiation exposure from the Totem 1 and 2 tests on her country. She describes how the fallout got into her land and into the bodies of those living there, how it 'seeped in' and 'made scars'. It was important to Karina that we sit and talk about the testing and the fallout in the place where it happened, so we followed her on a short drive from the homestead to the sand dunes. It was around 11 in the morning; the sun was full and fierce, and I was sitting under the small amount of shade that a mulga tree provides. Karina sat in front of a *wiltja* with a lapel microphone and the lens of a camera directed at her, as some of this conversation was going to be filmed and used as an educational resource (see figure 2).

Figure 2: One of the old wiltja (shelters) at the sand dunes, the Anangu camp at Wallatinna Station. Author's own photo.

One of the linguists was working the camera, another was holding a silver reflector to catch the sunlight, and the third was walking around the sand dunes with a zoom recorder taking soundscapes. Under the mulga tree, I was simultaneously trying to keep May quiet during recording and trying to take notes and ask prompting questions for Karina to speak to. She spoke in Yankunytjatjara for about twenty minutes, and then paused, had some water, and began to re-tell her story in English.

I am including here a large unedited portion of the transcript that we recorded down at the sand dunes, in Karina's own words. I do this in line with Jennifer Biddle's assertion that including original transcriptions, translations or images can 'bring into being and make-present what my words only gesture towards' (2019: 414). I am also informed by Max Libioron's description of reading transcripts and citations as 'an event to sit with…rather than as a source to pull things from' (2021: 15). As a witness to her words, having been allowed to hear them on her country, I can summarise Karina's story, or I can let her tell it:

> So the sand dunes where we are at are the sand dunes at Wallatinna and there's one story I wanna tell which is the story of British nuclear testing that happened in 1953, in October 1953. This is where a lot of Anangu lived around this area here and the old shelters. And this black mist that rolled toward Anangu, they could see it but it came with no noise. Anangu who lived out here knew about dust storms, they could see dust blowing and this one didn't come with any noise, it came silently through, but they could see it, which is where it was quite scary for a lot of Anangu not knowing what this thing was that was approaching them. So there was a lot of fear in this camp here and a lot of Anangu who didn't know what this was started to dig holes in the dunes to hide children away from it because they didn't know what it was – something evil, silent, black was coming over them and they didn't know what it was so in fear they started digging holes in the sand dunes to protect the children, well, trying to protect their children.
>
> And you see the old scars. You see the old shelters and you know the stories. You hear stories from old people who have passed on but who were around in the 1980s to give evidence in the Royal Commission and then also to dad's credit I guess in really exposing what happened to Aboriginal people, to Anangu people in particular at that time with the Totem 1 and Totem 2 [tests]. So Emu had a huge impact over *Anangu tjuta* on the Anangu Pitjantjatjara Yankunytjatjara lands, and Maralinga had a huge impact on communities further south like Oak Valley and Yalata way and Koonibba area as well where there was a lot of radiation. But this particular location is where we and a lot of

Anangu from the Wallatinna community experienced that radiation fallout over this community, and this main camp here where my late father Yami Lester grew up and spent a lot of time through this area here as a young boy. And he remembers that particular day when the ground shook and the black mist rolled, you know in those testimonies [to the 1984 Royal Commission] he spoke about his eyes becoming very sore, very pussy, very painful. He talked about how he had to be led around with a stick by somebody, I think it was his older brother, and he would hold a stick to be able to walk about country. Over time then he was able to get some sort of vision in one of his eyes and then one eye completely went, and then he was sent down to Adelaide where he lost complete vision, where the doctors made a decision to remove his only eye that was sort of working, and that's when his life completely changed then, where he became completely blind. It happened in '53 so within seven years dad was completely blind. So it took something away, that particular day in '53 Totem 1 took something away that is something that's quite … close I guess and always will resonate with us with children and descendants of Yami Lester that it took his vision away.

And so that act of what happened in 1953 by governments of the day – the Australian government and the British government – they made a decision, they were testing out here but these tests took away our people, *Anangu tjuta*. They took away peoples' vision and people's abilities of living a full and healthy and normal life. And there are still many scars. It's a big part of our Anangu history and it's a history that *Anangu tjiti tjuta* (Anangu children) should know about because it's your story…for you to know that history and know that story.

This is where we felt the impact. This is where we heard the ground shake roughly 100kms south from here and this black mist rolling silently towards us, and one bit of evidence that nana Pinkkayi [Karina's grandmother] gave was that it had a really strong smell to it, a stench to it, which was ... I can't even describe it. She said it just had a really horrible smell to it. So all of this country was completely exposed by that cloud that rolled silently through this area here. And that was scary. A lot of fear. They lived out here, they knew country here. They knew dust storms, they knew rain, they knew smells. This was completely different. This was something they had no knowledge of and that

> was the fear because they didn’t know anything about it. But it moved closer and closer, and people became very fearful of what was going on and you know… needing to bury family. A nana of mine in our Anangu history, nana Angelina, talks about how within days she was digging a grave for her parents. Many died and many were scarred up and we are living to this day with some of those effects of radiation fallout and exposure to radiation. This is our little Anangu story here and our little story in South Australia, but then you hover out to the globe and you realise that there are many other Indigenous groups around the globe that have been exposed to British nuclear testing – or to nuclear testing – and that’s a global issue then. Our little story of what happened with Emu, Totem 1 and Totem 2, is a link to that global picture.

After finishing this recording, we walked through the sand dunes for a while before heading back to the homestead for lunch. We were talking and reflecting, and Karina made reference to the constant concern in the back of her mind that potential radiation in this same land, sixty years later, was still ‘getting in’ and harming her family; ‘how do we know whether there’s small doses of radiation that we’re sucking in and you know, *taking into our own body*?’ She remembered being in her early teens and hearing snippets of conversations at the kitchen table about bone marrow testing to search for traces of radiation in her and her sibling’s bodies. She told me that ‘it was always a worry in the back of dad’s mind, and I heard just in dad’s conversations and talks with the family that there were possible tests to do … you know and that was trying to gather that evidence and really *going in deep* to get your traces of your marrow to see if you did have radiation fallout or you know a high dosage of it or whatever the test would reveal.’ Her parents never went ahead with the tests. When I asked Karina how she felt about it at the time she said ‘I don’t really want to think about you know doing a test and is it really necessary? And maybe they discussed it both mum and dad and said ‘Oh well, let’s maybe not expose our children to that trauma’. It is clear from these conversations that whether or not ionising radiation was or is present in Karina’s body or land, the trauma that comes from living with the fear of this potential exposure that has always been in her life – from a young child overhearing conversations about bone marrow testing to the staunch anti-nuclear advocate and mother that she is now – builds and builds. Her body has always been open to harm, and now she worries about her children’s bodies.

Later that night after we had done a full day's work of filming and language work, and had made dinner in the homestead kitchen, the walls of which were covered in anti-nuclear and anti-waste dump stickers, I made Karina a cup of tea and we sat outside to keep talking. It was the 'settling, the resting, and the taking up residence of grief' that trauma can cause that we focused our discussion around that night (Agard-Jones, 2017: 10). We talked about the way that radiation had settled on her country, and about the ways that fear can settle in the body. In particular, I was curious about how the events of 1953 had been felt intergenerationally, across time. The overwhelming way that the Totem 1 and 2 tests made themselves known in the present was Karina's concerns that the land itself might not be safe. Yami was concerned when 'the three children came along' that he was passing radiation exposure on to his children, as evidenced by his brief interest in bone marrow tests. One of Karina's sisters has an auto-immune disease, and although no link to radiation exposure can be proven (a common story when it comes to illness and radiation), Karina said that:

> …that's a worry that's always sort of ringing in our head, was that something that was passed on from dad?…And I don't know, it's my sister going through that trauma and she's so stoic and continuing to get up every day and do what she needs to do in order to have some sort of normality in her life. It's a bit tough and I sometimes feel a bit sort of hopeless and I always do think you know in the back of my mind was it because of this place here?

Of the three children, Karina's older sister is the one who spent the most time at Wallatinna Station. She managed the cattle and the property in the early 1990s, and when working in the cattle yards, the dust 'is just *constant*. You're inhaling a lot of topsoil and you're pretty much covered from head to toe in the dust'. In the Royal Commission into British Nuclear Testing in Australia, dust was a major focus (see Kingsley Palmer and Maggie Brady's 1991 text *Diet and Dust in the Desert*). On outstations and in camps, life is lived with dust. Karina's association with dusty cattle yard work and her sister's auto-immune disease is fuelled by a fear that the very soil of her land is still contaminated, and that this contaminated dust travelled into her sister's body and damaged her health. In this instance, the permeable body is clearly a cause for anxiety. There is no clear way for Karina and her family to know if her sister's illness is in part due to radiation exposure, but it is something that she cannot exclude; 'we think about it and go well our family has second generation survivors of these British nuclear tests you know'. There are these 'little signs in front of you' and 'red flags' that the land could be causing harm. 'Your body *takes some in* and then you have children, and it will always be in the back of your mind whether you're passing something on…with what happened back then with the trauma as well…this could be serious and there could be evidence of it being passed on from generation to generation you know'.

As well as the dust, Karina and her partner have shared their concerns over the quality of the water at Wallatinna; 'you kinda question whether it is a safe space and is it a safe place to raise children and you know young people, little people! I've got my six-year-old running around here and driving in the dust and *taking those things in* and showering in the waters that are from bores that have been sunk that could potentially have – and we've done a few odd tests around on the water…no traces of radiation but you do start to question 'is it really safe for us?' The fact that Karina and her partner have been compelled to test the bore water is a striking indication that the legacies of contamination and damage to her country have not gone anywhere. Her concern for her family, especially May, reflects the tensions of living with exposure. In these conversations, we see that the state violence and desecration of boundaries which led to the exposure of Anangu people to radiation in the 1950s has left enduring marks in the present. It is an example of what Agard-Jones calls the long-lasting 'interface among pain, inheritance, and intimacy' that trauma can engender (2017: 11). Karina is clearly concerned with sharing and understanding the pain her father Yami went through, and the potential for that to be inherited. However, we also turned to the question of intimacy, of how Karina and her family navigate their intimate relation with Anangu land within the context of this pain and destruction. When the citrus trees withered, when the dust is a threat, has that intimacy been severed?

Karina has made reference to the scars on her country, but this country is also sacred. When May took us to see her poppa, she used the present tense – he is just over here, and he is in and of the land. Yami Lester secured a thirty-year lease on Wallatinna Station (only possible thanks to the 1981 APY Land Rights Act which he championed) to make sure that the boundaries of his land would no longer be infiltrated by government. When I asked Karina whether, in the face of all this anxiety over the safety of the land, she would try and go for another thirty-year lease, and then another one, she looked at me like it was the most obvious answer in the world; ‘This is home. And it’s Dad’s country and we feel that, the children and the siblings we feel that it is home and we have this connect’. She began to point out to me how the country was blooming, and how despite the legacies of harm, this very same land is what allows her to heal. There had been a big rain in the weeks preceding our trip, and she said, ‘it’s looking greener than it has for a long time you know, so there’s still life out there on country which is really uplifting. And you kind of think the country’s healing and the country shows, and there are indicators in the landscape and in country that you think well can we hold that as well or can we live a healthy life too out here? It’s a personal journey too and you sort of work through that and go ok I think it’s *payla* (all good). I mean I’m out here and it’s been great being on country, and it is that balance and I think Walla gives us other things.’

The other things that Walla[tinna] offers to Karina are a separation from the demands of the city, an opportunity to teach her family her language, to ‘be grounded and strong in our Anangu law and culture’. Being at Wallatinna provides ‘so much of that mental health and wellbeing’, seeing how ‘country’s bouncing back, and I’m very much a part of this country, and this is dad’s country. It’s gotta be healing for myself to be out here on country’. She referred to this as a ‘balancing act’ – the need to acknowledge the potential risk in the land and simultaneously recognise that being on country is crucial to the healing process after the trauma of the atomic bomb tests. Through her everyday practices at Wallatinna and being with her family on country, Karina is demonstrating how to ‘hold’ these things together; ‘this land did go through trauma, and there was this experience felt over here, felt on our people but felt on our country, but feeling the need to feel that little bit resilient and bounce back after such trauma and that’s bouncing back in your own health and wellbeing – mental health and wellbeing - and *this is what this country offers you,* that balance of being able stop and take note of yourself and more of that spiritual connect that you have to country, because it’s your father’s country and your people moved around and your ancestors moved around and you know there’s that holistic side of our Anangu law and culture. I’m hoping that there is space to overcome what happened in ’53 and what my people experienced and what country experienced, and that there is…that we are both healing. Anangu are healing and that country is healing as well, which is powerful because those two work very closely together, very closely together.’

What we see here is how ongoing trauma and environmental harm can lock people into ‘conditions of woundedness’ (Agard-Jones, 2017: 10), but also how living with, or ‘holding’ these wounds can open space for healing – in this case, healing with the land. There is a direct assertion here that having access to Wallatinna, to Anangu country, is crucial for Karina’s families’ wellbeing and capacity for healing. The boundary of the APY Lands is a boundary that keeps her well, that offers her space to heal. The land may be seen as damaged, but it is also what provides her with the ‘spiritual connect’ that she needs.

In their paper ‘Alterlife and decolonial chemical relations’, Michelle Murphy highlights the fact that most scholarship on environmental exposures, including ethnography, tends to measure the damage that chemicals do to bodies, and to ‘bear witness to the evidence of damage’ (2017: 496). This process can frame already marginalised peoples and communities as ‘inhabiting irreparable states’ (Murphy, 2017: 496). What I am trying to allude to here is that lands which were exposed to radiation due to atomic testing are not and were never uninhabitable or irreparable, and that they can offer the capacity for healing just as much as they can be perceived through a lens of damage. Through navigating relationships with boundaries and permeability, both can be true at once; this is what Karina shows us in Wallatinna.

Science & Technology Studies: an orientation

This thesis examines questions of porous bodies and borders, and explores how the search for biological evidence of intergenerational trauma has become a highly contested space within Indigenous health research in settler colonial Australia. To do so, I engage with key theoretical contributions from the field of Science & Technology Studies (STS). STS is a field of social science which critically engages with technoscience and scientific knowledge production as a social practice. Thomas Kuhn’s 1962 text *The Study of Scientific Revolutions* is often cited as one of the earliest works of what is now termed STS, and the field has expanded and developed from the 1960s onwards. Scholars of anthropology, sociology, history, philosophy, gender studies, postcolonial studies, critical race studies, and many other fields increasingly find STS to be a generative home within which to situate their work. Broadly, an STS orientation is one that ‘rejects the view that science and society are separate spheres and sees science as *part of* culture, and inseparable from it’ (Martin, 2019: 161, original emphasis). Within this orientation, science is understood as a something that is shaped by and actively shapes culture and society.

Indigenous STS scholar Kim TallBear writes of science and society as ‘mutually constitutive - one loops back in to reinforce, shape, or disrupt the actions of the other’ (2013: 11). Angela Willey notes that science ‘has rules’, and that ‘the basic rules are finite: scientific knowledge is based on the scientific method and is objective, that is, value neutral and therefore universal and reproducible’ (2016: 11). STS scholars, including Willey, challenge this ‘pretence’ of science as objective, and highlight its tendency to ‘minimize the complexity of its objects’ (ibid). Donna Haraway has termed the supposed objectivity of science ‘the God trick’, and Thomas Nagel has called it ‘the view from nowhere’ (1988; 1986). In Haraway’s influential 1988 article on ‘situated knowledges’, she describes science as not objective, but rather ‘partial’, and agitates for a view ‘from somewhere’:

> I am arguing for politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims. I am arguing for the view from a body, always a complex, contradictory, structuring, and structured body, versus the view from above, from nowhere, from simplicity. (Haraway, 1988: 589)

Other scholars whose works in the 1980s challenged the view of science as independent from and outside of culture include Sandra Harding (1986), Bruno Latour and Steve Woolgar (1979) and Latour (1987) – all of whom remain important figures in the development of STS as a field. In the last twenty years, STS has continued to expand, and to ‘explore technoscience’s deep imbrications in almost all facets of society and culture’ (Pollock & Subramaniam, 2016: 952). Importantly, those facets of society and culture in which science is imbricated include gender, race, sexuality and ‘other structures of inequality’ (ibid). The role of colonialism and state power in the production and circulation of scientific knowledge has particularly concerned scholars in Feminist STS and Indigenous STS (Pollock & Subramaniam, 2016; TallBear, 2013; Kolopenuk, 2020; Liboiron, 2021; Willey, 2016). In 2019, Smith and Bolnick wrote:

> We consider the decades-long debate about whether science provides a “view from nowhere” to be over: it doesn’t. Science is always of culture – it is always a view from somebody’s somewhere…we ask: How can we centre situated perspectives and embodied knowledges as a way to get “somewhere”? (2019: 465)

In taking an STS approach to the methodology and theoretical orientation of this thesis, I keep this provocation in the foreground. Where can a situated study of the embodied knowledges present in enacting and searching for evidence of intergenerational trauma in Indigenous bodies (and lands) across Australia and across time take us?

There are a key STS concepts which are particularly useful to me in seeking to open up the above question. One of these is ‘boundary-work’, developed by Thomas Gieryn, who writes that ‘“science” is no single thing: its boundaries are drawn and redrawn in flexible, historically changing and sometimes ambiguous ways’ (1983: 781). Gieryn uses boundary-work to make sense of how scientists actively make demarcations between what counts as science and what doesn’t, and how these moves construct ‘a social boundary that distinguishes some intellectual activities as “non-science”’ (ibid.: 782). As we will see throughout this thesis, the boundaries of what knowledge counts as science and what does not, and thus what knowledge is understood to carry ‘authority, objectivity, universality, and truth’, has important implications for the use of science, particularly environmental epigenetics, to demonstrate ongoing intergenerational trauma and harm from colonial policies and nuclear testing. Through boundary-work, Gieryn theorises science as ‘no single thing’. Annemarie Mol similarly argues that objects are no single thing and more than one thing (multiple) in her 2002 text *The Body Multiple*. In this text, Mol offers a theoretical contribution in which she suggests a shift from ‘understanding objects as the focus point of various perspectives to following them as they are enacted in a variety of practices’ (Mol, 2002: 152). This approach, which Mol terms ontological politics, centres multiplicity, enactment, and practices. This theoretical standpoint is one which I carry throughout this thesis, along with boundary-work and its analyses of what counts, and where, and why.

Building on what counts as science and how those boundaries are enacted, I also draw on work from Ehlers and Esselborn on what counts as *evidence*. In their recent book *Evidence in Action: Between Science and Society*, Ehlers and Esselborn extend ‘science in action’ to ‘evidence in action’, exploring how demarcations are made between different forms of knowledge that are considered to be evidence or not evidence, and how evidence is enacted in various spaces (2022: 7). In the same volume, Lancaster and Rhodes refer to evidence as a ‘situated achievement’, and examine how ‘evidence is constituted, gathered, and made to matter within its particular sociomaterial conditions’ (2022: 148). Paying attention, like Mol, to ontological politics, Lancaster and Rhodes challenge the notion that evidence is available to be 'picked up and used', and instead they trace 'the *ontological* transformations in how science is made to perform as knowledge *in* a specific situated assemblage of policy practices and relations' (ibid: 150, original emphasis). They also note that these assemblages of practices and relations are 'thoroughly and inescapably political', and that like science, evidence is 'not outside of this politics; it is enacted *in* it' (ibid: 158-9).

To consider how the production of evidence is 'inescapably political' in an Australian context, I draw on the work of Munanjahli and South Sea Islander theorist Chelsea Watego (2021). Watego is concerned with how the notion of the 'evidence-base' in Indigenous health research serves to foreclose rather than open up opportunities for knowing Indigenous lives and health, and she asks what happens when settler colonial states both request evidence of certain forms and choose not to listen to it (Watego, 2021). In their paper on 'epigenomic stories', Lappé et al. write on what is 'at stake socially, politically, and materially when we tell stories with science' (2022: 5). Similarly framing evidence as stories, Watego asks what is at stake when settler colonial states attempt to shape what stories can be told and which stories are listened to. In the terms of this thesis, approaching the enactment of biological, primarily epigenetic, evidence of intergenerational trauma as a 'situated achievement', a story, always in the making through politically charged relations and sets of practices, allows for an analysis in which epigenetics (like science, like boundaries, like evidence) is 'no single thing' (Lancaster & Rhodes, 2022; Gieryn, 1983).

Chapter outlines

This thesis, like the objects studied within it, travels. Here I briefly outline each chapter in order to provide a 'Road Map' for the spaces through which the thesis moves (Liboiron, 2021).

In chapter one, I discuss the methodological orientation of the thesis, including how the methodology was significantly altered due to the emergence of COVID-19. I reflect on my relationship to ethnography as an STS-aligned anthropology student, and detail how patchwork ethnography (Günel, Varma & Watanabe, 2020) and multi-object ethnography (Yates-Doerr, 2015) helped me to pivot towards a form of ethnography that worked for both the conditions of COVID-19 and the conditions of my personal ethics. I also detail how I incorporated archival research, collaborative online interviews, and online observation of scientific conferences into my methods, and demonstrate how engaging with a combination of methods and research sites allowed me to build a collaborative archive of emergent knowledges, on which I draw throughout the thesis.

Chapter two centres on the emergence of 'trauma' as an unstable concept in Indigenous health research in Australia. It traces how trauma became a diagnostic category through the introduction of Post-Traumatic Stress Disorder (PTSD) in the *Diagnostic and Statistical Manual of Mental Disorders,* and how this process was always political. The chapter then details how complex-PTSD, historical trauma, collective trauma, and intergenerational trauma became important concepts in Indigenous health in Australia that served as forms of evidence, in order to make the ongoing impacts of colonialism and racist policies visible. However, as interview participants note, there is a risk that the concept of trauma is increasingly becoming decontextualised, and is rendering the colonial conditions of harm it originally sought to highlight invisible instead. This oscillation between understanding trauma as a form of evidence which makes visible and makes invisible, and which centres either the collective or the individual, is the central tension of this chapter. These tensions remain when biological measures of trauma such as epigenetics enter the frame.

In chapter three, I draw on the tensions raised in the previous chapter to demonstrate how, like trauma, environmental epigenetics is an unstable and contested concept. This chapter introduces some key concepts of environmental epigenetics research, namely plasticity, reversal, and transgenerational epigenetic inheritance, and demonstrates how they are intimately linked to the rise in popularity of environmental epigenetics as an explanatory model for intergenerational trauma in Indigenous contexts. This chapter follows narratives of transgenerational epigenetic inheritance as forms of 'evidence-in-the-making' and provides an Australian case study of what Meloni and Testa refer to as epigenetic fascination (2014). Throughout chapter three I demonstrate how a range of actors – lab scientists, medical doctors, social workers and health workers, and social scientists themselves – are all enacting epigenetics into being in diverse ways.

Chapter four examines how the notion of reversal is crucial to some participants' understandings of epigenetics as a hopeful and progressive form of evidence, despite it being bio centric. The chapter introduces critiques of damage-centred research (Tuck, 2009; Fogarty et al., 2018), and explores how some researchers navigate concerns over a focus on damage in epigenetic studies by highlighting concepts of reversal and change, and by seeking to measure resilience instead of damage. These participants view epigenetics as uniquely positioned to provide ‘hope’ and positive change compared to other forms of knowledge, and especially compared to other forms of genomic knowledge. This chapter demonstrates how these same participants make moves to distinguish epigenetics from ‘negative’ forms of science by telling stories of hope, and how they do so to navigate the uncomfortable tension of how to speak of biological harms without perpetuating negative and damage-centred narratives. The chapter also raises tensions around the limits of ‘evidence as hope’, particularly when the biological measures on which hopeful evidence is predicated are still relatively emergent and may be for some time.

Chapter five explores what can happen when lands and bodies are made to matter through particular forms of scientific evidence. In this chapter, I return to Karina’s family’s story of radiation exposure due to the British Nuclear Testing Program in Australia. Drawing on archival materials that were presented as evidence during the 1984-85 Royal Commission into British Nuclear Testing in Australia, I link the valence that biological (epigenetic) evidence has taken on in recent years in relation to intergenerational trauma to a much longer history of using biological evidence of harm to bring the ongoing impacts of colonial policies to the forefront. In the case of the McClelland Royal Commission, scientific evidence was highly privileged, and highly contested. A key tension of the Royal Commission process which I demonstrate through archival data and analysis, was that making areas of land known solely through their damage in some ways served to reinforce colonial views that the land was not desirable or habitable, rather than leading to improved conditions for those who had been denied access to their land for so long. The chapter thus explores the tensions that surround desires to make harm to bodies and lands visible through scientific evidence without upholding the epistemic power of such evidence, a tension that carries throughout the story of nuclear testing presented in this chapter and the stories of contemporary epigenetic science presented throughout the thesis.

Chapter six engages the concept of colonial unknowing (Vimalassery et al, 2016) to explore some participants’ confidence that biological, here epigenetic, evidence of ongoing harm due to colonial and racist policies will be listened to in ways that other forms of evidence have not been. Many participants of this study were committed to epigenetic research and knowledge production as they understand it to be a form of evidence that will be seen by government and policymakers as more powerful and legitimate than other ways of knowing trauma. This chapter challenges that understanding by demonstrating how epigenetic studies, in their current formations, do not simply reveal or uncover molecular evidence of trauma, but instead remake and reassemble it through narrow frames. This chapter, consisting of an article manuscript submitted to the journal *Science, Technology & Human Values*, uses the work of Watego (2020) and Lorde (1984) to suggest that producing more evidence of certain forms may be a fraught exercise, one of perpetually appealing to concepts of evidence that the settler colonial state deems valid and thus allowing the state to retain the power to reject them all the same.

In the conclusion I trace how, through integrating interviews, observation at conferences, a visit to the APY Lands, and visits to archives, this thesis brings an exploration of the contemporary interest in environmental epigenetics and intergenerational trauma in Australia together with and examination of what happened when lands and bodies became intelligible through scientific evidence in the 1984-85 Royal Commission into British Nuclear Tests in Australia. In doing so, I demonstrate that the concepts that are foregrounded in this thesis, concepts of trauma, inheritance, porosity and boundedness, and the privileging of the biological when it comes to knowing trauma, have long been central questions. In the conclusion I show how bringing these concepts and questions together allows for an opportunity to unsettle how biological evidence of intergenerational trauma is imagined, produced, and contested in Indigenous health contexts in settler colonial Australia.

Chapter one — Creating an archive of emergent knowledges

Introduction

In January of 2020, I submitted my first ethics application to the Human Research Ethics Committee (HREC) at the University of Adelaide. I had submitted ethics applications to the HREC and to other ethics committees before, so I was not too surprised when my first application came back with substantial comments and changes. What did strike me, however, was the level of explicit concern about genetics. To be clear, my project is located in the School of Social Sciences, and I am trained in social and cultural anthropology. I have never studied biomedical science at university (I just managed to scrape through Year 12 biology with sheer luck on my side – the final exam essay question asked us to discuss the ethics of using HeLa cells).[3] In my ethics application to the HREC I tried to make it very clear that I was interested in the politics, contestations, and ethics of genomics in Indigenous contexts, and repeated throughout the application that I was studying social and cultural anthropology and therefore not at any stage going to be *doing* any genetics. What I did write about was my plans to visit labs and speak with researchers who are engaged in the field of 'Indigenous epigenetics'. I used the term 'Indigenous epigenetics' because that was the term used on a grant that my supervisor had been awarded and through which I am partly funded. One of the most interesting comments I received on my ethics application was:

'This is not Indigenous epigenetics – this is epigenetics in an Indigenous context. Indigenous and Western science are not the same'

What this demonstrated to me was a significant hesitation when it comes to folding Indigenous knowledges and Western science into each other or positioning them as congruent. The reason this was so interesting to me is because that is exactly what had been happening around Australia, and that was why an Australian Research Council (ARC) project was funded and why I came on as a PhD student – to look into the question of what constitutes 'Indigenous

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[3] Learning the story of Henrietta Lacks and the movement of her cells across labs and countries in high school could be read now as my first introduction to Science & Technology Studies.

epigenetics'.[4] What I was being told by the anonymous HREC was simply, 'it's not a thing'. Right at this early stage of the project, well before I had started collecting data or having conversations with people about the subject, I found that I was facing the trickiness of even calling a thing as slippery as 'Indigenous epigenetics' a 'thing'.[5] Before receiving this HREC feedback, I took 'Indigenous epigenetics' to be an established object onto which I would then map contestation, hesitation, enthusiasm, suspicion. But thanks to the HREC review process, I realised that it is not yet and has never been one 'thing', and that framing it as such at the point of academic departure was too simple.

This informed my methodology, then, by encouraging me to shift my starting point from studying the reception of an object called epigenetics by different actors to studying how different actors co-construct many objects which are called epigenetics. This is of course influenced by Mol's 2002 text *The Body Multiple*, as well as other central works in STS and medical anthropology including *Native DNA* by Kim Tallbear (2013). The crucial point for me, which was only illuminated after I received feedback from the HREC, is that 'Indigenous epigenetics' does not necessarily exist for everyone, and that as a researcher, especially one coming from a critical perspective, I needed to think about how to represent something which is not only complex, but which many people do not agree on, or in some cases do not want to be a thing at all. How to avoid reifying or 'making real' those elusive, co-constructed things which we study? I needed a methodology that allowed me to represent these moving parts in their mobility – the slipperiness, and the messiness.

This led me to think about being in many places at once and talking to many people at once in order to follow and trace the threads of my topic, rather than go to a singular field site for a set period of time. In this way, well before COVID-19 was on the radar, I was moving away from more traditional ethnographic approaches in Anthropology. Having been trained in anthropology I am committed to the unique insights that long-term ethnographic fieldwork allows for, but I have also embraced critiques of the old-school 'being there' and 'deep hanging

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[4] The ARC Discovery Project, DP190102071, ran between 2020-2023, with Chief Investigators Professor Emma Kowal, Professor Megan Warin, and Associate Professor Maurizio Meloni. Dr Jaya Keaney was employed as a Post-doctoral researcher and I was a PhD student researcher.

[5] I no longer use the term 'Indigenous epigenetics' in my writing or conversation, and instead say 'epigenetics in an Indigenous context'.

out' approach, namely feminist critiques such as those in *Women Writing Culture* (Behar & Gordon, 1995). Especially being a settler studying settler-Indigenous relations in health and science, I am attuned to the extractive and colonial relations that ethnographic research can reproduce, even when done under the 'good intentions' of social justice and change (Tuhiwai Smith, 1999: 28).[6] I knew that I would be deeply uncomfortable with going to an Indigenous community for a set period of time, gathering data, and then returning to a university in an urban city to write a thesis without the ability to confidently say that the thesis would be of benefit to that community. This was never my plan. Instead, I took inspiration from STS scholars and anthropologists who move across different sites of knowledge production, and who particularly focus on places of Western or settler knowledge production as rich sites for ethnography and critique. I intended to go to scientific conferences and workshops to see how epigenetics was being framed in relation to Indigenous health and the concept of intergenerational trauma, as well as spend time in labs with researchers who are trying to 'do' epigenetics across Australia. At one point I considered travelling to Canada for a comparative component with researchers at the University of Alberta. This is all to say that I was building a methodology that involved multiple field sites and much movement across institutional, geographical, and political spaces, and I was doing so from an intentional ethical standpoint which I felt good about.

I was enthusiastically building up this methodology between December of 2019 and March of 2020. On Sunday 15 March 2020, while I was visiting a close friend, their housemates and I all gathered in their living room to watch the Prime Minister address the country via a breaking news announcement on national television. Lockdowns, border closures, and restrictions were to come into effect the next day. We immediately started texting our mums and googling what counts as an essential service and calling friends inter-state. A while later, when I was able to think about what this might mean for my PhD, a strong sense of grief kicked in around not being able to do ethnographic fieldwork. This was quite interesting to me, as before this point I had been confidently running around talking about how the anthropological obsession with 'being there' and 'deep hanging out' was colonial and old-fashioned and anti-feminist, and that distinctions between being 'at home' or 'in the field' made absolutely no sense anymore,

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[6] I refer to myself as a settler here in line with Flowers' assertion that settler is 'a critical term that denaturalises and politicises the presence of non-Indigenous people on Indigenous lands, but also can disrupt the comfort of non-Indigenous people by bringing ongoing colonial power relations into their consciousness' (Flowers, 2015: 33).

especially in a place like Australia. I had given a presentation to the Anthropology and Gender Studies departments in December 2019 where I put up my slide on multi-sited fieldwork and talked about the fact that my plan to study settler science meant doing anthropology differently. But once COVID-19 came into the picture, the idea of not being able to go anywhere *at all* completely messed with my plans, and it challenged my sense of resolve around being an anthropologist who does fieldwork differently. As it turns out, I actually really wanted to do fieldwork; to go to places and talk to people and sit around and take scratchy handwritten notes and – dare I say it – hang out. The grief I felt really took me by surprise, and it took me a long time to make sense of this loss and try and work out where to go from this place of total confusion, not just about my situation but also about my reaction to it.

Where I ended up was that, even though I had never intended to spend a long period of time in a specific place that I could call 'the field', and even though the sites I was planning to study (conferences, labs) were not 'conventional' field sites, I was still planning to be in places with people. This doesn't change, whether you are deep in the desert or deep in a restricted access ancient DNA lab, which is in fact the whole point. I had a (problematic) notion that by eschewing long-term old-school fieldwork, I was already making some sort of sacrifice/political stance, and then the pandemic came along and took away the small bits of ethnographic goodness I had allowed myself to desire and to plot into my plans.

'Pivots' of a pandemic: adapting and working online

I recall talking to a friend during the 'writing up' phase of my project about the 'renegade' energy that some of the male epigenetic scientists I spoke to emulated – the types who see their research as going against the grain and go for multi-day hikes on the weekends and own t-shirts that say 'blame it on my epigenetics'[7]. He laughed and jokingly asked me what sorts of stickers they have on their laptops. I couldn't answer the question, because I'd only ever spoken to these scientists on Zoom, and it made me realise how much I missed those details that you glean from being in a real place with another person. I don't think it's a coincidence that the writing I've felt most attached to in this PhD process is the writing I did about a fieldtrip to the APY Lands, where I got to write about being in real places with real people in 'real' time. With lots of

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[7] In February 2021, during an online only conference which I attended titled 'Aus Epigenetics 21', the Welcome video on the conference web portal featured a scientist wearing a t-shirt which read 'Blame it on my epigenetics'.

support and encouragement I did manage to ‘adapt’ and ‘pivot’ my methodology in the face of the pandemic, but that doesn’t mean I don’t miss what it could have been. For me, these ‘pivots’ led to working online and working with archival texts. These are both things I had never done before and never anticipated I would do as part of a PhD in Anthropology.

In mid-June of 2020 I participated in a three-day workshop led by Ethos Lab in Copenhagen called ‘Research Interrupted’. The purpose of this workshop was to bring together PhD students in anthropology and related fields whose research had been, unsurprisingly, interrupted by the pandemic. I was really excited to participate in the workshop as it promised to provide us all with toolkits for adapting, re-working, and re-designing our research, which I had been trying to do for a few months already by that point. To apply for the workshop, we all had to submit a brief essay on our research and how our plans had been derailed. Below is what I submitted:

> My PhD project sits within Anthropology, Science and Technology Studies, and Gender Studies. The title so far is ‘Exploring epigenetics in response to intergenerational trauma in Indigenous Australia: race, gender, expertise, and the production of scientific knowledge.’ It looks at how discourses of epigenetics are intersecting with concepts of intergenerational trauma, wellbeing, and healing amongst Aboriginal and Torres Strait Islander peoples in Australia, and at the ways in which these discourses are being strategically employed by different actors for different reasons. Epigenetics is a rapidly growing scientific concept which blurs the boundaries between DNA and environment, and many people are using epigenetics to attempt to answer questions surrounding how trauma ‘gets into the body’. I am looking at how this concept is being taken up and how it is intersecting with race and gender in Australia (and possibly in other settler-colonial states).
>
> Impacts of COVID-19: My methodology is (was?) built on participant observation and ethnography, interviews, and some critical discourse analysis. Strict travel restrictions between states in Australia, which are referred to as ‘hard borders’ has meant travelling for interviews has not been possible and might not be possible for some time. One of my major sites for fieldwork is a DNA Lab which is closed until at least the start of 2021,

> and my other field sites were going to be scientific conferences and trauma/healing workshops across Aus and NZ, almost all of which have either been cancelled, moved online, or rescheduled to late 2021 which extends my timeline more than I think is workable. I have been finding it quite difficult to focus while working from home and imagine this will continue to be tricky for some time. The main things I am concerned about and am wanting to work through are how to make my methodology work for my research but also for my interests – I am not the biggest fan of purely textual or online work but I think this may have to become a big part of my project now. Re-fashioning a methodology that makes sense for our current situation, for answering my research questions, and for keeping my own 'keenness' in the work ignited is the main thing I have been trying to figure out and is why I am participating in this course.

Even at this point, before I had started data collection and before I knew how long the conditions of the pandemic would last for, it is already glaringly evident how hesitant I was to let go of ethnography. Reading back my sentence, '*I am not the biggest fan of purely textual or online work',* does make me laugh a little bit! This workshop put me in touch with other students who were struggling with similar problems, and allowed me to think through some potential ways to navigate a shifting methodology, but ultimately the only options that were really available to me were those that I had already identified - working online and working with texts. During this workshop, we talked about other methods such as photo voice, elicitation, asking research participants to record snippets of their days and send the footage back to us, asking them to make maps or illustrations of their everyday surroundings. Although these methods did seem more creative in some ways, I decided that they would not work so well with my participants, who are mostly researchers and academics who, by the time the pandemic had been around for a few months, were very accustomed to having meetings and conversations on Zoom, but who might not have necessarily been comfortable or well-versed in making audio/visual recordings of their days. I chose to stick with the Zoom interview format because it was not overly demanding of research participants, and also because, as I was contacting some of the participants out of the blue (the opportunity to meet potential participants at scientific conferences having been mostly taken away), it helped to follow a fairly 'formal' recruitment style through snowball sampling– email a researcher, introduce myself, suggest a Zoom call, receive confirmation and consent forms, do the call. Though this was not necessarily as creative as I might have liked, it led to a higher rate of engagement than I had initially expected when COVID-19 came along and altered my plans.

I began contacting participants and organising interviews in early June, and my first official ‘Zoom interview’ took place on 6 August 2020. From then on, my calendar was full of Zoom invites. Together with my colleague Jaya (introduced below), we interviewed twenty-one researchers over Zoom. All of these researchers are based in Australia – nine are Indigenous, and the remaining twelve are non-Indigenous. Eleven participants were women (five of whom were Indigenous and six were non-Indigenous) and ten participants were men (five of whom were Indigenous and five of whom were non-Indigenous). The participants worked in ancient DNA, epigenetics, psychiatry, nutrition and general medicine, social work, psychology, and education, and as such have an incredibly diverse range of engagements with and relations to the concepts of epigenetics and trauma. Each Zoom calendar invite would be set for one hour, and though we would always give participants the option to continue the interview, they very rarely did. Each interview therefore lasted between 40-60 minutes. Similarly, we ended each interview by saying we were contactable any time and happy to stay in touch if a participant wanted to discuss something further down the line, but never received any follow-up from participants, other than asking them to confirm if they wished to be anonymous or named in publications. Informed by Weiss and McGranahan’s critique of the power dynamics present in pseudonyms, we offered participants the choice to decide, rather than making an assumption that each participant would desire anonymity (2021). Eleven participants requested to be named, and the remaining nine requested a pseudonym be used. These requests have been respected in this thesis. Along with the use of pseudonyms, the workplaces and organisations at which participants who requested anonymity work have not been named.

Due to the constraints of the pandemic, our interviews were incredibly bounded, much more so than I have ever experienced before as a researcher/ethnographer. This is interesting to me as one of the themes I untangle throughout this thesis is ‘boundedness’ and ‘boundaries’. In trying to explore this, I faced an incredibly bounded interview structure, where there was no stopping to make a cup of tea, no reflections that get briefly mentioned and then picked up again in details the next morning over breakfast, no aimless walking around to encourage my participant’s ideas to bubble up. It was all question and response, all fast, all contained within a

60-minute timeframe and a desktop window. Of course, for my participants, I recognise that a bounded interview format might in fact have been much more manageable – it is practical, easily fits within a busy day of other meetings and family commitments, and given we were all reeling from the shock and grief of COVID-19, to ask people who did not know me to give me more than one hour of their time may have been unreasonable. Yet despite these practicalities, for me as a researcher, bounded Zoom interviews originally felt superficial and lacking in ethnographic opportunity. When I listen back to a recording from the APY Lands, where my informant Karina made up an excuse to get away from the others and drive down the road with me just so that she could follow up on something she had said the night before during an interview ('Hetty get in the car would you, bring your recorder'), the difference between interviews in an ethnographic context and interviews on Zoom seems so stark and pronounced. The embodied, 'always on' disposition of ethnography is my familiar place; Zoom is not. However, the material which I covered with participants over online interviews is no less expansive or important, and so this almost feels like another moment of personal reckoning. The data itself is still good, I just didn't get to feel as *anthropological* as I would have liked while I was gathering it. Again, this brings us to the question of what makes a methodology 'traditional' and worthy in anthropology, and what sorts of histories, assumptions, and ethical moves come up when making distinctions between feeling/being anthropological, and not.

Patchwork ethnography and multi-object ethnography

During this time, amongst the confusion of asking myself questions such as 'what counts as anthropology?' and 'how can I say I am doing fieldwork if I don't understand what my field is anymore?', I came across a piece which had been published online in *Cultural Anthropology* in June 2020 called 'A Manifesto for Patchwork Ethnography' (Günel, Varma & Watanabe).[8] I immediately felt gripped by the concept of 'patchwork ethnography' and read the piece. Unlike the generic advice that the University's institutional arms such as the Graduate School had emailed to graduate students when the pandemic first broke out, which amounted to something like, 'just work it out! It's digital but it's fine!', the authors of the patchwork manifesto did not

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[8] Varma has since been embroiled in an ethical conflict related to her research in Kashmir. Anthropologists and researchers who attend to ethics in their theory and writing are not exempt from making ethical breaches in their practice and fieldwork. See The Wire https://thewire.in/books/debate-does-familial-proximity-to-the-security-state-compromise-academic-research-on-kashmir

shy away from the collapse we were witnessing, writing that 'the pandemic has evaporated many a future fieldwork plan and the prospect of continued ethnographic research in the same vein seems uncertain' (Günel, Varma & Watanabe, 2020). They drew on feminist critiques of 'traditional' fieldwork and wrote about how this myth of traditional fieldwork impacted not just research subjects, but also impacted researchers themselves and the types of knowledge that can be produced and valued when researchers hold themselves to rigorous 'traditional' standards of fieldwork practice.

Patchwork ethnography includes 'ethnographic processes and protocols designed around short-term field visits, using fragmentary yet rigorous data, and other innovations that resist fixity, holism, and certainty' (Günel, Varma & Watanabe, 2020). Thinking back to my original ethics submission, which I wrote well before COVID-19, I was already trying to make sense of the lack of 'fixity' and 'certainty' that my research topic engenders. What patchwork ethnography allows for is a methodology which reflects the slipperiness of my topic, rather than trying to package it up into a neat 'ethnographic' picture. Patchwork ethnography 'reconceptualizes research as working with rather than against the gaps, constraints, partial knowledge, and diverse commitments that characterize all knowledge production' (Günel, Varma & Watanabe, 2020). Reading this at a time when all I could see in my project (both conceptually and practically) were gaps and constraints and partiality was incredibly meaningful. Working *with* rather than against the slipperiness of my topic, I allowed myself to see a methodology which did not try to squeeze myself or my research participants into a pre-pandemic picture of fieldwork as a legitimate methodology. It encouraged me think about 'how we can transform realities that have been described to us as "limitations" and "constraints" into openings for new insights' (Günel, Varma & Watanabe, 2020). The innovation of patchwork ethnography did not take away all of my concerns and stress about doing fieldwork remotely during COVID-19, but it gave me a set of language to think about what I was doing as still being research, and to engage fully in what I was doing as a legitimate exercise in study and relationship building and knowledge production, even if it didn't look like how I had pictured it, or feel had I had anticipated it might feel. In this sense, 'patchwork ethnography' gave me the confidence/permission I needed to see my work as legitimate, which allowed me to actually go ahead and do it. Committing to a 'patchwork' style, I became well-versed in Zoom interviews, and in February of 2021 I added archival research into the mix. Though in some ways I remain ‘*not the biggest fan of purely textual or online work’,* I saw that bringing archives (text) into conversation with Zoom interviews (online work) made for a set of methodological practices that could yield ‘fragmentary yet rigorous data’ (Günel, Varma & Watanabe, 2020).

In addition to Zoom interviews and archival work, which I discuss in more detail below, I also turned to public media, grey literature, and online conferences to trace how discourses of epigenetics and trauma were travelling in Australia. By collecting screen-shots of welcome pages and presentation slides from online conferences, transcripts of television appearances in which epigenetics and trauma had been mentioned, and quotes from popular media articles, I began to curate an archive of my own, and to patch together additional sources of data. As Emily Yates-Doerr writes, when studying an object that is ‘not solid but is made and unmade variously’ across different sites, engaging with a variety of data sources from a variety of sites can help to ‘keep alive the inconsistencies and ambiguities’ of the object (2015: 230). In her paper on ‘uncertain accounts of global hunger’, Yates-Doerr (building on Mol’s earlier thinking) writes that:

> One cannot unambiguously track or trace an object through the word, as the object that might be traced does not remain fixed or constant. This article is thus a contribution to a burgeoning field of what might be termed as multi-object ethnography. This is a methodological approach that does not have knowledge of ‘an object’ or ‘the world’ as its goal, but is instead invested in examining the specificities of realities, and the tensions and connections that bring different realities together. It is a method that does not aim to eliminate uncertainty, but rather to open up – and thereby make space for – ambiguity, contingency, entanglement, and variation. (Yates-Doerr, 2015: 232)

Armed with methodological guidance from both patchwork ethnography and multi-object ethnography, I came to view the variety of sources available to me during the pandemic – online interviews and conferences, public media and grey literature, boxes of text housed in archives, and an ethnographic encounter in the APY Lands – as crucial to my exploration of how objects such as trauma, evidence, and epigenetics come to be enacted in various spaces. My objects of study, as Yates-Doerr reminds me, were never fixed, and embracing non-fixedness as part of my methodology itself allowed me to accurately study and follow the enactment of such slippery objects as these.

Archives

In March of 2020, just a few weeks before the COVID-19 pandemic took over and the doors of Adelaide Uni closed indefinitely, I met my mentor and former colleague Karina for a coffee. I was in that fresh, energetic stage of getting ready to start my fieldwork and wanted to see what she thought of my plans. I introduced Karina in the Introduction to this thesis – she is a Yankunytjatjara-Anangu woman and fierce advocate for Indigenous language revival as well as an internationally recognised anti-nuclear activist. In fact, in 2018 on my first day working for the Mobile Language Team (MLT), an SA based Aboriginal language centre which Karina co-manages with Dr Paul Monaghan, there was a United Nations mouse pad on my desk. When I asked how it had ended up in the office one of my colleagues casually said that whenever Karina goes and talks to the UN, she brings back all sorts of things. She had just been in New York to deliver an Indigenous Statement to the UN negotiating conference for the Treaty on the Prohibition of Nuclear Weapons. She sees everything through a lens of power, politics, and anti-nuclear activism. Over coffee, we were talking about my PhD project, and I kept using the word ‘exposure’ in the way that scientists and DOHaD researchers use it in their papers on epigenetics. Almost everything becomes an ‘exposure’ in epigenetics – nutrition, alcohol, family environment, stress. Karina observed that in a settler colonial state these ‘exposures’ are all things that Indigenous people are then told to modify or control themselves. But what about exposures people have no control over? Had I thought about, for example, exposure to radiation? I hadn’t, and she said I better think about it.

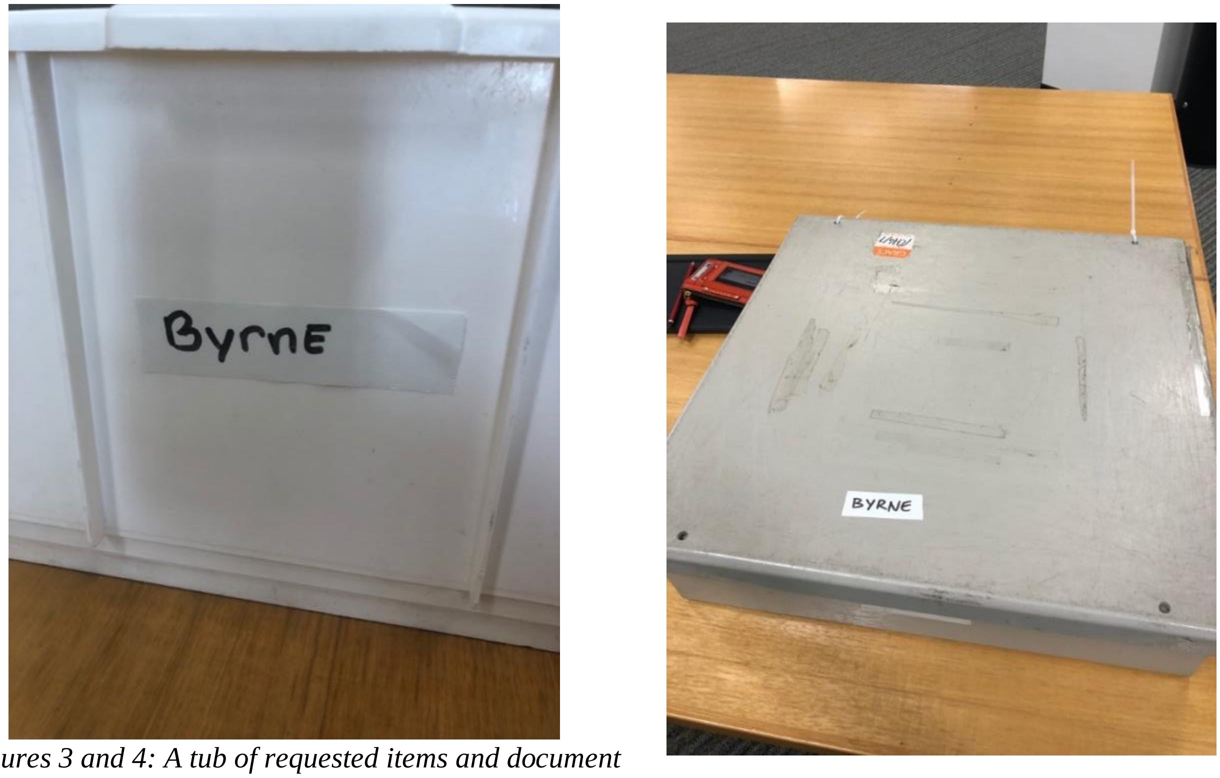
Our conversation was cut short as we decided to rush down to Writers Week, an annual literary festival in Adelaide, to see Indigenous historian Dr Jenni Caruso in conversation with lawyer Dr Antonio Buti – a conversation on the legacies of the Stolen Generations and potential paths to compensation by the state. Heading back to my office that day, having listened to both Karina and Dr Caruso talk about exposures to harm that were explicitly rooted in colonial and racist state policies – British Nuclear Testing and the forced removal of Indigenous children from their homes – the concept of exposure in a place like Australia crystallised into something much more complex and sinister than how it appeared in the scientific literature I had been reading.

Taking Karina's provocation to heart, I began to think more about radiation exposure in South Australia. Of course, then the pandemic happened, and my thinking was all jumbled up for a while as I've described above, but this question of nuclear exposure stayed with me.

For a while it seemed like an extra but not crucial part of my work, given that my PhD project up until that point had only been formulated as a project about epigenetics, not as a project about nuclear testing or nuclear ethnography or nuclear colonialism or chemicals or toxicity. However, I came to realise that my work was not actually about 'epigenetics', but rather it was about concepts of exposure, evidence, bodies, and the porous boundaries between all of these things. Epigenetics was one of many objects through and within which I could explore these concepts – and nuclear exposure was another one. With this in mind, and since I was having to redesign my research anyway due to COVID-19, I was encouraged to think more seriously about how to incorporate the question of nuclear exposure into my research. British nuclear testing in mainland Australia first began in 1953, and the information about it was incredibly secure, and in many instances, totally secret. For this reason, there is a striking situation where there is only really one documented/established narrative of the details of 'what happened' – the final report of the 1985 Royal Commission into British Nuclear Testing in Australia, sometimes referred to as the McClelland Report. Karina's father and grandparents testified in this Royal Commission, and a host of scientists, lawyers, anthropologists, politicians and historians from Australia and the UK submitted documents and testimonies which resulted in a three-volume report. It became clear that if I wanted to dig into the questions of scientific and Indigenous concepts of exposure, and the legacies of these understandings over time, I would need to read further than the final report and look at the archival materials related to the testing and the subsequent Royal Commission. In May of 2020, I submitted an application to the Australian Academy of Science for the Moran Award for History of Science Research, and in October 2020 I was awarded funding to travel to Canberra to study the archives related to British nuclear testing at both the National Archives of Australia (NAA) and the Australian Institute for Aboriginal and Torres Strait Islander Studies (AIATSIS). Crucially, in September of 2020 I also spent a week in the central desert with Karina, talking to her about what the nuclear testing meant to her family and what it did to her land. By the time I found myself in the archives, I had already conducted interviews on the lived experiences of the legacy of nuclear testing, and I was able to hold Karina's lived experience in mind as I worked in the archives.

Having been trained in Anthropology and ethnographic methods, I had never worked this closely with archives before. I have some familiarity with archives through my previous work at the language centre, however I had never formally considered archival work as part of my academic toolkit. Yet, finding myself in a situation where ethnography was less and less possible, turning to archives encouraged me to consider how they might help to paint a broader, more complex picture of history, time, and place – a picture which could complement the highly detailed and small scale of ethnographic data. Punathil writes that ethnographic fieldwork and archival research are 'invariably postulated as opposing epistemological and empirical modes' (2021: 313). Asad has similarly written that focusing on ethnography as a sole empirical mode means that 'many spatio-temporal complexities and variations [are] excluded from the object of study because they [are] not directly observable in the field' (2002: 68). Engaging in both ethnography and historical/archival work can therefore broaden not only the scope but also the epistemological grounding of a study or piece or research. However, Punathil also notes that, if anthropologists are to properly engage with archives, they 'must not view archives merely as the material of another discipline, and must overcome the tendency to see archival labour as a mere extractive enterprise' (2021: 314).

This is something that I struggled with at first during my two weeks at the archives in Canberra; as an anthropology student with limited experience in archival research, working with archival texts at the beginning did feel extractive, and it felt flat, like I was working with someone else's tools and that everything was already fully formed before I came along. Part of this was simply because of the mechanistic nature of accessing the archive. Before arriving at the NAA, I had requested items, which were pulled out of the collections for me to view (a 'series' consists of multiple 'items' which each have their own 'control ID', like a specific code), and when I arrived for my first day of research, I was confronted with three large plastic tubs in which my items for the week were being held (see figures 3 and 4). To carry the first tub to my assigned desk I had to hold it close to my chest to take some of the weight, and then shuffle across the room before placing it down with a large thud. I must have looked visibly perplexed, as the archivist made a joke about the other two boxes I still had to 'dig into'. Inside the tub were boxes, and inside the boxes were faded yellow folders tied together with string, and inside the folders were documents. I couldn't help but feel like this was an extractive practice.



Figures 3 and 4: A tub of requested items and document folder with my surname on the side. Author's own photo.

In Natalia Harkin's text *Archival-Poetics*, the question of how to engage with colonial archives without upholding their power is central (2019). Harkin is a Narungga activist-poet whose work seeks to decolonise state archives by re-presenting and re-inventing their contents with Indigenous sovereignty at the forefront. In one performance work, titled 'Bound and Unbound: Sovereign Acts II', Harkin and the Unbound Collective - Ali Gumillya Baker (curator), Simone Ulalka Tur, Faye Rosas Blanch and Natalie Harkin – segments of poetry were projected onto the limestone walls of the 'Cultural Precinct' of Adelaide, a precinct that includes the South Australian Museum and State Library of South Australia. On the walls of these state institutions, which house archives both of text and of Aboriginal remains, words of refusal were displayed:

> a storage-place for Aboriginal Records where paper-trails trace surveillance and control / consider the paperwork the archiving process to consign and classify this resource maintained / consider this fantasy monolith-archive its stunning all-knowing so easily sustained / these limestone walls these limestone walls / strive to navigate this violent place be still and listen there are waterholes here / these fresh water springs flow a

> limestone-memory erode and expose our truth will appear. (Unbound Collective, Sovereign Acts II Catalogue, 2015: 27)

In Harkin's *Archival-Poetics*, she writes of archives as spaces that are 'alive', and thus able to be engaged with as living things. Her intention when working in archives is not to extract knowledge, but to search for and pull out the people, the 'stories and hearts that seethe and pulse' within the archive's storage units and boxes and tubs. She described her engagements with colonial archives as transformations and ruptures:

> A small spotlight on the state, its institutions/systems/processes, that generate and maintain particular fantasy-discourses and representations on histories, on people; that actively silence/supress/exclude Indigenous voice and agency; stories and hearts that seethe and pulse from violent repositories to rupture fixed-imaginings, contribute counter-narratives and repatriate 'something else' transformative and just; new offerings through and beyond the colonial archive, to carry forward, for the record. (Harkin, 2019: 5)

Informed by Harkin's theorising of archives as living spaces with opportunities for rupture, I began to search for such opportunities within the materials presented to me in boxes and tubs. Using their research on riot reports in India as an example, Punathil asks, 'how can we understand the 'experience' of the event, 'be there' ethnographically and listen to the 'voice' of the actors involved in riots from archival reports, surpassing their problematic assumptions?' (2021: 314). Over my time at the NAA and AIATSIS, I tried to 'be there' in the texts I was reading, rather than simply noting down the important dates and names and accepting the materials uncritically. It took many days of accommodating to the practice of archival research before I could begin to engage with archives in an ethnographic and critical way; viewing an ethnography of archiving as an active practice. This was especially challenging when working with the final reports of the Royal Commission, as they are written in a way which holds authority and projects a certainty and finality to the topic at hand. When reading the documents which informed the final reports though, such as the thousands of pages of transcripts from interviews with Anangu people included in the 'Aboriginal Collation', I was able to 'listen' to the voices in the texts – to what was said and unsaid. Listening, noticing, observing, questioning taken for granted assumptions – these are all ethnographic skills, similar to those of participant-observation. Though it took time, by the end of my trip to Canberra I was picking up the big tubs of text with a swifter motion and a clearer head.

As mentioned above, before reaching the archives I first compiled lists of requests for both the NAA and AIATSIS. The NAA holds thousands of items relating to British Nuclear Testing in Australia, which I searched through from Adelaide in order to identify the most relevant items and lodge a request to view them. Some items have been digitised and are therefore accessible online, so I cut these out of my list for Canberra. In Adelaide, I met with historians Tom Gara and Professor Margaret Allen for advice on how to navigate the item search functions at the NAA. Tom Gara has worked on Indigenous history, particularly of the West coast of South Australia, for many years, and has done extensive research on the British Nuclear testing program's impacts on Mission closures in the West of South Australia (Goodall & Gara, 1994; Gara 2017). Given his research background, Tom was intimately familiar with the collections at the NAA on the Royal Commission into British Nuclear Testing in Australia, and his guidance helped me narrow my search. Learning from both Tom Gara and Margaret Allen taught me practical archival search skills I did not previously have, and bolstered my confidence in bringing archival historical data into conversation with ethnographic data. After roughly one week of searching and identifying items which seemed most relevant to my research questions around scientific and Anangu concepts of 'exposure', I requested to view fourteen items at the NAA. Some of these items included 10-20 pages of documents and others included over 400 pages. Once I arrived at the NAA, some of these items led me to other ones, and I requested and viewed an additional eight items – leading to twenty-one items of various lengths in total. Some of these items I spent multiple hours or even multiple days with, and others I viewed quickly and placed back in the plastic tubs. Making these decisions was another challenging aspect of working in the archives, as I was trying to engage deeply, but I did have to make quick choices and judgements about the 'value' of certain materials in the interest of maximising the limited time I had with them.

Similarly, at AIATSIS, I used the online catalogue system *Mura* (a Ngunnawal word meaning pathway) to search for items relating to British nuclear testing and the Royal Commission. I requested to view eleven items which are not digitised, nine of which were able to be retrieved for my visit. The main items I focused on at AIATSIS were related to what is known as the 'Aboriginal Collation' – a large collation of documents which informed the 'final report submitted to the Royal Commission on behalf of Aboriginal groups and individuals', a report of 529 pages compiled by lawyers Geoff Eames and Andrew Collett (1985). At AIATSIS, I also viewed documentary footage, catalogues from art exhibitions, and poetry about the testing, in order to counter the purely scientific/legal reports I had been reading. The materials at AIATSIS were given to me in piles, not tubs, and I was able to leave them in a locked private room where I worked during my visit. This led to a slightly less clinical experience than the one I had had at the NAA. By this point, I had also begun to piece together not only the process of working with archives but also the details of the stories I was working with, so I felt more comfortable at AIATSIS than I had at the NAA the previous week. In my second week in Canberra, I also met with scholars who had been involved in collating materials for the Royal Commission and worked on the Technical Assessment Group (TAG) studies, which became important to my research. These informal conversations were very helpful to me, as I couldn't resist the need to talk things through as I read them.[9]

Upon returning to Adelaide, I organised the photographs and notes I took at the NAA and at AIATSIS and continued to undertake detailed analysis of the materials. I organised the materials by Series and Item number, according to the search conventions of both the NAA and AIATSIS. Under each Series and Item number, I collated the most important sections of the document, and attached photographs to these sections. I also wrote a preliminary analysis of why I had chosen to highlight each section as important, and attached a theme to each section. Themes included 'boundaries', 'fences', 'land use', and 'exposure'. This allowed me to collate and categorise the materials according to my research interests. Having organised the materials in this way immediately after returning from the archives, I was able to undertake more detailed analysis throughout the writing period taking the above themes as a starting point, and identified connections across the different Series' and across themes.

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[9] Both people declined to be formally interviewed for this project, as ensuring anonymity would have been challenging. Their conversations were invaluable to my development at the archives, and I am grateful for their generosity.

Collaborative interviews

Dr Jaya Keaney joined the ARC-funded Discovery Project to which my work was attached as a post-doc in February of 2020. We first met in person at an 'Indigenous Epigenetics Symposium' which was organised by our team and was held at Deakin University in mid-February. This one-day workshop included talks from key theorists and scientists in the field of epigenetics, as well as provided a space for the project team and the Advisory Board members to introduce ourselves and our goals for the three-year funded project. At this stage, I was developing my fieldwork plans and Jaya was developing hers separately, though of course we had begun to discuss what we were interested in and where we were interested in going. I was quite curious about the Ancient DNA centre in Adelaide, as well as some intergenerational trauma organisations in Melbourne and the Northern Territory. Jaya had begun making connections with scientists working in Newcastle, NSW, and in Perth. Between us we had complementary connections and we were excited about the breadth of our planned fieldwork, which we planned to conduct independently and bring to our team for collaborate analysis further along in the project. However, just three weeks after this symposium in Melbourne, COVID-19 lockdowns were introduced.

As I have already described, we realised that in-person fieldwork would not be possible and instead turned our attention to online opportunities. At the suggestion of the Chief Investigators of the Discovery Project, Jaya and I each wrote a list of people we would like to interview using online methods such as Zoom. When we shared our lists, we realised there was a lot of crossover. Given that the field of epigenetics in Indigenous contexts is relatively small in Australia, this was not necessarily surprising, but it did create a challenge for us. We did not feel comfortable asking people to speak to us separately given that we were working on the same project and would be asking very similar questions, and we figured it would cause too much confusion for participants to be contacted on two separate occasions to talk to two different people about the same thing. We considered splitting the list up, so that Jaya could interview a certain number of people and I could interview the rest, but as our list was small anyway, to make it smaller seemed like a shame (we were both trying to make sense of fieldwork in a pandemic, and both felt like our opportunities were already limited by those conditions). After much discussion and encouragement from the Chief Investigators of the project, we agreed to try a collaborative interview process.

Both Jaya and I submitted and received amendments to our ethics approvals from the University of Adelaide and Deakin University, and finalised our participant information sheets (see Appendix 1) and Consent forms (see Appendix 2).[10] We contacted prospective participants via email, and found that the new language of Zoom invites and calendar meetings was a shared one. Our sample was Indigenous and non-Indigenous researchers, professionals, and 'experts' across Australia who worked with questions of intergenerational trauma, epigenetics, or both. Selecting participants who are experts in the emerging field of epigenetics in Indigenous contexts and who work in Universities and well-funded research institutes was done in line with ethnographic methods of 'studying up', as Laura Nader termed the practice in her influential piece 'Up the anthropologist: perspectives gained from studying up' (1974). Studying up as a methodological choice involves a commitment to examining 'the complex landscape of power' that arises in elite spaces such as clinical trials and genomics labs (Valdez, 2023: 193). Thus, questions of power, hierarchies of knowledge, and expertise were entangled in the selection of participants as well as in the questions we asked them. As we wanted to study how concepts of trauma, evidence, and epigenetics were being enacted in different spaces, we sought participants from different disciplinary fields – genomics and lab science, psychology, primary healthcare and midwifery, social work, and education.

In some cases, Jaya and I had previously met participants, either at conferences or at the Epigenetics Symposium our Discovery Project team had organised in February 2020. The remainder of the participants were researchers we had not met, and who were not aware of the Discovery Project. We identified these participants by searching online for researchers and professionals whose work focused on intergenerational trauma and/or epigenetics, and sending emails with participant information sheets and consent forms attached. We also used a snowball sampling method to identify further participants. In one instance, we received an email declining our interview request, citing a lack of time. The remainder of the people we contacted via email who we had not previously met agreed to be interviewed.

Although our work had been collaborative from our first meeting, after receiving ethics approval to co-interview, our relation to each other and to our research as a collaborative practice

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[10] This project received Human Research Ethics approval from the University of Adelaide (H-2020-086) and Deakin University (DUHREC 2020-262).

was embedded more formally in the design of the project. This led me, again, to reflect on the traditional anthropological image of the often male sole ethnographer, and to put this image into question through engaging with feminist anthropology. In her piece, 'Feminist Anthropology is Teamwork', Torres succinctly describes the feminist commitment to collaborative research and writing processes; 'much hope can be placed on the power of collaboration to build community, change how we dialogue, and support social change that challenges the power inequities upon which scholarship and the academy rests' (2019: 3). Importantly, Torres also highlights the 'conceptual nuance' and 'plurality of terminology for concepts that defy universal abstraction' that collaborating with other scholars from other disciplines can engender (2019: 2). Jaya's academic work is firmly rooted in gender studies and science and technology studies, whereas, before beginning this PhD, I was firmly rooted in anthropology. Though these fields are similar in many ways, I often felt that Jaya and I brought 'conceptual nuance' to our interviews because of our different histories, experiences, and orientations to our work and our disciplines.

Before our first semi-structured interview together in early August of 2020, Jaya and I wrote a thematic list of questions to frame our interview (see Appendix 3). The questions were oriented around our participant's understandings of 'epigenetics' and 'trauma'. We developed questions about how they had come to engage with these concepts and whether they saw potential benefits or concerns in their usage in Indigenous health spaces. I printed this document out, wrote 'H' next to some questions and 'J' next to others, and taped it to the wall behind my computer so as to not be seen to be constantly looking down (I worried about how this would look on a video call, almost like someone who looks down to check their phone rather than keep eye contact). After the first 15 or so minutes of the interview, I didn't look at the piece of paper at all, and instead I formed questions which Jaya's own questioning had sparked, and Jaya formed questions which flowed on from mine. In my moments of silence, when I was reflecting, notetaking, or simply taking time to process something, Jaya would lead our participant to discuss something of interest or importance to her, and when Jaya was processing the answer, I would step in again to contribute a nuance of my own to the interview. It felt as though we were silently guiding each other to thoughts, places, openings, which we may not have seen on our own.

I like to think that this real time collaboration and teamwork helped to put our participants at ease in what was at the time a very strange situation – talking to two (mostly) strangers on this web program (which was new to many of us) called Zoom. At the end of this first interview, our participant made a joke that we were ‘not scary’ and ended by saying that ‘you two were both fabulous with your interviewing’. For my first ever formal interview for this PhD, I was quite happy with that, and I would not have been so confident in my skills as an interviewer had Jaya not been in the room/zoom with me. I know that this type of positive reinforcement from a participant is not the point of an interview, but after many months of feeling lost in my research design and feeling like my chances for ethnography – essentially, relationship building – had been dashed, building a collaborative relationship with a colleague through co-interviewing was something of a lifeline. It allowed me to both acknowledge and resist the ‘collective loneliness in the academy’ that was exacerbated by the pandemic (Charania, 2022: 62). Co-interviewing also meant that our work has been co-constructed from the very beginning. It was an invaluable chance to learn and work with another feminist scholar with a feminist ethic, one which might not have happened if COVID-19 had not forced us to pause and think.[11] We contacted participants together, we interviewed them together (with a few exceptions due to availability/time constraints), we then had informal ‘debrief’ conversations together after each interview to reflect on how they went, and finally we wrote a list of codes (see Appendix 4) together and analysed the transcripts together, along with the Chief Investigators of the project.

The interview data presented in this thesis has been thematically coded. Thematic analysis methods are ones in which ‘theory emerges through the coding process’ (Ezzy, 2002: 86). All interviews were recorded with participants’ knowledge and consent, and were transcribed by myself or professionally transcribed. In the case of Zoom interviews, video as well as audio was recorded, however professional transcribers were only given access to the audio files. Following each interview, myself and Jaya privately discussed the interview session and wrote individual field notes, allowing for reflexivity and opening up potential for restructuring of our interview questions and themes as we moved through the interview schedule. After all interviews had been transcribed, we shared the transcripts with the Chief Investigators

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[11] Jaya and I have continued this collaborative work in other projects related to the Discovery Project. It is important for me to acknowledge this work, as building collaborative outputs and co-writing with Jaya has informed the ways in which I think with and engage with the material in this thesis.

of the project, and collaboratively began a process of experimental open coding (Ezzy, 2002: 87). This coding was done in a shared word document, and each transcript was coded by two members of the research team. This allowed the team to build collaborative methods and encouraged reflexivity in the coding process – some lines of text would be coded in one way by one researcher and in a different way by another researcher. We reflected on the differences and discrepancies in our open coding within the text, comparing our codes, leaving comments to each other, and noting sections of the transcripts which, through open coding, had developed as key thematic sections. I then coded each transcript using a more formal selective coding process, drawing on the themes that had been generated through open coding. This selective round of coding allowed for clear themes in the data to develop.

Conclusion

In this chapter, I have integrated details of the process by which I recruited participants and gathered qualitative data with details of how doing so during COVID-19 altered the process in serious and relevant ways. I entered this project with a clear theoretical and ethical imperative to leave traditional ethnography to the side, yet when state borders closed and I was unable to leave my home, I felt intensely impacted by the reality of not being able to do ethnographic fieldwork. I shared my confusion with other researchers, and found methodological and emotional anchors in patchwork ethnography and multi-object ethnography. I brought text, through the use of archival materials, into my project in a way I had never anticipated, and I built an archive of my own through collating popular media and grey literature. In some ways, the collaborative interviews I conducted, coded, and analysed with my colleagues resulted in the formation of a new collaborative archive - an archive of emergent knowledges. Through organising and analysing my various sources of data, I have ethnographically archived them into different windows, different openings into the varied stories of knowledge production that surround how epigenetics and trauma have emerged as evidentiary spaces in Australia.

The relationship between what might be called Western science and Indigenous knowledges, a relationship which I was cautioned not to collapse by my human research ethics committee at the very beginning of this project, is a tense relationship that can be found in many spaces, from records of a Royal Commission into British Nuclear Testing in the 1980s to contemporary transcripts of interviews with leading experts in genomics. By bringing these sources together into an ethnographic archive – a patchwork – I seek to open up space for, as Yates-Doeer writes, the ‘ambiguity, contingency, entanglement’ in this relationship (2015: 232). This ambiguity of knowledge production about trauma, of the knowability of harm in the body and across bodies over time, is able to be kept at the forefront of this thesis because of the variety of sources I have used to explore it. While some of this variety felt out of my control at the time due to the pandemic, it has come to be crucial in constructing the archive from which I draw throughout this thesis.

Chapter two — Trauma: an unstable category

Introduction

When approaching a research question about epigenetics, trauma, and evidence, it may be tempting to start with epigenetics, and to place all sense of instability, novelty, or confusion onto this particular form of postgenomic technoscience. However, that approach risks framing 'trauma' as a relatively stable foundational concept, and framing 'epigenetics' as the complex, slippery thing that is entering the frame. Yet trauma has never been stable – it has always had its own histories, complexities, and contesting discourses. The purpose of this chapter is to highlight the instability of trauma as an object of inquiry, and to describe its history and emergence in Indigenous health in Australia. Formulating a genealogy of trauma as related to Indigenous health in Australia is important as it helps to inform and elucidate some of my participant's responses to epigenetics – both positive and hesitant ones. These responses are related to not only the complexities of epigenetics, but also to the histories of how trauma has been leveraged in Indigenous health settings in Australia. In many ways, the themes, concerns, and potentials that epigenetics brings up for my participants are also reflected in how they speak about, relate to, and understand the concept of trauma.

I begin this chapter by sketching a chronology of the establishment of the concept of trauma in Western biomedicine, and detailing the process by which trauma became formalised as a diagnostic category through the emergence of post-traumatic stress disorder (PTSD) in the 1980s. I then turn my attention to the development of complex-PTSD and other concepts of trauma, namely collective trauma, historical trauma, and intergenerational trauma. I explore the ways in which discourses of collective and historical trauma became embedded in Indigenous health in Australia through the establishment of the 'Social and Emotional Wellbeing' model of mental health. However, some participants of this study struggle with the increasing prevalence and decontextualisation of the concept of trauma, and thus resist discourses of trauma in Indigenous contexts. I demonstrate that a key tension in discourses of trauma and its effects is one of in/visibility – they slide between making the impacts of collective events of harm visible through a focus on the collective, and making them invisible through a focus on the individual. Through tracing the varied embedded discourses of trauma, I show that the concept has never been stable, and that it is necessary to first understand the complexities that surround 'trauma' and its uses in Indigenous health settings before turning to epigenetics, as these discourses underpin and are intimately intertwined with the emergence of epigenetics as a biological framework of intergenerational trauma in Indigenous contexts. Informed by Foucault, throughout this chapter I approach discourses as sets of knowledges, with 'conditions of existence' and capacities for transformation (1972; 1978: 16).

The rise of 'trauma'

In an influential text titled *Trauma: A genealogy* (2000), historian of science Ruth Leys confirms that 'there is the absolute indispensability of the concept for understanding the psychic harms associated with certain central experiences of the twentieth century', however she also alludes to the concept of trauma as an increasingly 'debased currency', in that it can be used to describe everything and nothing (2000: 2). This tension is central not only to this chapter but to my thesis more broadly. Notions of physical shock and distress have greatly interested physicians since the 1860s, however it was not until the late 1800s and early 1900s that Sigmund Freud and others became interested in 'the wounding of the *mind* brought about by sudden, unexpected, emotional shock' (Leys, 2000: 4). Ever a gendered concept, at this time male researchers began to develop an interest in the hysterical female, first as related to repressed sexual seduction and sexual assault, and then thought to be related to the effects of 'repressed erotic infantile wishes and fantasies' (Leys, 2000: 4). In 1889, Charcot wrote that 'cases of male hysteria can be met with frequently enough in everyday practice' (Charcot in Micale, 1990: 365). During the First World War, it became increasingly clear that the symptoms of what was termed 'shell shock' in male soldiers were indeed similar to those that Freud and others had studied in 'hysterical' women. After the First World War, a 'small and increasingly influential minority' of physicians began to revisit Freud's earlier work to help them understand shell shock as an example of what they understood to be the psychogenic, traumatic effects of war (Leys, 2000: 5). Importantly, work on trauma at this time was already grappling with the question of individual internal pathology vs. collective external events of harm. For example, in 1918, there was a strong medical consensus that 'flawed heredity and constitution have a determining effect in the great majority of cases of war neuroses' (Young, 1995: 55). In other words, the prevailing discourse was one in which men who received diagnoses of shell shock or other neuroses were seen as being 'naturally' and innately vulnerable or deficient *before* their exposure to the traumas of war. I raise this here to highlight how even during the First World War, diagnoses of trauma/neuroses were producing both compassionate *and* discriminatory effects for the populations in question.

Though it is difficult to imagine now, this psychiatric interest in trauma declined at the end of the First World War – and most of the work remained relatively forgotten until the Second World War (Young, 1995: 85). Indeed, Leys posits that the 'history of trauma itself is marked by an alternation between episodes of forgetting and remembering, as the experiences of one generation of psychiatrists have been neglected only to be revived at a later time. Just as it took World War II to "remember" the lessons of World War I, so it took the experience of Vietnam to "remember" the lessons of the Holocaust' (Leys, 2000: 15). It was only after this 'remembering' during the Vietnam War that a concerted effort on the part of US Veterans, social workers, and psychologists to mobilise attention around what was then called 'Post-Vietnam Syndrome' began (Scott, 1990: 301). Thanks to this activism in the 1970s, as well as the activism of feminist physicians such as Judith Herman, previous work on trauma (particularly the concepts of shell shock and 'traumatic hysteria') was synthesised and included in the peak text relating to mental health – the American Psychiatric Association's (APA) *Diagnostic and Statistical Manual of Mental Disorders* (DSM) in 1980 (Herman, 1992; Leys, 2000). The concept was codified in the DSM-III as 'post-traumatic stress disorder', or PTSD. In her extensive genealogy of trauma, Leys writes that:

> The diagnosis of PTSD represents the culmination of an attempt to do justice to the earlier psychiatric literature on the Holocaust survivor by integrating it into a *unified theory* that applies to the victim of natural disaster, the combat victim, the Holocaust survivor, the victim of sexual abuse, and the Vietnam veteran alike. (2000: 16, my emphasis)

In presenting itself as a 'unified theory', PTSD has come to stand in for the many conceptualisations of trauma that preceded it, and is the point of departure from which current studies of trauma, particularly those which are concerned with the biology of trauma (including epigenetics), launch off. In a review of how PTSD came to be included in the DSM-III, sociologist Wilbur J Scott demonstrates that this 'unifying' potential of PTSD as a new trauma diagnosis was intentionally cultivated by its supporters to bring trauma 'to light as an always-already-there object in the world' (1990: 295). The inclusion of PTSD in the DSM-III was also opportunistic in some ways. A foundation called the National Veterans Resource Project (NVRP) was founded in 1970 and became concerned with the need for empirical data on the struggles faced by Veterans, with the director at the time stating that 'we're going to have to prove that we're not talking about something that's an illusion' (Scott, 1990: 303). A few years later, in 1973, homosexuality was removed from the DSM-II, demonstrating in a public-facing way that the classifications within the DSM were not fixed and were able to be challenged.

In 1974, the APA began working on the third edition of the DSM, and the NVRP began to agitate for the inclusion of a classification for 'stress reactions associated with combat'; by this time the NVRP 'had sufficient empirical evidence for a diagnostic category devoted to combat-related stress', and they also strengthened their case by linking in with researchers who worked on stress and trauma in concentration camp survivors (Scott, 1990: 304). By 1978, their efforts to legitimize war traumas were formally recognised by the APA, and PTSD was included in the DSM-III which was released in 1980. Andraesen, leader of the Committee of Reactive Disorders which assessed and approved the submission for including PTSD, wrote that PTSD was 'a disorder that has long been recognised in clinical psychiatry but for which official recognition has been minimal, late in arriving, and long overdue' (1980: 1517, in Young 1995: 111). I have briefly sketched the story of how PTSD got into the DSM here to show that PTSD has always been a political concept tied to recognition and proof, and that it has always been intimately connected to a desire to *make visible* the already-existing impacts of harmful experiences.

In the case of PTSD and the war Veteran, a central driver for all of the activism which led to the successful inclusion of PTSD in the DSM-III was its potential to shift perceptions around origins of trauma from the *individual* to *collective, external experience.* As Scott writes, the formal diagnosis of PTSD in war Veterans 'called for the clinician to take seriously the patient's combat experience. This orientation shifted the focus of the disorder's cause from the particular details of the individual soldier's background and psyche to the nature of war itself' (Scott, 1990: 308). Similarly, in her work on trauma and domestic abuse, Herman highlights that the majority of research on women survivors/victims of domestic abuse before the DSM-III focused on 'the personality traits that might predispose a woman to get involved in an abusive relationship', rather than viewing the exploitative relationship as an environment of trauma (1992: 116). Young writes that 'acknowledging PTSD would be a small step toward repaying a debt', a way of taking blame away from the individual and directing it towards the state (1995: 114). As I will show in this chapter, this oscillation between a focus on the constitution of the individual and on the impacts of external experiences to which the individual is exposed remains a key tension in contemporary conceptions of and political uses of the concept of trauma.

I have sketched the social construction of PTSD here to highlight the fact that, much like epigenetics, PTSD and trauma are not stable constructs. Writing in 1995, anthropologist Alan Young encouraged scholars of PTSD to remember that:

> The disorder is not timeless, nor does it possess an intrinsic unity. Rather, it is glued together by the practices, technologies, and narratives with which it is diagnosed, studied, treated, and presented by various interests, institutions, and moral arguments that mobilized those efforts and resources. (1995: 5)

I argue that this reminder is just as necessary today, especially as biological mechanisms of trauma transmission such as epigenetics are increasingly entering the frame. Writing about discourses of trauma in Canada, Million notes that Canadian First Nations peoples are 'thickly ensconced in the intensities, logics, and languages of trauma', and it is these logics, languages, and narratives that are the subject of this chapter (2013: 3).

Complex-PTSD and other concepts of trauma

After its inclusion in the DSM, PTSD became the central classification for mental health impacts of traumatic experience, though it was by no means universally lauded. In particular, it was (and remains) seen by many as too narrow and simple in scope – as it focused on a particular trauma 'event' and as such did not address prolonged, repeated traumas (Herman, 1992: 119). Since PTSD was more likely to be accepted into the DSM if it were a 'unified' concept that collapsed many forms of trauma and traumatic environments into one definition, it has been highly criticised for its simplicity. In effect, when campaigning for the inclusion of a trauma diagnosis in the DSM, complexity was intentionally taken out so that the classification could get in. Some ten years later, Herman proposed a new diagnosis, which she labelled 'complex post-traumatic-stress-disorder' (complex-PTSD or c-PTSD) (1992). In particular, Herman found that people, mostly women, who were experiencing symptoms of what she understood to be complex-PTSD were commonly misdiagnosed as having borderline personality disorder, multiple personality disorder, or somatization disorder. Interestingly, these three diagnoses used to be classed under the same 'obsolete name, *hysteria*' (Herman, 1992: 123, original emphasis).

Here again, Herman and her supporter's aim in campaigning for an extended definition of PTSD, complex-PTSD, was to direct attention away from the perceived deficits or flaws of the individual, and to re-place attention on the cumulative impacts that repeated traumas can have on a person, framing an acknowledgement of these traumas as central to compassionate and accurate care. She was also clear in framing trauma events as cumulative. Young writes that 'PTSD's defining feature is its etiological event' (Young, 1995: 120), whereas Herman's contribution was to pluralise this etiological event from one into many. This 'complex' construction of trauma also problematizes the chronology inherent in the DSM PTSD diagnosis. In the DSM definition, time flows from the etiological event to its symptoms, whereas complex-PTSD allows for 'a picture in which time flows in two directions: from a significant event out to its symptoms (the DSM conception of PTSD) and from a person's current psychological state back to the event, where it acquires a genealogy and a discrete set of meanings' (Young, 1995: 135). Here we find cycles, repetitions, and multiplicity – complexities which do not appear in the singular and unified construction of PTSD in the DSM-III.

Around the same time that definitions of complex-PTSD were being developed, a group of American researchers began publishing findings of their 'Adverse Childhood Experiences Study' (Felitti et al., 1998). The 'Adverse Childhood Experiences Study', known as the ACE Study, linked experiences of childhood abuse and neglect to poor adult health, and was explicit about the compounding impacts of 'Adverse Childhood Experiences'; 'studies of the long-term effects of childhood abuse have usually examined single types of abuse, particularly sexual abuse, and few have assessed the impact of more than one type of abuse' (Felitti et al., 1998: 246). The authors created a list of seven different types of ACEs – 'psychological, physical, or sexual abuse; violence against mother; or living with household members who were substance abusers, mentally ill or suicidal, or ever imprisoned' (ibid). They found that adults who had experienced multiple of these ACE's were more likely to have also experienced significant mental health impacts later in life. Similarly to complex-PTSD, the ACE Study highlighted the cumulative nature of exposure to harmful or distressing situations, challenging the ‘single etiological event’ of PTSD. For these reasons, complex-PTSD and ACE’s were often invoked by my participants who worked in mental health fields with Indigenous peoples.

One such participant, Jill, a settler social worker and narrative therapist with over 20-years’ experience working with Indigenous peoples in regional and remote settings, said that ‘I think people love things like the DSM-V, and so there’s a propensity to use diagnostic tools. The most sophisticated ones I’ve seen are complex-post traumatic stress disorder’ (Interview 14). Another participant, Rachael, an Indigenous epidemiologist and researcher in Indigenous maternal health, reflected on how she came to view complex trauma as a useful framework:

> It really clicked into place when I started to read the evidence around complex trauma. So reading the qualitative – you know, a lot of the intervention studies, for example, about what works in – you know, why studies haven't worked and interventions haven't worked in Indigenous communities. Looking at the qualitative studies and observational studies describing – you know, there's a really interesting study in an American Indian community talking about low self-efficacy and heightened perceptions of risk. That really comes up – you know, really matches with the complex trauma diagnoses and all the adverse childhood experiences evidence. So that's just like the elephant in the room. We know that those – not only are there higher risk factors for health risk behaviours, but also that the interventions don't seem to work as well for people that have experienced traumatic events in the past. I think the World Health Organisation, Michael Marmot in the European Review of Health Equity in 2012, provides a really nice framework for understanding those compounding intergenerational effects of complex trauma on Indigenous communities and it's really well backed up by the evidence. So it's been kind of learning over the last couple of decades I'd say, but certainly – you know, and personally as well. (Rachael, Interview 9)

By the mid to late 1990s, a view of trauma in medical literature was emerging in which multiple, compounding traumatic events were understood to have long-lasting impacts on an individual’s life over time. Then, this extended to considerations of the impacts of trauma over *generations*.

In Indigenous health contexts in Australia, scholarship on intergenerational impacts of trauma was significantly impacted by the publication of Judy Atkinson's book *Trauma Trails: Recreating Song Lines* in 2002. The book details Atkinson's study of experiences of violence in the lives of Aboriginal people in Central Queensland between 1993-98, a place (like much of the continent) where massacres, forced displacement, and incarceration has led to what Atkinson calls 'trauma trails running across the country' (2002: 10). Importantly, under this umbrella of 'violence', Atkinson is careful to include colonial violence, not only interpersonal or family violence:

> In spite of the fact that colonisers have disregarded the rights of Indigenous peoples, and have used force to dominate, intimidate, subdue, violate, injure, destroy and kill, they do not consider their actions, either morally or under their law, to be violence. (Atkinson, 2002: 11)

In focusing on violence, Atkinson demonstrates that experiences of violence 'are traumatic, and that trauma, if unhealed, may compound, becoming cumulative in its impacts on individuals, families and indeed whole communities and societies. The layered trauma that results from colonisation is likely to be expressed in dysfunctional, and sometimes violent, behaviour at both individual and large-scale levels of human interaction, and these are re-traumatising' (2002: 24). Her important contribution here is framing colonisation as a trauma event which stretches, through trauma trails, across time and space, impacting people in the present. As I have already noted, one of the key political actions of 'trauma' is its capacity to encourage people to see a particular experience (e.g. war combat, sexual abuse) as a traumatic event. Writing in 1992, Herman stated that:

> At the moment, the study of psychological trauma seems to be firmly established as a legitimate field of enquiry. With the creative energy that accompanies suppressed ideas, the field has expanded dramatically. Twenty years ago, the literature consisted of a few out-of-print volumes mouldering in neglected corners of the library. Now, each month brings forth the publication of new books, new research findings, new discussions in the public media. But history teaches us that this knowledge could also disappear. Without

> the context of a political movement, it has never been possible to advance the study of psychological trauma. (Herman, 1992: 32)

Writing in 2002, Atkinson is clear that the ‘political movement’ to which her scholarship on trauma is rooted is recognising the impacts of colonisation in Australia. Atkinson’s study took place while the so-called ‘history wars’ were in full swing.[12] By linking cotemporary trauma and violence to past colonial violence, Atkinson was (and is still) engaged in a political project of *making visible* the intergenerational impacts of colonisation, in a similar way that linking war combat to trauma in the 1980s in the US was highly political. One of my participants, Amber, an Aboriginal social worker who works in hospital settings, reinforced the impact of this linking move in our interview, saying that ‘when Judy Atkinson wrote *Trauma Trails* and really clearly documented how trauma presents itself for a person, and she linked it to kind of symptoms of PTSD, and for a lot of people really put words to the intergenerational experience of trauma, but she really located it in colonisation. So that was really helpful back then.’ (Interview 15).

Rachael, an Indigenous epidemiologist and researcher in maternal health, also talked to me about the impact of reading and learning about trauma in relation to Indigenous health, saying that she remembered thinking to herself, ‘well, why didn’t anyone tell me about this before – we should really kind of nail – you know, I was working in this area [maternal health], studying it, I probably should have heard about it if it’s such a big issue and why isn’t anyone talking about it…that was 2004’ (Interview 9). In *Trauma Trails*, Atkinson acknowledges that PTSD as defined in the DSM is ‘inadequate as a diagnostic tool when considering colonial conditions and cumulative traumatic stress situations’, however she concedes that it does ‘provide a starting point’ (2002: 51). From this starting point, Atkinson engages with concepts of ‘collective’ and ‘communal’ trauma, writing that the insidiousness and slow violence of collective and communal experiences of harm are more readily applicable to Aboriginal experiences of colonial violence than PTSD is, however she often references the DSM definition

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[12] The ‘history wars’ refers to a period of academic and media conflict in the early-mid 1990s in Australia, during which attempts by some academics to reckon with Australia’s violent colonial history were lambasted by conservative politicians and media as untrue, and/or as portraying Australia’s history as unfairly negative.

of PTSD to link her argument about the impacts of colonial violence to the (by this point popularised and established) effects of post-traumatic stress disorder.

Social and Emotional Wellbeing

In Australia during the 1990s and early 2000s, informed by the increasing amount of international scholarship on intergenerational trauma, ACEs, and complex-PTSD, Indigenous health workers and researchers along with non-Indigenous researchers began to develop the framework of Social and Emotional Wellbeing (SEWB). The first national report into Aboriginal mental health, published in 1995, was titled ‘Ways Forward’ (Swan & Raphael). In 2004, the ‘National Strategic Framework for Aboriginal and Torres Strait Islander Peoples’ Mental Health and Social and Emotional Wellbeing’ was published, detailing a Framework for the subsequent five years (2004-2009). This ‘Wellbeing Framework’ was authored by the National Mental Health Working Group and the National Aboriginal and Torres Strait Islander Health Council, who appointed a ‘Social Health Reference Group’ to research and develop the framework. Importantly, this wellbeing framework eschewed ‘mental health’ for ‘social and emotional wellbeing’, which is defined in the report as being premised on the recognition that ‘optimal conditions for health and wellbeing requires a holistic and whole-of-life view of health, referring to the social, emotional and cultural wellbeing of the whole community’ (Wellbeing Framework, 2004: 3). A more recent definition of SEWB places it in contrast with mainstream understandings of ‘mental health’, asserting that ‘mental health from an Aboriginal and Torres Strait Islander perspective is an intrinsically linked aspect of a person’s overall health. It is a more collective and holistic concept than the mainstream view’ (NACCHO, 2021: 5). The 2004 Wellbeing Framework utilises the guiding principles which were developed in the ‘Ways Forward’ report from 1995. Of these nine guiding principles, number four makes direct reference to intergenerational trauma as resultant from colonisation:

> 4. It must be recognised that the experiences of trauma and loss, present since European invasion, are a direct outcome of the disruption to cultural wellbeing. Trauma and loss of this magnitude continues to have inter-generational effects. (Swan & Raphael, 1995)

In the 2004 Wellbeing Framework, this is highlighted again by the authors, who refer to PTSD as a response to unresolved grief, loss, and trauma:

> In essence, issues of social and emotional wellbeing cover a broad range of problems which can result from unresolved grief and loss issues, trauma and abuse, domestic violence, issues associated with the legislated removal of children, substance misuse, physical health problems, genetic and child developmental problems, gender identity issues, child removals, incarceration, family breakdown, cultural dislocation, racism and discrimination and social disadvantage. These factors can influence the way a person thinks, feels and responds to situations. Mental health problems and mental illness are also encompassed, yet form a distinctive subset, within this broad holistic framework and include problems related to crisis reactions, anxiety and depression, post-traumatic stress, suicide and self-harm behaviour, as well as psychotic disorders, affective disorders, and organic and degenerative disorders. These conditions are clearly impacted upon by the many factors discussed above and also contribute to an individual and family's capacity for social and emotional wellbeing. Many of these issues are interconnected, coexist or influence each other. (Wellbeing Framework, 2004: 13)

In this excerpt, as in Atkinson's work, discussions of trauma are directly and explicitly linked to experiences of racism, discrimination, incarceration, and displacement. To respond to the broad and interconnected factors related to SEWB, at the time of this Framework some Aboriginal Community Controlled Health Organisations (ACCHOs) began to install 'Social Health Units'. These Units were multi-disciplinary, and a 'specialised knowledge of history, culture and social health problems' was essential to their functioning (Wellbeing Framework, 2004: 30).

In these units, trauma was never separated from history and from social, collective experiences. Almost twenty years later, these units are most commonly referred to as SEWB Teams, and SEWB has become a fairly common and mainstream parlance within the Australian healthcare system. The National Aboriginal Community Controlled Health Organisation (NACCHO), the peak body for Aboriginal community-controlled health services, is campaigning to increase the SEWB workforce across the country (NACCHO, 2021: 6). After the National Apology in 2008, when former Prime Minister Kevin Rudd formally apologised to members of the Stolen Generations, funding was assigned to establish a national Aboriginal and Torres Strait Islander healing foundation, to 'address the harmful legacy of colonisation, in particular the history of child removal that continues to affect Aboriginal and Torres Strait Islander people'

(Healing Foundation, 2022). In 2009, the Healing Foundation began, an organisation which uses the frame of intergenerational trauma to advocate for healing. The Healing Foundation is clear that unresolved trauma is 'caused by colonisation and actions like the forced removal of children' (Healing Foundation, 2022). Here, like in the SEWB framework, mentions of trauma are always explicitly linked to history, colonial policies, and colonial violence.

From the 1990s onwards, trauma has been a foundational concept in the development of SEWB and healing initiatives, but it has always been linked to collective and historical experience. Within SEWB, trauma is never an individual mental health 'problem', as it might be understood in PTSD definitions, (or, as I detail in the following chapter, in epigenetics). Jill reinforced this, saying that 'there are definitely traumatic effects that land in people's bodies, behaviours and their minds, but that's as a result of violence, abuse, subjugation and oppression' (Interview 14).

Here I have sketched the careful and sensitive ways in which scholarship on complex-PTSD, collective trauma, and historical trauma led to the creation of SEWB, an Indigenous model of mental health which is holistic and rooted in understandings of history, racism, and violence. The SEWB framework is one which was developed to make visible the connections between trauma and colonial violence. Talking about trauma was a way of talking about racism, colonisation, and oppression. In the next section, however, I detail how some of my participants, particularly Indigenous and non-Indigenous social workers and community workers, shared a concern that over recent years this connection has become lost, and that instead the concept of trauma in Indigenous health has become uprooted, amorphous, and decontextualised.

Trauma: a 'debased concept'?

When I was sitting in Karina's backyard in Wallatinna, late in the evening as we had been working with linguists all day, the Aboriginal flag behind her lit by bright clear stars, we started talking about the term 'intergenerational trauma' in relation to central desert communities:

> H: Can I ask what you think of this idea of intergenerational trauma that's being used a bit more often – the term's coming up in NACCHO documents and government discussions and programs and that kind of thing. Is it something that resonates with you?

> K: Yeah I kinda hear that through the issues that we have in our remote communities on substance abuse. Whether its drug and alcohol abuse that comes in and then there is this intergenerational trauma that is passed on and you know, kids are exposed to these things. But this is, this is that ‘other thing’, this other system that’s out there that has come in and complicated that. That’s not trauma from our system, that’s trauma from another system that has come in to really complicate and impact a generation, two generations, three generations…so it’s outsider system abuse coming in and impacting and now Western[ers] are saying “that’s intergenerational trauma” without good messaging around it to talk about why like…it’s out of control now because it was brought in by that outside, and I hope that makes – I hope that’s clear it’s like we haven’t, it’s not us introducing stuff to the western world, this is western world introducing us to new ways and new worlds so what have been their communications about educating, but also at the same time about respecting this diversity as well that there is another culture that we need to be very mindful of and very respectful of. They came in and they brought these things. They came in and brought in tea leaves, sugar, flour, jam, you know *again* more influences coming in thinking for whatever reason that that was providing an exchange or better nutrition, or introducing these foods to us when we already came with great knowledge of our native foods and so it was that imposing of outside stuff coming in, but we’ve never imposed any of our ways the other way to the western world or western culture.
>
> And then they tell us that we’re all traumatised! Yeah we’re all traumatised! But we’re all traumatised by things that have been imposed on us! And the education around it is not respecting the strong Anangu system or strong First Nation or strong Indigenous systems across the nation, and so there’s a devaluing of this complex system that we have and they’re undermining, western culture undermining Anangu culture.

Karina was visibly frustrated and exasperated during this conversation; when she said ‘and then they tell us that we’re all traumatised! Yeah we’re all traumatised!’ she was laughing at the absurdity of it all. The absurdity that settlers ‘are saying “that’s intergenerational trauma” without good messaging around it to talk about why’. Here it is clear that Karina views trauma as a word that has become detached from histories of colonisation and violence. She highlights that the current discourse and education around intergenerational trauma is not respecting First Nations strengths and sovereignty and that, instead, the word ‘trauma’ is being used by settlers in remote communities in the same way that they might use the word ‘dysfunction’.

This conversation illuminates a concern that was shared by other participants I interviewed, particularly those whose professional backgrounds included social work, SEWB, and community work. Amber, a social worker in an emergency department in Queensland, said that she is ‘very careful in using the word [trauma] in my work. I would prefer to, first, call it what it is, call the issue what it is. Really try to specifically name what people are going through, instead of just saying “Oh yeah, they've experienced trauma.”’ (Interview 15). She said that since Atkinson’s work in *Trauma Trails* and other earlier works on trauma in Indigenous contexts, trauma has ‘become a discourse’. She continued:

> When people are coming in also to the ED [Emergency Department], and then you'll see things like ‘they've had a trauma background,’ a ‘trauma-informed approach’ is what people say that they use, I don't know how they did that, and then just how that gets linked to this discourse. That anybody who's experienced either colonisation or rape, or any other events that can be experienced as traumatic, and so it's just called trauma. So it's not called what it is. It's not called rape, it's not called colonisation, it's not called racism. It's just called trauma. So it kind of ‘invisible-izes’, I think, the experience that people are going through.
>
> Then there's the whole, you know … two weeks ago a woman from an organisation in Cairns that is linked, you know, they do a lot of work around suicide, she did a professional development activity with a local service, all Aboriginal, Torres Strait Islander participants in the group, and she said that people who suicide, scientists have found that they're missing a gene. What the heck, you know.
>
> Increasingly I'm getting really angry at just how kind of frivolous people are in using the term. Everything's trauma. I think that it also, as well as not calling it what it is and making all of the social context invisible, it's also determining for people what is trauma. I'm not saying sexual assault is not traumatic, but it does take away the person's ability to

> name things for themselves if we just have a blanket “Oh, that's trauma.” I'm not saying it's not, but if somebody said that it's not, then it's not. (Interview 15)

Many things are striking about this excerpt (which is why I have included it in full without edits). Firstly, Amber introduces the idea of trauma as a term which ‘invisible-izes’ peoples’ experiences. Earlier in this chapter, I wrote about how introducing PTSD into the DSM was a political project of *making visible* the impacts of harmful experiences. Similarly, the work of Indigenous theorists, health workers and activists in the mid-1990s to mid-2000s was a political project of *making visible* the harmful impacts of colonisation. But what Amber is witnessing now, in 2021 (when this interview took place), is that trauma has become such a ubiquitous concept, with an increasingly ‘frivolous’ usage, that it is ‘making all of the social context invisible’. In her statement, ‘Everything’s trauma’, we see echoes of Karina’s comment that Westerners are coming into central desert communities and ‘saying “that’s intergenerational trauma”’ or, “you’re all traumatised!”’ Both women describe how the concept of trauma has become separated from the social and political contexts it is meant to highlight; Amber made this point explicitly, saying ‘if you're talking about trauma as a pathologized experience, then usually [you're] not talking about the effects of colonisation and how it is an ongoing project.’

In talking about pathologizing here, I am reminded of Tess Lea’s observation that, often, in settler colonial Australia, ‘Aboriginal people must yield to forms of extraction to receive infrastructural services, just as they must cede to pathological portraits of their population for health, education, and other social programs’ (Lea, 2020: 21). It could be argued that discourses of trauma have always been concerned with representing a ‘pathological portrait’ of a population, however this was originally done with a sense of activism or political change-making behind it. In more contemporary iterations of trauma discourse in Australia, the concept is so diluted that the pathological portrait (“you’re all traumatised!”) has become disentangled from its original enmeshment with Australian colonial histories, such as forced child removal, and instead stands alone, without context and without political framing. Similar observations of the separation of trauma from colonial histories have been made in Canada, another settler colonial nation with colonial policies of forced child removal, known as the Residential Schools system, by Laurence Kirmayer et al. (2014). Here in Australia, both of these participants highlighted this dilution, and they also show how, if used by settlers without an understanding of not only histories of colonisation in Australia but also histories of the very emergence of the concept of trauma in Indigenous contexts, the word ‘trauma’ can amount to an accusation.[13] In my interview with Jill, we discussed this idea of pathologization as related to trauma and other mental health diagnoses. Jill said that:

> If you’re working with [Aboriginal] kids or people who’ve been incarcerated or families and communities, what you will often see is, you know, there’ll be a plethora of ADHD, compulsive obsession disorder, oppositional defiance disorder. A whole load of disorders that are actually descriptive of behaviours that speak to responding to context of injustice. So even in Aboriginal research and Aboriginal organisations, people are leaning more into that space. My concern is that we continue to pathologize responses to structural and systemic oppression. (Interview 14)

Jill noted that ‘trauma’ itself is not seen as a mental health diagnosis in the SEWB model, for example, but that due to its association with PTSD and the way it has been constructed through the DSM and other tools of psychiatry and psychology, it can slip into framings which are much more aligned with a mental health diagnosis, rather than as a collective experience of harm as rooted to colonisation. This slippage is of concern not only to Jill, but also to another Rachel, an Aboriginal epidemiologist who I introduced earlier in the chapter. When we spoke she was leading a research project to develop a tool to help clinicians identify complex-PTSD in Aboriginal parents during the perinatal period, in order to then be able to direct them to relevant and appropriate support services. In this project, one of her main concerns is that things like ‘trauma’ and ‘complex-PTSD’ can sound clinical and can be removed from local contexts and local experiences. She said that:

> The language of trauma is - I don't know how we get it. I think it’s, physicians and healthcare professionals need to understand trauma in the background, but then we need another whole language with how to talk about it. People like Professor Judy Atkinson, and NPY Women's Council with their beautiful book, *Tjulpu and Walpa*[14], they have that

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[13] To read more about how histories of colonisation in Australia have impacted health systems, see Emma Kowal (2015) and Chelsea Watego (2021).

[14] *Tjulpu and Walpa: two roads, two children,* is an illustrated story book published by the NPY Women’s Council Aboriginal Corporation in 2016. It was developed in collaboration with the Healing Foundation and Australian Childhood Foundation. Jill,

> deep understanding of trauma, but they understand it deeply and well enough to be able to story tell, use analogies that are telling it in a way that's less threatening and less scary. I think it's telling that there weren't Aboriginal words for trauma prior to colonisation, and that it's all really around focusing on fostering social, emotional wellbeing connectedness. You know, trauma is the disconnection of all of those, so I think we need another, we need one language. We need to understand it, but we actually need a different way of talking about it because the language is off-putting. (Interview 9)

Her comment that there were no Aboriginal words for trauma before colonisation demonstrates how 'trauma' as understood today is a relatively recently constructed concept. Young calls it a 'man-made object. It originates in the scientific and clinical discourses of the nineteenth century; before that time, there is unhappiness, despair, and disturbing recollections, but no traumatic memory, in the sense that we know it today.' (Young, 1995: 141). In the above interview excerpt, trauma is described as something which is important for health professionals to understand, but when it comes to communicating the concept to Indigenous parents, Rachael says that 'we need another whole language'. Again, the instability of 'trauma' is emerging here; this constant hesitation and tension around how to engage with a concept that is connected to 'off-putting' narratives.

Conclusion

As Young reminds us, the concept of trauma is 'glued together by practices, technologies, and narratives' (1995: 5). In this chapter, I have demonstrated how trauma came to be widely known within psychology and public health as PTSD, through making visible the impacts of war and combat on Vietnam veterans. The inclusion of PTSD in the DSM was inherently and explicitly political, and as Herman wrote, from the 1980s onwards studies of psychological trauma have always been linked to a political movement of one kind or another (Herman, 1995). From the First World War to the present day, making the impacts of collective events of harm publicly known and visible through invoking trauma has produced important political effects, but these effects have also been tangled up in questions around individual internal pathology, establishing

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who I interviewed, was a lead story developer. The book tells the story of Tjulpu, an Anangu child who grew up with strong family and culture, and Walpa, an Anangu child who was taken to Adelaide by welfare and had a difficult childhood, but who ultimately heals her trauma with support from Anangu community and culture.

a situation in which the focus of trauma discourses shifts between a) the constitution of the individual and b) the impacts of external experiences to which the individual is exposed. Nonetheless, PTSD became firmly established in American psychiatry and mental health spaces more broadly. In the mid-90s, alternative constructions of trauma were proposed, constructions which challenged the 'single etiological event' on which the PTSD definition relied. Namely, the development of complex-PTSD and the incredible popularity of the ACEs Study led to a recognition of cumulative, ongoing experiences of trauma.

It is here that I turned towards First Nations engagements with trauma in the mid-90s and early 2000s – specifically the development of the Social and Emotional Wellbeing framework, as well as Judy Atkinson's essential text *Trauma Trails* (2002). As my participants noted, these frameworks and theories of trauma were explicitly tied to making visible the impacts of colonisation on First Nations peoples, especially in relation to the intergenerational impacts of trauma. At that time, talking about trauma was a way of talking about the impacts of colonisation, racism, and oppression. However, as the terms 'trauma' and 'intergenerational trauma' have become increasingly used, they have become disentangled from their political origins. Rather than making colonisation and racism visible, interviews with my participants demonstrated that contemporary constructions of trauma render social systems of oppression *invisible,* and that the dominant narratives of trauma in Indigenous health have become pathologizing and off-putting.

I have sketched this story of the many shifting understandings, uses, and effects of the concept of trauma and its powerful discourses from the nineteenth century onwards to demonstrate that it is not a stable concept. In all contexts, though especially in relation to Indigenous health, where settlers engage with the concept in diluted ways, 'trauma' is complicated, contested, and repeatedly constructed. By describing the emergence of trauma in Indigenous health in Australia with attention to the complexities around its use, I have shown that the themes, concerns, and potentials that trauma encapsulates for my participants are multiple, and that this only becomes more so when epigenetics enters the mix. For a study such as mine to approach 'trauma' as a stable object, and 'epigenetics' as a messy one, is to miss a large portion of the story. Indeed, epigenetic and biological knowledge on trauma is so fraught *because* the concept of trauma is fraught too. In the following chapter, I build on the instability of trauma which I have presented here by turning to contemporary biological understandings of the concept, including neurobiology and epigenetics. In this chapter, I have highlighted the oscillations between individual pathology and collective external experience, the tensions between making social systems visible and rendering them invisible, and the challenges of language that arise when using the frame of trauma to tell stories about harm. These oscillations and challenges are also present in the following chapter on biological mechanisms and trauma, thereby reinforcing that the key questions that surround epigenetics when it comes to trauma and Indigenous health are not new at all.

Chapter three — Enacting environmental epigenetics

Introduction

Many years before commencing my PhD, I participated in an internship program for Australian undergraduate students to gain work experience in what is often termed the ‘Indigenous Affairs sector’. Students from across the country studying mainly Law and Anthropology, but also Geography and other related disciplines, applied to work for six weeks at a time in overstretched organisations who, the program told us, benefited both from the support that unpaid interns could provide in the short-term, and the increase in employment/retention in the sector that the internships led to over the long-term. The program had a focus on regional and remote placements, offering up to enthusiastic students the chance to experience ‘authenticity’ in far-away places. Indeed, if you meet young non-Indigenous people who work in Darwin, Alice Springs, Broome, or the Kimberley, many of them got their start through this internship program. I was already very interested in Medical Anthropology by the time I applied for this program, so I skipped past the Land Councils and Native Title organisations on the application list and ticked the boxes next to Aboriginal Community Controlled Health Organisations and University-led health and medical research institutes.

I was assigned a placement on Larrakia country, at the Darwin office of the Aboriginal Medical Services Alliance of the Northern Territory (AMSANT). AMSANT is a large organisation, with teams working across policy in public health, housing, alcohol and other drugs, Aboriginal workforce leadership, and Social and Emotional Wellbeing (SEWB). Because of my undergraduate study in anthropology and my interest in the social and political aspects of medicine, I was placed in the SEWB team for six weeks, to help them research a working paper on trauma-informed care. At that time (early 2017), the SEWB team consisted of three workers. At the time of writing, the SEWB team is one of the largest in the whole organisation, and has 14 staff. When I was interning there though, the program was fairly new, and even the concept of trauma-informed care that they were seeking to develop into a training program for the member organisations of AMSANT was relatively new in Australian primary health-care settings. Five years later, AMSANT now run a comprehensive ‘culturally-responsive trauma-informed care’ program called *Damulgurra* - the Larrakia word for heart - all across the Territory. As I described in the previous chapter, the rise of 'trauma' and associated concepts has been rapid over the last ten to fifteen years. When I was an intern at AMSANT, I could feel that I was getting a very small glimpse into something very, very big. I was reading reports from North America and New Zealand about trauma-informed approaches in schools, juvenile detention centres, and hospitals. I first read about the ACEs Study, which I described in the previous chapter, while the heavy wet-season rain pounded down on the window in front of me. An American company came to Darwin to give a talk about one of their trauma-informed care training programs, with the hopes that it would get picked up by organisations in Darwin (it didn't). I had many conversations for which I am very grateful with the members of the SEWB team – thinking through questions such as, if trauma is rooted in local histories, how can a company or organisation make a training program that will 'translate' across different countries? Is 'trauma-informed juvenile detention' at all possible, and is focusing on that getting in the way of abolition?

One of the conversations I remember most clearly from this learning experience up in Darwin was actually one of the shortest, and most clipped. While having lunch at my desk one day, an Aboriginal man who worked on the Alcohol and Other Drugs program popped in and asked me how my research was going. He asked if I had come across epigenetics yet. By this point I had been reading papers on ACE's, the flight or fight response, self-soothing - the sorts of things that talked about physiology and the body - but I had never heard of or read this word 'epigenetics' before. I asked him what it was, and he became quite animated, saying that it was an exciting new development that used science and genetics to show that things like trauma and addiction were inherited, and so no one could say it was an Aboriginal person's fault anymore, because it was a genetic thing. As he was talking about this, I looked over at one of the Aboriginal workers in the SEWB team who rolled her eyes and turned around to her computer, essentially stopping the conversation short. In this small interaction, I saw both the explanatory power of a biological model of trauma inheritance and the danger of such a model, as encapsulated by my colleague's rather scathing eye roll. I opened up a tab on google, searched 'epigenetics + trauma', and immediately closed it as soon as the two million or so hits came up. I had a sense that this was going to get messy and distracting. I did not include any information about epigenetics in my final report or ask any of the SEWB team what they thought of it, but that interaction stayed with me when I got back to Adelaide. In fact, I went into my first meeting with my Anthropology Honours supervisor a week after returning from Darwin, and I told him I was thinking a lot about epigenetics, trauma, and Indigenous health. Could that be a thesis topic? He told me it was too complicated a topic for an Honours thesis, and that the whole thing was "wacky" anyway. (He also told me when I called him in 2019 to talk about whether I should do this PhD or not that yes, I should do it, but that he was "sorry to lose [me] to epigenetics"). So now I had a sense that not only was epigenetics a bit of a sticky subject in a peak body for Aboriginal health organisations up north, but it was also a bit of a sticky subject in an Anthropology department down south. What was going on with this thing? What even was it, really?

As I describe in the above story, one thing that epigenetics absolutely is, is controversial. In one small interaction epigenetics garnered keen enthusiasm (my colleague from Alcohol and Other Drugs), scepticism and disinterest (my colleague rolling her eyes), and utter confusion (me watching this play out). Similar to the concept of trauma which I explored in the previous chapter, epigenetics has never been a single, stable thing, but rather it is enacted in multiple ways across multiple contexts. This chapter introduces how epigenetics has emerged as a concept shrouded in confusion and contestation, and traces these multiple understandings and enactments of epigenetics, from its development in the 1950s to its current popularity within the fields of Indigenous health and intergenerational trauma.

My aim in presenting this information is not to answer the question 'what is epigenetics?' but rather to open up another question, 'what does epigenetics do?' Here I draw on Annemarie Mol's theoretical contributions in her 2002 book *The Body Multiple: ontology in medical practice*. In her ethnography of atherosclerosis in a Dutch hospital, Mol makes an important distinction; she does not treat atherosclerosis as a single object on which different people have different perspectives and understandings. Rather, she focuses on how atherosclerosis is *enacted* in a series of different practices, writing that 'unlike many other books on medicine and its processes, this one does not speak of different perspectives on the body and its diseases. Instead it tells how they are done' (Mol, 2002: viii). Moving away from visual metaphors of perspective, where we might consider atherosclerosis (or epigenetics) as a single object which people look at from different viewpoints, she repositions atherosclerosis as a 'slightly different [entity] each time' that a person enacts a practice with it; 'attending to enactment rather than knowledge has an important effect: what we think of as a single object may appear to be more than one' (Mol, 2002: viii). By focusing on practices and enactments, Mol exposes 'a complex set of affairs' that moves beyond perspectives and different interpretations (2002: viii). Mol describes this opening up of the complexities and multiplicities of the body through her work as a part of 'theorizing medicine's *ontological politics*: a politics that has to do with the way in which problems are framed, bodies are shaped, and lives are pushed and pulled into one shape or another' (Mol, 2002: ix, original emphasis). This is a helpful intervention when it comes to studying epigenetics. Rather than viewing epigenetics as a single object and studying different perspectives on this one 'thing', following Mol's contribution I am interested in studying how different sets of practices enact different things which we call epigenetics.

Biological mechanisms of trauma

I have chosen not to include scientific definitions of epigenetics and environmental epigenetics at the start of this chapter, as I am instead more interested in beginning by tracing its multiple emergences. First, I briefly sketch its emergence in relation to biological mechanisms of trauma more broadly. In Bessel van der Kolk's now iconic book *The Body Keeps the Score* (2014), there is a chapter titled 'Looking into the brain: the neuroscience revolution'. In the chapter, he describes how the introduction of brain-imaging technologies in the 1990s completely changed the game of trauma research, and psychiatry more generally, writing that 'neuroimaging made it possible to see inside the engine. By doing so it also transformed our understanding of trauma' (van der Kolk, 2014: 40). He likens the sensation of looking at the first functional MRI scans of his patient's brains to 'how early astronomers must have felt when they peered through a telescope at a new constellation' (ibid: 42). These metaphors of visualisation – seeing inside, looking in, peering through a telescope – paint a picture of clarity and transcendence, as though 'seeing' the brain through functional MRI technology allowed for medical knowledge to reach previously untapped heights and levels of accuracy.[15] Van der Kolk describes how the brain 'processes the imprints of the past', and how neuroimaging allowed researchers to view this

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[15] As Petchesky's work on visualisation and fetal imaging demonstrates, the construction of 'technologies of visualisation' in medical practice as avenues to evidence is intensely political: 'Evidentiary uses of photographic images are usually enlisted in the service of some kind of action - to monitor, control, and possibly intervene (Petchesky, 1987: 274).

process, giving new weight to the 'neurological and physiological disruptions' that trauma and traumatic memories can invoke (ibid: 46).

From the 1990s onwards, biological ideas such as the fight or flight response, the role of stress hormones in trauma, and different sides of the brain being activated by trauma memories, began to enter popular discourse and imagination. Importantly, so too did ideas about early child development. A few chapters later in the same book*, The Body Keeps the Score,* van der Kolk writes about 'developmental trauma: the hidden epidemic'. He gives a few examples of very young patients who had experienced child removal, sexual and physical abuse, and other forms of harm, and who were aggressive, 'non-compliant', and disruptive. 'With such pervasive problems and dysfunctional parents', he writes, 'we would be tempted to ascribe their problems simply to bad genes' (ibid: 151). Here, van der Kolk pauses to briefly sketch how, once technological advances allowed it, the search for biological mechanisms for mental illnesses and trauma shifted from a focus on neurology to a focus on genetics - 'and yet, after thirty years and millions upon millions of dollars' worth of research, we have failed to find consistent genetic patterns for schizophrenia - or for any other psychiatric illnesses, for that matter', including traumatic stress (ibid: 152). He continues:

> Recent research has swept away the simple idea that "having a particular gene produces a particular result. It turns out that many genes work together to influence a single outcome. Even more important, genes are not fixed; life can trigger biochemical messages that turn them on or off by attaching methyl groups, a cluster of carbon and hydrogen atoms, to the outside of the gene (a process called methylation), making it more or less sensitive to messages from the body. While life events can change the behaviour of the gene, they do not alter its fundamental structure. Methylation patterns, however, can be passed on to offspring – a phenomenon known as epigenetics. Once again, the body keeps the score, at the deepest level of the organism. (van der Kolk, 2014: 152)

And so, in the story of trauma research as presented by van der Kolk, we arrive at epigenetics; where 'life' seeps in to the 'deepest levels of the organism'. Epigenetics has been described by influential geneticist and epigenetics researcher, Moshe Szyf, as 'the way the social world talks to the hard-wired world' (2011: 46). These descriptions of 'life' (the social world) and the ‘organism’ (the hard-wired world) coming together through epigenetics are part of its powerful and captivating image. As Lock writes in her piece ‘Comprehending the body in the era of the epigenome’, this phenomenon of epigenetics, through which life experiences such as trauma become ‘literally embodied’, is worthy of anthropological attention (2015: 154).

The development of environmental epigenetics

In stories of innovation in Western science there is often a ‘father’, and this too is the case with epigenetics. The origin of epigenetics is attributed to the work of Conrad Waddington, a developmental biologist from the UK who ‘opened our eyes to the rich opportunities of adaptation through epigenetic regulation’ (Noble, 2015: 817). In 1956, he published a paper in the journal *Evolution* that successfully demonstrated what he called ‘genetic assimilation’, a process whereby an acquired characteristic from an environmental stimulus could be inherited by subsequent generations without applying the original environmental stimulus – he argued that this showed that the characteristic had been ‘assimilated’ into the genetics of the organism over time (Waddington, 1956; Noble, 2015). The organism in Waddington’s experiment was fruit flies, and he found that this ‘mechanism of assimilation’ that he identified in the fruit fly experiments can ‘in fact be an extremely powerful one’, lasting in up to 30 generations of flies (p 10). He also wrote that ‘an important part in the genetic constitution of the assimilated stock is played by a maternal effect’ (Waddington, 1956: 10).

Waddington’s paper was influential and controversial, and it was dismissed by Neo-Darwinists at the time. Neo-Darwinism, also known as Modern Synthesis, arose out of the synthesis of Charles Darwin’s theory of natural selection and Gregor Mendel’s theory of genetics (Noble, 2011). It purports that genetic adaptations in organisms are caused by mutations of DNA, and so Neo-Darwinists were not entirely convinced by Waddington’s work on ‘genetic assimilation’ from environmental influences. However, as research in genetics and development advanced throughout the last half of the twentieth century, this work on acquired inheritance in organisms such as plants, insects and rodents became less provocative within the scientific community, and eventually became known as soft inheritance, and then as epigenetics (Felsenfeld, 2014). Epigenetics can be defined as ‘the study of mitotically and/or meiotically heritable changes in gene function that cannot be explained by changes in DNA sequence’ (Riggs and Porter 1996). In other words, epigenetics is the study of changes in gene *expression* that are not a result of changes to the gene sequences *themselves*. It is within this definition that the addition of the prefix ‘epi’ – meaning ‘above’, ‘over’ or ‘upon’ – to ‘genetics’ seems most clear (at least to me).

When reading more contemporary definitions of epigenetics, metaphors abound. It is commonly described through the metaphor of a volume knob on a stereo; ‘turning down (or even off) certain genes in some cases and turning up other genes in other cases’ (Sullivan, 2013: 200-1). The light-switch metaphor is similarly popular, wherein epigenetic mechanisms are described as light switches that flick certain genes into action and turn others off. As Stelmach and Nerlich note, genomics has been ‘dominated’ by clusters of metaphors (2015: 198). Such metaphors of genetics include ‘the book of life’, ‘the computer program’ or ‘code of life’, the ‘blueprint of life’ and ‘the map of life’. All of these metaphors communicate the notion of a master plan or destiny held within genetic material (Stelmach and Nerlich, 2015). With the advent of the ‘epigenetics revolution’ (Carey, 2012), these metaphors have been extended, for example the metaphor that presents DNA as a book receiving an addition, whereby epigenetic mechanisms are ‘in charge of determining the accessibility of the pages to the readers of DNA’ (Calvanese, Lara & Fraga, 2012: 237). However, epigenetics has its own, unique metaphors as well - Stelmach and Nerlich point to the ‘music metaphor’ as a prominent example of this, writing that the music metaphor opens up ‘a conceptual space for arguing that we can now change our genetic fate, to play a different tune if you like' (2015: 202). Within this framing, in which epigenetic mechanisms are described as switches, knobs, and tiny members of a tiny orchestra, there is a focus on malleability and plasticity – things can be turned up, turned down, and turned up again – in contrast to descriptions of a DNA code/program/map that is fixed, or ‘set in stone’.

Key concepts: Plasticity and reversal

In order to explore how epigenetics is enacted in various spaces, I first need to provide an overview of some key concepts which many of my participants cited as important to or unique to epigenetics. Two of these key concepts are plasticity and reversal. In biology, the term plasticity refers to an organism’s adaptability or capacity to change in response to its environment. Mansfield writes that the ‘life-sciences [today] are generating a transformative view of the biological body not as fixed and innate but as permeable to its environment and, therefore, plastic’ (Mansfield, 2017: 355). This ‘transformative view’ is one where DNA is no longer one’s destiny, but rather one's destiny is much more malleable that previously thought, thanks to the role of epigenetics. Szyf was quoted in a popular media article saying that 'a new world is opening up, one that is so much more complex that the genomic world' (Szyf quoted in Kiem, 2005). The concept of plasticity or malleability is at the centre of this 'new' and 'transformative' world of epigenetics, though as Meloni reminds us, the plastic body is not a new idea at all. Drawing on examples such as humoralism, Meloni demonstrates that the 'ancient' body in Greek medicine was always in direct conversation with food, temperature, environment, and flows of exchange, and was therefore plastic (Meloni, 2018: 8). He writes that the 'porous and unstable physiology of the ancient body demanded a 'constant and detailed problematization' of the relationship with its surroundings' (Arikha, 2007; Foucault, 1990) in Meloni, 2015: 12). With the liberalist shift to individualism at the end of the 18th century, followed by the rise in genetics and its 'stable' units of heredity, the 'humoralist emphasis on the environment as the first cause of disease became a subject of ridicule', and plasticity was relegated to the background in favour of the bounded and non-porous individual body (Meloni, 2015: 18). Under this reading, the plasticity of environmental epigenetics – its capacity to 'open up' the body and show how things 'get under the skin' - is not really a novel idea.[16] Nonetheless, it is a key concept in contemporary epigenetics research, and is often positioned as central to the perceived novelty of epigenomics in contrast to genomics.

Many popular descriptions of what epigenetics *is* hinge on what it is *not* – that is, epigenetics is not 'genetics'. As with plasticity above, the potential for 'reversibility' in epigenetics was described by many of my participants as an exciting and novel shift away from the rigidity of genetics towards the expansiveness of post-genomics. Returning to the logic of the switch metaphor, if something can be turned off, it can also be turned on again, and thus reversed. Many researchers I interviewed cited the potential for reversal as a key motivator for their work in epigenetics. For example, one researcher, a non-Indigenous scientists with a history in 'traditional' genetics who moved into the epigenetics space in the last 15 years, said that:

> The thing I love about epigenetic research is that there is potential for methylation to be reversed. So if you can identify risk sites, then that can be targeted and reversed. With

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[16] The field of Social Determinants of Health (SDH) is notable for its focus on plasticity and the impacts of 'the environment' on health, without a focus on molecular mechanisms.

> genetics you’re born with your genes and there’s not much you can do, but at least with epigenetics there’s definitely room to change. (Interview 2)

Another participant, Brett, a non-Indigenous lab scientist with expertise in epigenetics and Ancient DNA research, described epigenetics as sounding ‘like stories. You know, it sounds like something that really is – can be passed on from a generation to another and changed, you know, like – and reverted back to something, whereas genetics always sounds like something very fixed’ (Interview 5). Both of these researchers described the capacity for change and reversal in epigenetics as hopeful and positive, whereas with genetics, there is ‘nothing you can do’ and it ‘always sounds like something fixed’. The last quote mentions another important (arguably the most important) key concept in epigenetic research – the concept of inheritance.

Key concepts: Transgenerational inheritance

As Brett, the epigenetics researcher above stated, epigenetics sounds like something that can be ‘passed on from a generation to another’. In scientific literature, this is known as transgenerational inheritance, and it refers to ‘the transmission to subsequent generations of cells or organisms of phenotypic variations that do not stem from variations in the DNA base sequence’ (Jablonka, 2017: 3). This has been clearly established in some plants and animals, such as drosophila flies (Xing et al. 2007; Ciabrelli 2018), nematode C. Elegans (Woodhouse & Ashe 2020; Frolows & Ashe 2021), honeybees (Remnant et al. 2016), and rodents (Horsthemke 2018; Miska et al. 2016; Gapp et al. 2014). However, there is currently no clear scientific consensus on whether transgenerational inheritance occurs in humans. The implications of potential transgenerational epigenetic inheritance in humans for the field of evolutionary theory are also contested, with some claiming it represents a return to Lamarckian inheritance, and others challenging this claim (Loison, 2021). Despite this uncertainty within and across scientific fields, the concept of transgenerational (also commonly referred to as intergenerational) transmission of epigenetic effects has caught the attention of many people worldwide.[17]

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[17] Despite having different definitions within the scientific community, the terms ‘transgenerational’ and ‘intergenerational’ are often conflated and used interchangeably, a conflation which demonstrates once more the uncertainty and slipperiness that surround epigenetics and its mechanisms. ‘Intergenerational’ refers to the next generation exposed to the same environment as the parent, such as in utero, whereas ‘transgenerational’ refers to further generations where there was no direct exposure to the original environment (Jablonka, 2017).

Transgenerational inheritance in humans is one of the most captivating concepts within epigenetics research, and it 'remains highly contested' at the time of writing (Dubois & Guaspare, 2020: 147). Whether or not transgenerational epigenetic inheritance is actually occurring in humans is not the focus of my work. Indeed, there is a strong debate in which I could engage about whether transgenerational epigenetic inheritance in humans is 'real' or not (see for example this *New York Times* headline from 2016: 'Growing Pains for Field of Epigenetics as Some Call for Overhaul'). However, I am less interested in discussing this controversy, and am instead more interested in exploring how and why transgenerational inheritance of concepts such as trauma has become 'a candidate for scientific knowability' in the first place (Willey, 2016: 28).

By focusing on the conditions that render a certain concept as a 'candidate for scientific knowability', I am drawing on the work of Angela Willey. In her 2016 book *Undoing Monogamy*, Willey traces how the concept of monogamy is enacted in certain lab studies as a stand in for 'social' and 'anti-social' behaviour in prairie voles, with social voles being ascribed a monogamous status and anti-social voles being ascribed a non-monogamous/'promiscuous' status (Willey, 2016). These lab studies are then extrapolated out to inform research on 'anti-social' behaviour, with a view to using oxytocin as an intervention to alter and improve 'anti-social' behaviour in humans (ibid: 54). Continuing the feminist STS commitment to ontological politics, like Mol, Willey is clear in asserting that her study of the concepts of monogamy/non-monogamy in lab science is not an attempt to define, isolate, or argue for a particular scientific 'truth' about a particular scientific 'object':

> This project does not retroactively condemn or recuperate sexological discourses about monogamy as "good" or "bad", "true" or "biased", scientific or pseudoscientific but rather seeks to understand the conditions of their intelligibility as science. (Willey, 2016: 28)

In attending to a certain concepts 'intelligibility as science' (whether that concept is monogamy or inherited trauma or something else entirely), whether or not it *is* a scientific fact falls to the background, and the reasons for which/the conditions under which it is being sought out *as* scientific fact become the central question. In exploring potential transgenerational epigenetic inheritance of trauma in humans, the question of how and why it is being rendered intelligible as science, and as evidence, is the most helpful place to start. It is a question which carries through not only this chapter but this thesis.

Narratives of inheritance

In my interview with Brett, he said that epigenetics 'sounds' like something that carries across generations. It 'sounds like stories'. Here, this researcher has identified one of the most alluring aspects of transgenerational epigenetics: its capacity to hold narratives, to build and tell stories across time. French researchers Dubois and Guaspare have identified four recurring themes, or 'registers of action', that popular media narratives of social epigenetics and inheritance of trauma tend to evoke: 'to attest, to repair, to intervene, and to treat' (2020: 144). They did this by collecting and analysing almost 250 documents from 2015 onwards which were of 'non-academic origins' and contained mentions of both 'epigenetics' and 'historical trauma' (Dubois & Guaspare, 2020: 160). They found that many of these reports and documents positioned transgenerational epigenetic inheritance in humans as an established phenomenon and ignored the extreme controversy surrounding this science. Instead, the captivating narratives and the social/political potential of the concept took over. This potential – to attest to and raise awareness of the impact of historical injustices on present descendants of those communities, to call for reparations, to intervene in cycles of trauma transmission for future generations, and to treat current populations through harnessing the reversibility of epigenetics, is all entirely speculative when we remind ourselves that the science of transgenerational epigenetic transmission in humans is unclear. But this does not make any of these narratives any less powerful or popular.

Just in the last few years in Australia, transgenerational epigenetic inheritance has been mentioned on national television by an Aboriginal musician and commentator, 'this transgenerational trauma stuff, it is scientifically proven it can be passed on through the DNA—it is real' (Tambo on the ABC program Q&A, 2021), and in popular news articles such as one written by Aboriginal writer and critic Stan Grant about the 2022 Oscars Ceremony, titled 'Will Smith's slap after Chris Rock's joke dominated the Oscars. But how does inherited racial trauma fit into the story?' (Grant, ABC News 2022), and in an opinion piece on a popular Indigenous owned media site, *IndigenousX*, in an article about motherhood as an Aboriginal woman and 'intergenerational trauma and the genetic effects of putrid racism' (Murrup-Stewart, 2021). In our interview, Brett told me a story about an Aboriginal comedian who performed at a scientific conference he attended:

> She had a lot of funny stories, but then at some point she really addressed us and said “who is working on epigenetics in this crowd of researchers?” and I’m the only one to lift my hand. You know, I was like, “oh this is not looking good”, but she was like “this is it, this is the future, and epigenetics is really connecting with our people. This is how we explain trauma, this is what’s going to help us” and she was just, like, talking about it.
>
> She is a stand-up comedian. She was supposed to entertain us, you know, and then she picked that very topic, you know, like, for a couple of minutes, and very seriously, like, trying to promote how epigenetics can help Indigenous people in Australia. (Interview 5)

These examples are from popular media and popular representations, yet there are also working papers and speeches from Indigenous health organisations and policymakers that mention some version of epigenetic inheritance (Gooda, 2014; Moore et al., 2017). One could be forgiven for thinking transgenerational epigenetic inheritance is not a hotly contested topic after all. These examples serve to demonstrate that of all the key concepts in environmental epigenetics, inheritance is the most widely circulated within popular discourse in Australia.

Returning to Dubois & Guaspare and their analysis of popular media documents, they also argue that a large part of the popularity of narratives of epigenetic inheritance of trauma comes from its perceived applicability to many situations, which allows for various publics to ‘create a ‘family resemblance’ between distinct situations, with varying degrees of similarity, and to try to extrapolate what they think they know about one to apply it to the other’ (Dubois & Guaspare, 2020: 166). Many different forms of adversity have been the subject of epigenetic inquiry, and as more situations are identified as candidates for epigenetic studies, the specificities of different traumatic ‘events’ can start to bleed into each other. Dubois and Guaspare summarise the breadth of events studied so far in the below ‘catalog’:

> Colonialism, Racial Discrimination against Native Populations, the Holocaust, the Dutch Hunger Winter, Racial Discrimination against the African American Population, the Congo Wars, the Tutsi Genocide, World War II, Slavery, the World Trade Center attacks,

> the Överkalix Famine, the Bosnian War, the Holodomor Genocide, the Great Chinese Famine, Political Violence in Lithuania, Racial Discrimination against Aboriginal Populations, the US Civil War, and the Armenian Genocide make up the bulk of the 'catalog' of extraordinary and historical forms of social adversity studied up to this point. (Dubois & Guaspare, 2020: 153)

Here, we can see how a diversity of complex experiences begin to collapse together when viewed through the prism of epigenetic trauma 'events'. In the months before commencing this PhD, I went on a work trip to Rwanda with the social work organisation I was employed by at the time. I was there as an admin worker, not a researcher, but as the trip progressed and people asked about my upcoming PhD, I ended up having conversations with a Rwandan social worker about epigenetics and the Rwandan 1994 genocide, and having conversations with an ultra-orthodox Jewish social worker about epigenetics and Holocaust survivors.[18] In both instances, there was ambivalence but also much excitement about the potential to make claims about inherited trauma through epigenetic studies. The social workers then started asking me if any scientific studies had been done on epigenetics and Aboriginal people in Australia.[19] I mention this here to illustrate the point that across three different countries and three different contexts, there seemed to be some sort of consistent 'fascination' (Meloni & Testa, 2014) with or interest in narratives of epigenetics and trauma inheritance.

A case study in epigenetic fascination: Australia's backyard millionaire

For a local and rather extreme example of epigenetic fascination, we can consider the case of Jim Penman, Australia's self-described 'backyard millionaire' (Moolenschot, 2019). Jim Penman began mowing lawns while he was undertaking a PhD in History at LaTrobe University in Melbourne. In 1989, he launched a business, 'Jim's Mowing', which now has franchises across the country and whose branding is instantly recognisable to Australians. A dark green Jim's Mowing trailer with Jim's face on the side of it was in my own driveway a few months ago when my landlord organised some yard work; they are dotted around Adelaide city and suburbs, they

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[18] Epigenetic studies have been undertaken in relation to both Holocaust survivors (Yehuda et al., 2014) and survivors of the 1994 Rwandan Genocide (Musanabaganwa et al., 2022).

[19] I was hesitant to answer this question when asked, and would usually reply in general terms, talking about how scientific studies, race, and colonisation in Australia have always had complicated intersections. See Warwick Anderson's *The Cultivation of Whiteness* (2002) for a detailed history.

are idling at traffic lights while I cross the road and walk to the office. Jim was self-funding his PhD, as he did not receive a federal government scholarship. In a 2013 article, Jim says that he was forced to self-fund and mow lawns because the university perceived his research interests as ‘too radical, too wild’ (Penman quoted in Amerena, 2013). He was pursuing a PhD in what he calls ‘biohistory’. In its present form, Jim’s concept of biohistory relies heavily on epigenetics, as demonstrated in the below quote from his self-published book, *Epigenetics and character: the biology behind history* (2021), a sequel to his 2015 self-published title *Biohistory: The Decline and Fall of the West*:

> Epigenetics is the new science which looks at the way in which genes are switched on or off by the environment. Thus, two people with similar genes but different early environments can be remarkably different in attitudes and behavior, as different genes become more or less active. These epigenetic differences can make people more or less hard working, rigidly dogmatic or open to change, peaceful or violent, timid or forceful, honest or corrupt, and much more. When people are epigenetically primed to be innovative, to act with integrity and inclined to work hard, national wealth grows. When men are epigenetically primed to be aggressive and proud, wars break out. Thus it is that biology, more than anything else, determines the nature of society. (Penman, 2021: 21)

The central thesis of the self-published book, and of Penman’s theory of ‘biohistory’ is that different countries are variously successful/unsuccessful (he measures this using metrics from the above quote i.e. national wealth, corruption, hard-working nature) because of the temperament of their citizens: ‘Some countries are wealthier than others because the people in them are harder working, more innovative, more willing to sacrifice present consumption for future benefit, less inclined to corruption as a government official, and so forth’ (Penman, 2021: 17). He then proposes that this ‘temperament’ is a result of epigenetics, writing that ‘different temperaments have a biological basis and can be understood in terms of hormones, brain physiology and gene expression…Different temperaments are traced back to the influence of early life, in particular the extent to which parents control or punish their children at different ages’ (Penman, 2021: 19). There are clear eugenic tones to this approach, whereby Jim uses epigenetic frames to bolster dangerous views reminiscent of genetic determinism. Using biology to explain history is an intellectual project that has been attempted, and has failed, many times before.

Almost all of the material in both of Jim's books is limited to abstract theorising on how biology, food restriction, and epigenetics can explain the 'decline of civilization', however, recognising that a key perk of engaging with epigenetics is that it is 'testable' (Penman, 2021: 21), he has used money from his landscaping business to privately fund lab research on rodents. As he writes on his website, 'the key to understanding Biohistory is that governing human civilizations are based on biological reactions to food shortage, even though triggered in humans by other factors such as limits on sexual activity. To study how these mechanisms work, a number of studies have been done on rats' (The Biohistory Foundation).

It is difficult to find public details about how much private money Jim has contributed to this lab research, though he has publicly said that he is 'doing things with rats that Elon Musk could never think of' (Penman in Dunn, 2018). I was able to find that each publication on which Jim is listed as an author has an acknowledgement of 'Jim's Group Pty Ltd and the Australian Research Council (LP0775284), for generously supporting this research financially' (Levay et al., 2007). This grant, from 2007, is a Linkage Project – grants that link Australian universities with 'industry' partners. In this case, we can extrapolate that the industry partner was likely to have been Jim's Group. The Linkage Grant, administered by La Trobe University, explored how calorie restriction in rats might 'act as a preventative intervention to help reduce the incidence and severity of these major health problems [obesity, type II diabetes, illnesses associated with 'overfeeding and reduced physical activity'], but also impact on social behaviour' (ARC website). The last phrase about 'social behaviour' is where Jim's financial contributions start to make sense; he can advance his theory of 'biohistory' – the role of epigenetics and 'temperament' in the rise and fall of civilizations – by attaching it to lab research with rodents on epigenetics and social behaviour. This lab work has resulted in ten publications, all co-authored by the same team (including Penman), and all peer-reviewed and published in either *Physiology and Behavior, Behavioural Brain Research,* or *Hormones and Behavior* between 2007-14. Jim is proud of this and has asserted that 'Biohistory is the only theory of history ever to have resulted in ten papers (and counting) in high ranked biomedical journals' (Penman, 2021: 22). At the time of writing, these journals, published by Elsevier, have impact factors of 2.9, 2.7, and 3.5 respectively. The term ‘biohistory’ is not mentioned in any of the ten papers.

Even though Jim’s research is fringe (to say the least), by attaching himself financially and publicly to a scaffolding of ‘epigenetics’, he invokes what Haig refers to as ‘the cutting edge of modern biology’ (2012: 15). Haig continues,

> …the movement [of epigenetics] is a broad tent that unites studies of environmental toxins on gene expression, of the fetal origins of adult disease and of how early rearing affects adult behaviour. The indefinite definition of epigenetics (together with the connotation of being ‘above’ or ‘beyond’ genetics) has meant that scientists from divergent disciplines, studying only loosely related phenomena, could all feel they were engaged in epigenetic research near the cutting edge of modern biology. (Haig, 2012: 15)

Jim’s theories and privately funded research are most certainly ‘loosely related phenomena’ when it comes to epigenetic research, however by harnessing the broadness of ‘what epigenetics is’, he is able to make claims that his work is cutting edge, and that his theories have been published by peer-reviewed journals. The story of Jim’s engagement with epigenetics - an engagement that seeks to advance discriminatory and problematic arguments under the umbrella of ‘biohistory’ - demonstrates how, due to its vague and shifting definitions, epigenetics can be picked up and moulded into all sorts of shapes to meet all sorts of ends.

Social scientists and epigenetics

Another group of actors that has eagerly picked up epigenetics and who often place themselves at the ‘cutting edge’ (of theory this time, not of modern biology) thanks to their engagements with it is social scientists themselves. Hannah Landecker & Aaron Panofsky summarise this interest within social science by saying that, ‘although molecular epigenetic research is highly biochemical, it is of interest to sociologists because some epigenetic changes are environmentally mediated and can persist across the lifespan or into future generations’ (2013: 333). In 2016, the geneticist Eva Jablonka wrote that ‘epigenetics can forge new experimental and conceptual bridges between biology, the social sciences, and the humanities’ (2016: 42). Encouraged by such exciting articulations, some social scientists began to see in environmental epigenetics an opportunity to advance what has been termed a ‘biosocial’ approach in social theory and research (Pickersgill et al. 2013; Meloni et al., 2018, Gibbon & Novas, 2007). In a ‘biosocial’ approach, the supposed binaries between social/biological and natural/cultural are challenged and, ideally, collapsed all together, in favour of an approach in which the social and the biological are in intimate conversation with each other. Many anthropologists and STS scholars have worked on epigenetics; in 2013 Lock wrote of ‘the lure of the epigenome’, and on epigenetics as related to the concept of ‘local biologies’ (Lock, 2013; Niewohner & Lock, 2018), and other scholars have approached epigenetics from both eager and critical standpoints (Lappé, Jeffries Hein & Landecker, 2019; Lamoreaux, 2016; Pentecost, 2021; Kenney & Müller, 2017; Valdez, 2022).

For social scientists and theorists who are invested in scholarship on the biosocial, environmental epigenetics remains an attractive topic. In their 2020 paper, Nerlich and co-authors describe interest in epigenetics as an avenue to advance the biosocial approach thusly: ‘epigenetics is used here to do something, in this case, sociological theory-building’ (Nerlich et al., 2020). Like the other actors I have touched upon in this chapter, social scientists too are enacting epigenetics into being. In slightly more critical terms, Deichmann describes this enactment as being motivated by the ‘self-interest of the discipline’ (2020: 2), i.e. the thing that environmental epigenetics is ‘doing’ for the social sciences is increasing their value within the epistemic hierarchy of the neoliberal university, where research associated with science and technology is regarded more favourably and funded more regularly. The interdisciplinary nature of environmental epigenetics is an appealing feature for some social scientists, and in some ways this enthusiasm for conceptual and theoretical research in epigenetics can add to the very epigenetic ‘hype’ that other social scientists critique.[20] In fact, in one of my interviews with Levi, an Indigenous geneticist who has also studied anthropology, he reflected with some amusement on the fact that, in his experience, epigenetics tends to come up in conversation more often with social scientists than it does with lab scientists, saying that ‘…it’s a subject that’s come up a lot in conversations I’ve had with social scientists around things. So my background’s… it’s half in the biosciences and half in anthropology. So I end up having a lot of conversations across the gap and epigenetics is one of those topics that comes up. (Interview 17)

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[20] See in particular Warin, Kowal & Meloni, 2020 on epigenetic hype.

This ‘gap’ which the interviewee mentions is an institutional and disciplinary one. Sitting somewhere across this gap has made him a perfect candidate for conversations about biosocial knowledge production. Another participant, a non-Indigenous researcher who runs animal model studies on stress, drug addiction, and mental health, and who works with Indigenous communities in Queensland, noted that ‘the framework [of epigenetics] is very attractive intellectually…and that’s why you yourself are interested, because you’re coming from a social science background.’ He continued to say ‘I think this is terribly interesting and I’m sure you love that way of looking at things’ (Interview 16). Here, the interviewee posits that I, as a social science researcher, must love how interesting, attractive, and intellectually compelling epigenetic (or biosocial) frameworks are, though he cautions me that ‘that does not guarantee for you that it’s true’. In this formation, social scientists can be seen as (un?)willing participants in the production of epigenetic hype, even if they critique it at the same time.

Conclusion

In their 2015 study, Stelmach and Nerlich highlighted how often definitions of epigenetics shift, writing that ‘not only do definitions of epigenetics vary wildly, but they also convey how difficult these authors find the task of pinpointing *what epigenetics is’* (2015: 205, my emphasis). In some articles, epigenetics is defined as a theory, in others it is a process, a phenomenon, a mechanism, a philosophical opportunity. The many metaphors and loose definitions of *what epigenetics is* allows for a situation in which epigenetics is many things at once. Epigenetics can be defined as much by controversy, seduction, popularity, and hype as it can be defined by histone modifications, proteins, and methyl groups. Using Mol’s engagement with ontological politics, I have also tried to introduce the notion that what matters about epigenetics is not so much what it is, but what it is doing. The practices that different actors enact – the discursive metaphors of light switches, the lab work, and the lawnmower-powered funding – all bring a type of epigenetics into being. In some instances these enactments romanticise epigenetic potential and contribute to epigenetic hype, and in others they perpetuate dangerous and discriminatory ideas.

Throughout this chapter, I have introduced the emergence of interest in biological mechanisms of trauma, from neurobiology to environmental epigenetics. Environmental epigenetics is positioned by many participants as a particularly novel and attractive phenomenon as its key concepts include plasticity, reversal, and transgenerational inheritance. Despite uncertainties within scientific fields, narratives of transgenerational epigenetic inheritance are prevalent in popular media, and policy documents, representing a form of epigenetic fascination that travels widely and can be unruly.

Despite the controversies that surround environmental epigenetics, especially transgenerational epigenetic inheritance, I have attempted to shift the focus away from whether transgenerational epigenetic inheritance of trauma is ‘real’, and instead interrogate the reasons for which it is enacted as a ‘candidate for scientific knowability’ – in other words, why do certain actors want it to be real? Who is invested in this question, and how are they enacting this knowledge? The slippery, shape-shifting nature of environmental epigenetics can be strange, and controversial, yet the commitment of lab scientists, social scientists, writers, health workers, and others to continually bring epigenetics into being demonstrates that, along with the ‘eye roll’ reaction to epigenetics, there is also a fascination, an enthrallment which I first got a sense of in that office in Darwin many years ago, and which is central to this thesis.

Chapter four — Measuring damage, measuring hope

Introduction

Throughout my research I have always been open about the fact that my interest in and work on epigenetics comes from a critical lens. But when some researchers see a glimmer of opportunity in epigenetics – an opportunity for change, for social justice, for compensation claims – who am I, a non-Indigenous researcher, to stand up and say that epigenetics is no good. When I gave my first PhD presentation at the Department of Social Sciences seminar in 2019, an Indigenous academic in History could sense that I was oscillating between critique and enthusiasm. I was talking about the risks of epigenetic research in Indigenous communities in the same breath as talking about the potential benefits. I was doing this knowingly, as I felt new and hadn't really started the work yet (I had been in the PhD program for six months and was yet to receive ethics approval for fieldwork), so didn't want to 'take a position'. But she pushed me and asked me what I 'really thought' about all this business, especially whether I even believed that it was real – 'it' being transgenerational epigenetic inheritance in humans. I paused for a moment, looked at my primary supervisor for some sort of permission to respond, and after a while I gave an honest answer – that I thought epigenetics was overhyped and there wasn't enough scientific evidence of transgenerational epigenetic inheritance in humans. She seemed to like my answer and a few other people in the room laughed, but she then said that if that were true, I needed to think about why I was getting involved in this space – why I was working on something I didn't believe in.

At the time it was quite easy for me to make sense of that – I was working on it because I thought it needed some critical attention. I am here to critique! But I quickly started to doubt this logic. Could I really have a singular focus on critique when I suspected that many of my interview respondents would be coming to me from a place of enthusiasm, a place of belief or faith in this idea of epigenetics as a force for good that I simply didn't share? Would my critical lens be getting in the way of their work? And how much airtime did I want to give to something I didn't necessarily believe in? Essayist Jia Tolentino writes that, 'to argue against an ideology, you have to acknowledge and articulate it. In the process, you might inadvertently ventriloquize your opposition …when you write against something, you lend it strength and space and time.' (Tolentino, 2019). Would my research lend space and time to something that already has enough of those things? In Haraway's 2016 book *Staying with the Trouble: Making Kin in the Chthulucene*, she writes against simple binaries of critique v. enthusiasm, despair v. hope, and instead invites theorists and scientists alike to 'stay with the trouble', writing that:

> Staying with the trouble requires making oddkin; that is, we require each other in unexpected collaborations and combinations, in hot compost piles. We become-with each other or not at all. That kind of material semiotics is always situated, someplace and not noplace, entangled and worldly. Alone, in our separate kinds of expertise and experience, we know both too much and too little, and so we succumb to despair or to hope, and neither is a sensible attitude. (Haraway, 2016: 4)

Guided by Haraway's call to stay with the trouble, I also take seriously Kim TallBear's invitation to 'stand with' (2014). In reflecting on her own methodology as an Indigenous STS scholar, TallBear suggests a method of 'standing with', wherein a researcher who is 'willing to "stand with" a community of subjects is willing to be altered, to revise her stakes in the knowledge to be produced' (2014: 2). In the spirit of being 'willing to be altered', I entered the data-collection phase of this project with unsettled thoughts about how to interview/write about/work with scientists whose work concerned me, but I also entered this project with a curiosity about how to push myself to 'stand with' them. One thing I quickly realised was that my feeling of being unsettled by how to do interdisciplinary epigenetics research is one that my participants also shared. Contrary to my expectations, few of my participants were definitively 'pro' or definitively 'con' the concept of transgenerational epigenetic inheritance in Indigenous health. Instead, many of them moved between positions within the course of our interviews together. A large part of this oscillation, for myself and for my participants, was related to the question of damage. For transgenerational epigenetic inheritance to be 'real', it has to identify the presence of an epigenetic 'mark' or 'tag' of damage in multiple generations. What does this mean in the context of Indigenous health, where damage is already a prevailing narrative – one that many researchers are advocating a move away from?

This chapter explores the ways in which participants of this study made moves towards a 'positive' and hopeful orientation to epigenetics as related in intergenerational trauma. Firstly, the chapter details the context and history of ‘damage-centred research’ in Indigenous health research, and subsequent calls for strengths-based research instead. I illustrate the differences between damage-based and strengths-based research paradigms by providing examples from a Developmental Origins of Health and Disease conference that I attended as an ethnographic researcher, before turning to interviews with my participants to explore the ways in which they managed their concerns about the prevailing narratives of damage in epigenetics research design. One of the primary moves towards positivity and away from damage that they made was highlighting stories of hope, reversal and resilience. The other way participants managed their uncertainties about damage in epigenetic research, particularly in the context of Indigenous health, was by framing epigenetics as different from, and therefore less harmful than, ‘old fashioned’ genetics, which became a catchall for deficit-based research and poor research ethics. By detailing these two techniques, I demonstrate how some participants who are involved in epigenetic research and study designs are aware of the prevailing focus on damage in epigenetic research, and how they attempt to navigate these concerns by telling different stories about epigenetic reversal, resilience, and novelty – stories that they consider to be more positive and more liberating than other genomic stories of inheritance.

Damage as a theory of change

In my field book where I was frantically writing notes during a national gender studies conference in 2021, one page is covered in exclamation marks. Professor Chelsea Watego gave a keynote talk entitled ‘Always bet on Black (power): the fight against race’, in which she wove her personal experiences with Black scholarship to discuss the politics of refusal and Black power in a settler colony. One of my notes from her talk is ‘we can’t expect that violent institutions will stop being violent if we give them enough evidence’. This was in reference to the reasons for which she left an academic position at the University of Queensland, an institution where she was constantly needing to convince people that racism was real, through providing ‘evidence’. Her refusal came from a place of not wanting to do that work any longer, and instead she only works in spaces where there is no need to ‘convince’ others that racism and its impacts are real (for her this space is currently the Institute for Collaborative Race Research). What struck me about Watego’s keynote was her acknowledgement that ‘evidence’ of the existence of and the harms of racism, no matter how rigorous it might be, does not often lead to change in racist settler colonial institutions.

Raising a similar argument to Watego, Tuck's influential piece 'Suspending damage', interrogates this theory of change in relation to what she calls damage-centred research. Damage centred research describes Indigenous communities only in relation to their perceived damage or suffering (Tuck, 2009; Liboiron, 2021). She writes, 'here's a more applied definition of damage-centred research: research that operates, even benevolently, from a theory of change that establishes harm or injury in order to achieve reparation' (Tuck, 2009: 413). Tuck's paper is written as a 'letter' and it addresses readers directly, readers such as community members, researchers, educators, and 'all of those troubled by the possible hidden costs of a research strategy that frames entire communities as depleted' (Tuck, 2009: 409). The hidden costs of damage-centred research include telling a single story of entire communities, a story which 'reinforces and reinscribes a one-dimensional notion of these people as depleted, ruined, and hopeless' (Tuck, 2009: 409). Max Liboiron refers to 'blood-and-trauma talk' as 'arguments [that] are only heard in a way that allows many people to continue to believe that Indigenous people are inherently traumatized, always already bleeding' (2021: viii). A 2018 paper from the Lowitja Institute, a leading Indigenous Health research centre in Australia, uses the term 'deficit discourse' to explore similar ideas. They define deficit discourse as a 'discourse that represents people or groups in terms of deficiency – absence, lack, or failure' (Fogarty et al., 2018: vi).

This theory of change, in which 'pain and loss are documented in order to obtain political or material gains' (Tuck, 2009: 413) is one of the theories of change behind research on transgenerational epigenetic inheritance. It is also the theory of change behind the field of Developmental Origins of Health and Disease (DOHaD), a field that focuses on how environmental 'assaults' such as poor nutrition make themselves known in the bodies of those who are exposed to the assaults, and their children. DOHaD is popular in some Indigenous health spaces in Australia – researcher Kerry Arabena, for example, has developed the 'First 1000 Days Australia' program which is heavily informed by DOHaD research (Arabena et al., 2016). Though different from epigenetics, DOHaD uses a similar logic – that through identifying markers of harm in utero, one can advocate for environmental and social change. The provocations offered by Professor Watego (and echoed by Eve Tuck's piece) must have struck a chord with more conference attendees than just me. As I sat with a prominent researcher in the DOHaD field during lunch, she reflected that DOHaD 'was never meant to become part of the neoliberal project'. 'It was meant to push for change!' she lamented, 'and somewhere along the line it became all about surveilling women's bodies and behaviour'. Her faith in the change-making potential of her discipline was slipping, and my faith in the change-making potential of epigenetics was never particularly high to begin with.

The origins of Developmental Origins of Health and Disease

Environmental epigenetics is its own varied research field, but it is closely entwined with DOHaD, or perhaps it is more accurate to say that DOHaD is its own varied field, but it is increasingly being defined by its close entanglement with environmental epigenetics. As the name suggests, DOHaD is concerned with 'developmental origins', the factors in early-life and particularly in utero that contribute to health in later life. DOHaD uses the concept of the 'life-course' to trace a linear timeline of health – from early life/developmental origins to adolescence, and lastly adulthood. The origins of the field of DOHaD are attributed to Professor David Barker and his research team at the University of Southampton in the 1980s. Originally termed the 'Barker hypothesis', then the 'fetal origins hypothesis', his research centred on the impact of early-life environments on a person's likelihood to develop chronic disease in later life. The theory/hypothesis first garnered attention after the publication of a 1986 paper, titled 'Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales' (Barker & Osmond, 1986). One of the key findings of this paper was that 'adverse influences in childhood, associated with poor living standards, increase susceptibility to other influences, associated with affluence, encountered in later life' (Barker & Osmond, 1986). In this way, Barker and Osmond speculated a link between poor living conditions in early life and poor health outcomes in later life. In a later paper, Barkers asserts that 'the seeds of inequality in health in the next century are being sown today – in inner cities and other communities where adverse influences impair the growth, nutrition and health of mothers and their infants' (Barker, 1991: 67). From the 1990s onwards, DOHaD as a field was concerned with the ways in which people's living conditions were contributing to the health of subsequent generations in those communities.

I first encountered DOHaD research in Australia in October 2019, during the DOHaD World Congress, an international conference. The Congress was held in Melbourne along with a satellite meeting in Darwin on ‘Social Determinants and the Health of Indigenous peoples’. About 40 delegates attended the Darwin satellite meeting, which ran for two days, and then met again in Melbourne for a further five days of DOHaD events and conferencing. The first two days in Darwin were designed in collaboration with the Menzies School of Health Research to have an explicit focus on the health of Indigenous peoples as it intersects with research in and concepts of DOHaD.[21] The majority of attendees and presenters were from Australia, Canada, North America, and New Zealand. All of the researchers from Australia who presented papers were non-Indigenous. In contrast, of the nine presenters from Canada, five were First Nations peoples. Although there are many programs led by Indigenous researchers in Australia which operate within a DOHaD model – such as the ‘First 1000 Days Australia’ program and the ‘Strong Women, Strong Babies, Strong Culture’ program – these programs were not visible at the DOHaD World Congress Satellite meeting. The notion that a conference on Indigenous Health and DOHaD could be organised in such a way that no Indigenous Australians were actually presenting was intriguing, and perhaps demonstrative of the general tone of the DOHaD World Congress, which was highly focused on lab-based research findings and innovations, rather than on community-controlled programs and innovations. Presentations from First Nations delegates from Canada integrated scientific DOHaD models with First Nations-led community health programs and Indigenous research methodologies.

The first session I saw was delivered by Dr Singh, a non-Indigenous health researcher with a long history at the Menzies School of Health Research and long-standing research relationships within Indigenous Health in Australia. Dr Singh provided an overview of the ‘ABC Study’ – the Aboriginal Birth Cohort study, which was founded by Professor Susan Sayers in 1987 (Life Course Program, Menzies). The ABC study is the largest Indigenous birth cohort study in Australia. In 1987, 686 Aboriginal and Torres Strait Islander babies were recruited from the Royal Darwin Hospital, which represented over half of all ‘eligible Aboriginal infants’ in the Northern Territory at that time (ibid.). The maternal, perinatal and neonatal data collected in the

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[21] Menzies School of Health Research is a leading research institute on Indigenous health and tropical medicine in Australia.

first wave of the study in 1987 has been followed up in 4 data collection ‘waves’ since, providing a picture of Indigenous health across the life-course in the NT, with around 71% of original participants still engaging with the cohort study. When discussing the data collection methods of the ABC study, Dr Singh invoked an image of Indigenous participants all over the Northern Territory ‘being measured on the veranda’.

In her presentation, Dr Singh painted a broad picture of the findings from the most recent wave of the study, conducted in 2013-15, when the mean age of participants was twenty-four years. In addition to the usual collection of data on body size and shape, renal function, socioeconomic status and ‘lifestyle factors’ (namely nutrition, smoking, and alcohol consumption), this wave included additional lifestyle markers ‘such as major life events and stress biomarkers. She explained that this component was added to the ABC study to explore the impacts of ‘health damaging behaviours and stress’ on the body. She also mentioned that ‘we know childhood stress can get through to the next generation’, and that many of the participants in the ABC study were now parents – one third of the female participants who became mothers had had their first child at twenty years old. It was clear that this study was now pursuing an intergenerational focus on stress, and Dr Singh made a brief reference at the end of her presentation to the ‘exciting new development of epigenetics’ and the need to ‘look beyond the biomedical model’. Here, the speaker was positioning epigenetics as something ‘beyond’ the biomedical model, even though epigenetics (and other measures of trauma and stress such as cortisol) is a biomedical model and mechanism. This construction of epigenetics as uniquely novel, justice-oriented, and progressive rather than purely biomedical was present in other talks about intergenerational health and poor health over the next few days in Darwin.

The first slide of the next presentation was an image of the Horton map of Indigenous Australia.[22] Dr Rae, a non-Indigenous Australian researcher, began her presentation by acknowledging that given the international audience, not everyone in the room might be familiar with the particulars of the Australian history of colonial oppression. She explained that the

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[22] The Horton map of Indigenous Australia is a map of the Australian continent which shows the borders and names of different Aboriginal and Torres Strait Islander language groups, rather than the borders and names of Australian States and Territories. It was produced in 1996 by David Horton, and based off of a similar map produced by Norman Tindale in 1940. It is widely considered to be the most accurate map of Aboriginal and Torres Strait Islander nations and language groups, though it is not definitive.

Horton map shows 250+ individual language groups, how these groups were all impacted by frontier violence, and she homed in on the assimilationist policies of the 1960s onwards, particularly the Stolen Generations and missions. She also explained that she showed this map in order to ground her discussions of the 'impact of history' and 'significant trauma' that has affected Aboriginal and Torres Strait Islander peoples in Australia. As she described these events, First Nations members of the audience from Canada nodded in recognition. Dr Rae established this knowledge base of the history of colonisation in Australia (something which was absent from the first presentation of the day) so that when she began to talk about trauma and stress as indicators of poor health, there was a collective frame and understanding of the origins of this trauma as something that sat outside of individual health and individual responsibility.

Specifically, Dr Rae's work looks at young Aboriginal mothers involved in the *Gomeroi Gaaynggal* (babies from Gomeroi lands) study. Dr Rae did not spend any time in her presentation discussing scientific findings of this study, but instead focussed on the ways in which it is conducted, and why that matters when incorporating scientific research into health care. For example, when biometric data (blood samples, height, and weight) are collected from the mothers in the *Gomeroi Gaaynggal* study, they are only collected by Indigenous health workers, and Dr Rae emphasised the need for community-led research methods such as this. She also described the 'Arts Health' component of the project, where mothers would talk to researchers about their wellbeing (the goal being to identify potential PTSD 'markers') while painting and drawing in a shared space which was designed to be culturally safe and non-confrontational. I am noting this here because it stood in quite a strong contrast to some of the other presentations, including the one described above, where the focus was on data and findings, rather than on context, history, and research design. Dr Rae concluded the talk by positioning her study as an opportunity for the community to gather an 'evidence-base' for intergenerational trauma, and it was here that epigenetics was first mentioned. She positioned epigenetics and the collection of biometrics over time as a promising scientific method for 'demonstrating the powerful effects of intergenerational trauma' on Aboriginal mothers and their babies.

The final presentation I detail here was about another Australian longitudinal study. The presentation was titled 'Aboriginal and Torres Strait Islander kids growing up strong: Insights from ‘Footprints in Time, the Longitudinal Study of Indigenous Children’’. The audience was told enthusiastically that ‘Footprints in Time’ is one of the largest studies of Indigenous children worldwide, and it has been running since 2008, when participants were 0-5 years of age. In this study, mostly Indigenous research administration officers from the Department of Social Services visit families to conduct interviews and complete a survey. This survey was developed using a ‘socio-ecological approach’, and no biomedical materials (e.g. blood samples) were collected. Instead, the data from the study consists entirely of the responses to the survey, which focus primarily on child development. The representative from the study who presented the talk in Darwin spoke at length about the need for reciprocity and trust when working with Indigenous populations in a data collection capacity – the employment and training of Indigenous research administration officers for the first Wave of the Footprints in Time study was an ‘unprecedented initiative’ for a large-scale survey in Australia (Dodson et al., 2012). Guiding research questions in the Footprints in Time study include ‘what helps Aboriginal and Torres Strait Islander children stay on track or become healthier, more positive, and strong?’ and ‘What is the importance of family, extended family and community in the early years of life when growing up?’. The presenter described this as ‘strengths-based qualitative questioning’ which was developed explicitly to avoid a deficit or shame model when talking to Aboriginal children and their families about such complicated topics as ‘health and life outcomes’. The presenter concluded by discussing how the longitudinal large-scale survey data from ‘Footprints in Time’ is often referred to in policy conversations, and that it is ‘good to have the data to go on and fall back on for policy’.

As I watched these three presentations from the heavily air-conditioned lecture theatre in Darwin, it dawned on me that these three longitudinal studies on the health of Indigenous mothers, children and families throughout the life-course had different orientations to the concept of damage. All three studies used the cohort model, which is highly popular in DOHaD due to its longitudinal timescale, and has been described as a key ‘technology of evidence’ within DOHaD (Gibbon & Pentecost, 2019). However, the ‘evidence’ these studies were collecting and the methods through which they did so differed. Namely, the studies took different approaches to collecting data to understand the ongoing poor health of marginalised groups. The first study took a purely biomedical approach, one in which the researchers measured ‘health damaging behaviours' of individuals. The second study, while also concerned with collecting biological data, was clear in positioning collective experiences of stress/trauma as the contributing factors to poor health as opposed to the 'behaviours' of the women participating in the study. Lastly, the Footprints in Time longitudinal study did not collect any biological data, and used an explicitly strengths-based approach, as evident in the above example questions about what keeps children strong and healthy. These three studies, taken together, can be read as examples of the different ways in which DOHaD researchers approach (or do not approach) the dilemma that Tuck presented in her 2009 provocation to researchers and communities; is it possible to gather 'evidence' of marginalisation without perpetuating narratives of suffering? And if so, what forms of 'evidence' could help achieve this goal? Next, I turn to the ways in which some study participants reckoned with these same questions. In particular, some participants I spoke with positioned epigenetics as a form of evidence which, through narratives of reversal and hope, could challenge rather than reproduce deficit discourses.

'Positive' epigenetics?

This tension of how to study poor health and/or trauma across the life-course or across generations, and produce 'evidence' without perpetuating a focus on 'deficit' – is one that some of the epigenetics researchers I interviewed had considered at length. They were highly aware that the majority of epigenetic study designs, as related to trauma and to historical trauma specifically, were oriented around seeking evidence of ongoing disadvantage (Bombay et al., 2009; Bombay et al., 2014; Cerdeña et al., 2021). One way in which some researchers challenged this was by highlighting in interviews the concepts of resilience, change, and reversal. Ruth is a non-Indigenous psychologist who has recently begun collaborating with an epigenetics scientist on a study. Prior to becoming involved with this research team, she has worked with trauma survivors for twenty-five years using a 'post-traumatic growth' approach, and has been critical of purely biomedical models of mental health. However, she decided to collaborate with lab scientists to 'use objective measures to prove what I know is real and what counsellors have known for years' (Interview 18). Ruth has since become interested in using epigenetics to study resilience and growth, to 'confirm what we already knew'. She told me she was specifically drawn to becoming involved with epigenetics was because she 'wanted to have a more positive voice in the epigenetic space because it's all about single event trauma and PTSD or combat veterans'. When I asked her to clarify what she meant by a 'more positive voice', she responded by telling me how studies of epigenetics and trauma overwhelming focus on PTSD:

> We did a lit review, a systematic review a few years ago, and found I think we had 51 studies that were specifically looking at trauma and epigenetics. They were all focused on PTSD, six of them looked at resilience, four of which operationalised resilience as the absence of PTSD, two had measures of resilience as well as PTSD, and nothing looked at [post traumatic] growth. So that's like, 'ha! Let's do it.' (Interview 18)

Ruth had identified that studies on epigenetics and trauma rely on measures of PTSD and was therefore planning to intervene as a 'positive voice' by looking at measures of resilience and growth instead. She is interested in 'looking for resilience, for growth and I'm looking at what we can change in the environment so that your epigenetic expression changes'. In her view, using epigenetic studies with a longitudinal, comparative measure of growth or resilience could help to move epigenetic studies away from deficit discourses and towards strength-based ones. She continued:

> So just because everyone else has used epigenetics to look at PTSD, it doesn't mean we have to…if we can use our research to show what we can do to raise people up, to provide a stance, a way of people getting a sense of agency and hope, then we have a lot to learn going forward about how to make all of our lives more harmonious.

Curious about the mechanisms of a study of this nature, I also spoke with Divya, the lab scientist who was collaborating with Ruth. Divya has a background in human molecular genetics, and became increasingly interested in epigenetics throughout her post-graduate studies. Reflecting on her move from genetics to epigenetics, she told me that 'epigenetics is changes…So I guess that's the hope, hope in the sense that we're now – my guideline is always that epigenetics explains why DNA is not our destiny. So we're born with a genetic code, there's nothing we can do about it, okay, so let's leave that for the moment, that's not epigenetics, which is something which we can work on and change about ourselves. So I think that's the hope in a way.' (Interview 21)

Divya moved to Australia to pursue research in epigenetics as related to PTSD and postpartum depression, and was aware of the uneven focus on damage in epigenetic study designs. Divya was working to find alternate routes of using epigenetics through attempting to measure what she termed ‘positive factors’. She described her approach to me:

> The issue is that everyone’s focused on negative health outcomes, including in my own research. So I’ve obviously focused a lot on PTSD, depression, anxiety, etc. but there are other things like resilience, post traumatic growth. What I’m looking at now is things like social support, which is really important and can change a person’s epigenetics, and also things such as belongingness, so how valued a person feels, so this could be how well do they feel they belong to a particular team or an organisation. (Interview 21)

Both researchers provided me with similar summaries of how epigenetics might be used to tell a positive story. First, it would be necessary to capture some sort of base measure of a person’s epigenetic profile. Next, a longitudinal study with a focus on social supports and positive factors could be undertaken to determine whether the person’s epigenetic profile changed across time. This would then leave the researchers with ‘positive’, strengths-based data, and the participants of the research with ‘hope’. Ruth suggested that a study could measure epigenetic changes alongside the provision of therapy, for example:

> Now if making connections with your mob can – it can change your epigenetic expression. You can change things in the environment, you can change that expression. So if you follow people over time, through hardship, maybe through whatever kind of therapy, whether it’s a narrative therapy, a yarning therapy, yarning circles, fire circles, what have you, then you could see a shift in that epigenetic expression. That would really go a long way. (Interview 18)

Here, Ruth demonstrates her commitment to the political impact that epigenetic data could have, saying that a ‘shift in epigenetic expression’ could ‘go a long way’. Divya told me a similar story, using the language of ‘protective factors’ rather than ‘risk factors’:

> It would be really interesting to look at Indigenous communities from the protective factors point of view. So rather than the risk factors point of view, what if we could look

> at the different communities and say, okay, these are the things that can help. So giving people and communities more hope, rather than saying, okay, this is trauma that we've inherited for years and we're passing it onto our kids, but this can be changed and how can we change it. (Interview 21).

Both Ruth and Divya understand their orientation to epigenetics as hopeful and positive because they are interesting in using epigenetics to study how protective factors can 'shift' epigenetic expression for the better. They are committed to the change-making potential of epigenetic studies of this nature because they would, in their view, provide 'hard' data that certain environmental interventions improve the health and wellbeing of Indigenous communities, thereby providing hope instead of reinforcing a deficit discourse. In 2015, Lock took a similarly pragmatic approach to the capacity of epigenetic data to 'go along way', writing that:

> It is feasible that epigenetic data could be presented to governmental bodies and courts as rigorous scientific evidence of the harm that toxic and abusive environments cause to human well-being. Such molecularized findings may well add considerable weight in the minds of those in power to submissions of epidemiological or social science findings based on correlations alone. If so, this could be a positive move, but only if it is acknowledged that "fixing matters" should involve making changes of a much greater order than tinkering with individual bodies. (Lock, 2015: 163)

This 'positive move' to which Lock refers hinges on the power of scientific, biomedical evidence to persuade and provide hope. This is what both Ruth and Divya spoke of, yet in the hypothetical studies they invoked, they were motivated by providing 'rigorous scientific evidence' of the benefits of protective factors and community interventions, rather than of the impacts of 'toxic and abusive environments'. In either construction, though, the crucial element is the presence of biological evidence. Michael is an Indigenous medical doctor with experience in policy work who I interviewed with Jaya. He finds epigenetics to be 'pretty fundamental stuff' in terms of trauma and healing in Indigenous communities for two reasons. The first is because it is easy for Indigenous peoples to understand conceptually, and the second is because of its capacity to place concepts of intergenerational trauma and healing in biological terms, which, like Ruth and

Divya, he believes will have important implications for interventions. Michael described epigenetics to me as:

> …kind of a central plank, along with adverse childhood experience and trauma and toxic stress. If you look at it through Aboriginal health, there's actually implications for suicide, there's implications for domestic violence, and there's plenty of implications for the excess mortality, morbidity and chronic diseases around this kind of modelling. So for me it's pretty fundamental stuff that's shifted my thinking around how we deal with these issues. (Interview 12)

Michael also described epigenetics as 'logical', saying that 'it is pretty logical, from an Indigenous perspective, that we influence future generations in big ways. We already understood that through Law. So I don't think there's a big step to understand that the implications of the way we act now come out on future generations. That's cultural stuff' (Interview 12). What Michael sees as unique to epigenetics compared to other forms of scientific knowledge is the potential to connect cultural notions of wellbeing across time with biological mechanisms. He mentioned being inspired by a large-scale study in the US, which, though it did not explicitly engage with epigenetics, used other biological measures such as cortisol levels and allostatic stress loads to demonstrate that community interventions had a biological impact on the participants' wellbeing, as well as on other outcomes such as returning to school and employment. Reflecting on this study, he noted that it was unique because 'it had evidence, you know, and most of the other programs don't have any evidence whatsoever. Having said that, the evidence probably was in [non-biomedical] outcomes, but the biomedical mechanisms had a lot to do with epigenetics and stable families and stuff like that' (Interview 12). Here Michael both acknowledged that other outcomes are important in themselves yet placed biomedical outcomes as more crucial than nonbiomedical ones. He told me that having biological evidence, such as epigenetic data on community interventions, could provide hope to both communities themselves and to the workers that serve them, saying that:

> What I don't want to happen is for services and policies to be in that whole therapeutic nihilism kind of framework where they go 'well nothing we do is going to change

> anything, so why do anything?' because we're saying the opposite of that pretty much. We're saying everything we do can change things. (Interview 12)

Both Michael and Divya highlight the capacity for change when it comes to epigenetics. Michael notes that 'everything we do can change things', and Divya that told me that 'we're looking at epigenetics as something that is changeable' and even wondered aloud if people might be more receptive to epigenetics if it had a different name; 'if someone called it something completely different without the 'genetics' in there it might be looked at differently…everyone thinks it has something to do with the genetic code per se rather than the activity of the gene' (Interview 21). By reinforcing both the power of biological evidence to demonstrate positive changes, and the fact that epigenetics is changeable and different from genetics, participants like Ruth, Divya, and Michael all positioned epigenetics as a concept which would make 'positive moves', and provide hope (Lock, 2015).

In a 2021 study by Müller and Kenney, questions of hopeful epigenetics were also central. Müller and Kenney examined the circulation of biosocial knowledge claims – namely ACE's, environmental epigenetics, and neuroscience – in schools and a juvenile corrections facility in the United States, and found that the science of early-life adversity was received as uniquely hopeful, with one participant stating that 'the inevitable conclusion of this science is compassion' (Müller & Kenney, 2021: 16). In one instance, a set of restorative justice interventions was more openly received by a school because the interventions were 'newly reinterpreted as biosocial, able to intervene in the biology of early life adversity by building resilience and positive relationships' (Müller & Kenney, 2021: 23). Müller and Kenney argue that by attaching community interventions to the data and language of biological early-life adversity, the efficacy of the interventions is bolstered, and a 'buy-in' which was previously difficult to achieve became more possible (2021). In Australia, Arabena et al. have made similar findings through their First 1000 Days Australia program, where scientific data on early-life adversity and nutrition has been combined with protective factors such as 'cultural pride, family-centred approaches to reproductive health, and improved nutrition during pregnancy' (Arabena et al., 2016: 28). One participant of the initial First 1000 Days Australia planning workshop said that 'this is what hope looks like' (2016: 29). Ruth, Divya, and Michael present a similar narrative – biological (here epigenetic) data could help support community interventions and bolster the importance of certain protective factors (as determined by whether they lead to epigenetic changes). In this sense, epigenetic data and knowledge production would be a means to reach positive ends, rather than a way of measuring damage. As Müller and Kenney write, different actors could use the 'epistemic authority of science as a means to effect institutional change' (2021: 3). However, as I discuss below, the reach of this particular form of biosocial hope may have limits.

Hope on the ground

David is an Indigenous health worker and researcher with extensive experience working with Aboriginal and Torres Strait Islander families who have experienced complex trauma. When Jaya and I spoke with David in the midst of a nation-wide COVID-19 lockdown, I was calling in from Canberra, Jaya was in Sydney, and David was in Melbourne. He was in the middle of a busy day of back-to-back meetings, and our interview was imbued with a sense of urgency. David was clear that, even though he himself had previously been interested in the concept of epigenetics, the hope that some of its supporters frequently cited only goes so far. He told us that 'obviously there's a gene-environment interaction', and he 'still think[s] it's really important' but that:

> One thing has changed … when I was floating these ideas or talking about epigenetics with people on the ground, you know, intelligent people who are really working hard with the young kids, the response that really got me thinking was they were like 'well that's great, but at the end of the day, really, how is that going to change the fact that we know that they need love and attachment and a good diet? Isn't this really just – these findings just show that we're going to need the same interventions anyway, in terms of a safe, secure, and loving environment?' You know, it made me pause and think, well yeah, there's a good argument to that.
>
> It's certainly mentioned more about healing interventions and this idea of certain activities, speculation that consistent – well, love and attachment – but also maybe certain cultural practices that create repetitiveness and things like that with kids could help to change their epigenetics, you know, that's raised sometimes. But it's probably fair to say that there was almost a – not a honeymoon period, but it was first a period of 'wow'. But

> then people were asking the question, ‘well, does that really change what we’re trying to do in terms of the way we intervene and model our practices with kids in terms of their wellbeing?’ And I haven’t heard anyone say it, you know, or found anything that really says ‘yes, yes it has’. So it’s kind of died down a bit. (Interview 7)

Here, David challenges the impact that the production of epigenetic knowledge may have on the ground. He notes that there was an initial period of excitement about the capacity for epigenetic knowledge to effect change, but that this has since ‘died down’, and that epigenetic data – whether it is measuring ‘negative’ factors or ‘positive ones’, might not change what people already know about which interventions are important and why. Here, rather than embracing the ‘epistemic authority of science as a means to effect institutional change’ (Müller & Kenney, 2021: 3), he resists its allure and challenges its power. David continued:

> In the Aboriginal community, we can’t really wait 50 years for these findings to infiltrate down and then use these findings to…you know, I’m sure they’ll inform interventions one day, but I’m just trying to work as hard as I can, at the service-delivery level to improve services. Because there’s a lack of engagement in Aboriginal communities, and there’s all the entrenched poverty and social disadvantage, and that takes priority, basically, for me at the moment.

In our interview, David challenged the notion that epigenetics is differently positioned to other forms of biological knowledge, and clarified that even though he did see value in the concept of a gene-environment interaction, he did not have confidence in its capacity to make any changes on the ground. In this instance, epigenetics, whether oriented around measuring damage or measuring hope, was not seen as a useful addition to David’s toolkit. Similarly, Philippa, a non-Indigenous researcher with a background in Indigenous maternal and child health and who did an undergraduate degree in genetics, clarified about five minutes into our interview that she is ‘a bit of an epigenetics sceptic’, and though she acknowledged it is easy to get ‘swept up in the fashions in science’, she said that ‘I just think some deep and difficult thinking is required here’ (Interview 19). Like David, she recalled a period of excitement, which she called ‘the first heady days’ about developments in epigenetics, and again like David she did not outright deny it, saying that ‘I’m sure there’s some role, but I just think we’ve got more important things to do’.

Philippa's work is heavily informed by the social determinants of health, and throughout out interview she frequently cited housing, child removal, and nutrition as the three key priorities in improving Indigenous maternal and child health. When asked if she thought epigenetic research could lend support to these social interventions, or be used in service of them (as a hopeful measure in the way that Divya and Ruth describe) she was not convinced, saying that:

> It seems a bit mixed up, it doesn't seem very clear, it seems to me there are more urgent priorities to address and I'd rather work on those areas rather than something that's talking about DNA methylation, supposedly. I do worry that if it's all under the epigenetic banner, we are missing a lot.' (Interview 19)

Here, Philippa and David both challenge the enactment of epigenetics as hopeful, and consistently draw the focus back to what is already known – interventions and practices that support Indigenous families, and do not in their view require bolstering and validating through epigenomics frames. Another interview participant, Tanja, is an Indigenous psychologist who has many years' experience working in trauma-informed ways. Where Divya, Ruth, and Michael saw epigenetics as distinct from other forms of biological and genetic knowledge because of the capacity for reversal and change, Tanja had concerns that while this may indeed be the case, this message of change and hope did not translate on the ground. She said that:

> Sometimes when people hear that [epigenetics] it does give people a sense of loss of hope and, okay, it's in our genes, so what can we so about it. So there is a bit of a fine line in how we talk about it. So when you're talking about gene expression…as clearly and as carefully as possible, the danger still is…it doesn't matter, we could be out there talking to a community and they will still come away with whatever they got out of it. That's the danger. (Interview 20)

Because of this lack of clarity, and the risk that discussions of epigenetics on the ground could lead to a determinist genomic perspective rather than a hopeful epigenetic one, the organisation Tanja works for avoids discussing epigenetics on the ground: as Tanja said, 'we stay away from it. We quite intentionally stay away from it'. She clarified that 'epigenetics may have a place but it doesn't have the only place'. In this interview, like Philippa and David, Tanja does not deny epigenetics altogether, but she actively positions it as just one of many forms of knowledge on trauma and associated community interventions, reducing its epistemic power rather than upholding it.

Conclusion

In this chapter, I have detailed how some participants of this study struggled with the question of damage – a question that is figured as central to epigenetic knowledge production and trauma. Amidst calls from Indigenous theorists to resist damage-centred research and to instead focus on strengths-based approaches, I described three scientific presentations I viewed at an international DOHaD conference to demonstrate the different ways in which (and extents to which) researchers oriented biological evidence around individual damage. I then turned to interview data to explore how some participants are also attempting to reorient their research in epigenetics to centre on protective and positive factors such as growth and resilience rather than negative factors like PTSD, which they believe will provide narratives of hope.

For these participants, the main way in which they framed epigenetic research as ‘positive’ was by contrasting the capacity for change and reversal in epigenetics to the ‘set in stone’ narrative of genomics. This capacity for change was understood to provide significant hope to both communities and to researchers. In this way, epigenetics, and biological evidence more generally, was positioned as a ‘hopeful domain open to environmental and structural intervention and manipulation, a pathway that expands the potential sources and mechanisms of intervention in Indigenous people’s lives’ (Warin et al., 2020: 89). However, I also demonstrate that some participants challenged the notion that epigenetic data would bolster interventions, and instead they resisted the ‘epistemic authority’ of this form of biological evidence (Müller & Kenney, 2021). These participants noted that while it certainly leads to excitement, it might not lead to much more.

Chapter five — Evidence, containment, and contamination

Introduction

This chapter is a return to the Introduction of this thesis, in which I wrote of the legacies of nuclear exposure from the British Nuclear testing program in Australia. In the previous chapters of this thesis, particularly chapters three and four, I have demonstrated that one of the key elements that makes epigenetics so attractive to researchers and health workers is the potential it holds to present the state or the government with biological evidence that what happened in the past has had a lasting impact on Indigenous peoples. Further, there is a desire to use this biological evidence to agitate for better conditions in the present. In this chapter, I link this situation, in which biological evidence of harmful legacies takes on such an important valence, to the British nuclear testing that occurred in South Australia during the 1950s and 60s. I present the McClelland Royal Commission into this testing, which took place in 1984-85, as a useful case study through which to examine how biological, scientific evidence functions across generations. For Aboriginal activists, a key motivator for a public inquiry in the British nuclear testing program was to demonstrate that the nuclear testing was having an ongoing impact on people's bodies and land, and that this impact needed to be understood as intergenerational.

This search for biological evidence to validate experiences of harm can, in both the case of environmental epigenetics and radiation exposure, lock people into situations of pathologizing themselves and their land in order to be seen as legitimately impacted by the colonial acts and policies of the past and present (Lea, 2020). This is where tensions and contestations arise, for example in seeking proof that radiation has negatively impacted Anangu land, but not ceding sovereignty of it when colonial authorities make claims that it should not be used. Within trauma research, epigenetic evidence of trauma was presented to me as useful in convincing settlers of ongoing harm, but was also presented to me as reducing a whole population to a certain narrative of biological suffering or deficit. Here we can see how biological evidence of intergenerational harm can bring up questions of damage and deficit, and risk eclipsing healing and sovereignty. In this chapter, I turn to the nuclear testing program and subsequent McClelland Royal Commission to attempt to untangle these tensions that circulate around biological evidence of intergenerational harm. I also pay attention to how containment and contamination played central roles in attempts to control and place boundaries around a harm as porous and long-lasting as radiation exposure.

Nuclear exposures

In the Introduction to this thesis, I began by introducing Karina, a Yankunytjatjara-Anangu woman whose father was eleven years old when the first Totem test bomb exploded at Emu Field in the North of South Australia and travelled west over his country at Wallatinna. When I met with Karina in early 2020, just before the COVID-19 pandemic reached Australia, she told me that if I was interested in questions of exposure and environments, I had to think about the nuclear testing that happened on Anangu land. In the scientific literature I had been reading at that time about environmental exposures and epigenetics in marginalised populations, radiation exposure from nuclear testing on indigenous lands had not been mentioned. The exposures that were mentioned most often included alcohol, smoking, nutrition, and stress. Exposure to toxins such as radiation, lead, or polyfluoroalkyl substances (PFAS) did not tend to appear on these lists. This made me question what counts as an exposure, and who gets to decide.

One epigenetics researcher I interviewed defined external environmental exposures as ‘something that either the person subjects themselves to or they are subjected to’ (Interview 4). It is striking to me that most lists of exposures within epigenetics literature fall into the first category – within this logic people are seen as choosing to subject themselves to smoking, alcohol, poor nutrition, or high levels of stress, and this leads to recommendations for ‘lifestyle interventions’ that target individuals.[23] When it comes to the second category of exposures, the category that uses the passive voice, that denotes a lack of choice, the ‘something was done *to*’ the subject category rather than ‘the subject *did* something to themselves’ category; these sorts of exposures are less frequently represented in the scientific literature. These are the sorts of exposures that Karina encouraged me to think about through her lens of anti-nuclear activism and her family’s experience of the nuclear testing at Emu Field.

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[23] As Natali Valdez’ highlights in her ethnography *Weighing the Future* (2022), randomised control trials within DOHaD and epigenetics that centre ‘lifestyle interventions’ into diet for example, have not led to improved outcomes for pregnant people or their children. Despite this, individual lifestyle factors continue to be the focus of epigenetic studies and popular scientific reporting.

Within anthropological and STS scholarship, environmental exposures including nuclear exposures have been keenly discussed. For example, Adriana Petryna's ethnography *Life Exposed* intimately explores life after the Chernobyl nuclear reactor exploded in Ukraine, and engages the frame of 'biological citizenship' to make sense of how exposed populations took part in 'the opening and reconfiguration of the political process through their biological conditions' (2013: 143). Petryna highlights the states insistence on the scientific complexities of measuring radiation effects, and throughout her ethnography she uses the term 'environment' 'in two senses: as a scientific arena in which the indeterminacy and unknowability of radiation effects is the rule; and as a political opportunity structure where knowledge claims are made and social action takes place with respect to such rules' (ibid.). Throughout the McClelland Royal Commission process, we will see how the 'unknowability' of the biological effects of radiation on lands and bodies was also understood to be a fundamental rule, and that scientific evidence of radiation effects was both reinforced as unknowable and reinforced as a desired, privileged form of knowledge at once. Aya Hirarta Kimura has studied the interplay of gender, food contamination, and citizen science after the Fukushima nuclear disaster in Japan, and Joseph Masco's work *The Future of Fallout* examines American political world-building through the lens of nuclear expansion (Hirata Kimura, 2016; Masco, 2021). In Australia, the British nuclear testing program has primarily been approach through a political frame – questions of the Cold War, and of how the Australian government allowed itself to be 'voluntarily bombed by another country' abound (Gara, 2021, personal communication). Elizabeth Tynan has written two extensive texts on the testing program at Maralinga and Emu Field respectively (2016; 2022), yet this chapter is not intended to add to this political literature, but rather to take cues from the work of STS scholars to explore the boundary-work at play in making bodies and lands knowable through scientific evidence, even when such evidence is 'unknowable' (Petryna, 2013).

The establishment of the McClelland Royal Commission

Karina's father, Yami Lester, played a key role in agitating for a Royal Commission into British nuclear tests in Australia. As Karina tells it, he was listening to the ABC radio and heard a snippet of an interview with Sir Ernest Titterton, a British nuclear physicist who was heavily involved in the nuclear testing program in Australia and was a member of the controversial

Atomic Weapons Tests Safety Committee (AWTSC).[24] During this ABC interview, as Karina writes:

> Titterton [was] saying that they had taken good care of the blacks – Dad said “that’s bullshit”. They never spoke to Anangu to tell them about what they were planning on doing, they never asked for consent, they couldn’t even speak Yankunytjatjara. There was only one patrol officer to cover thousands of square kilometres informing the community of the British and Australian Government’s plans for nuclear testing in the outback of South Australia. With this interview in the back of Dad’s mind, he was determined to set the record straight and remind Australia of what they did to Aboriginal people of the western desert region. (Lester, 2021: 18)

In the early 1980s, Mr Lester began campaigning in earnest along with his colleagues at the Pitjantjatjara Council for a public inquiry into the impacts of the nuclear testing on Aboriginal people. In March 1984, the South Australian government announced they were commissioning a study into the health of Aboriginal peoples exposed to radiation from nuclear testing. In a newspaper excerpt from 11 May 1984, with the headline ‘Memories recalled as Aborigines seek testing inquiry’, Mr Lester is pictured with Philip Toyne at Parliament House in Canberra, where the two men showed a short film of testimonies in Pitjantjatjara and Yankunytjatjara languages to key Ministers, namely the Minister for Aboriginal Affairs and the Minister for Resources and Energy (The Canberra Times, 1984). By this point, the campaign for a Royal Commission was well underway, and mounting pressure from Aboriginal activists and the South Australian government led to the commencement of the McClelland Royal Commission in July 1984. Although much of the pressure to hold a public enquiry was most directly coming from Aboriginal peoples and organisations, such as the Central Australian Aboriginal Congress and the Pitjantjatjara Council of which Mr Lester was a leader, the Royal Commission, announced in July 1984, had much broader terms. Namely, it was decided that the inquiry would concern:

> the harmful effects of exposure to ionising radiation [...] with particular reference to the following persons, namely members of the Australian Defence Force and civilians at the

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[24] The ABC is the Australian Broadcast Corporation, a public broadcaster owned and funded by the Australian Government.

> test sites, Royal Australian Navy personnel in the vicinity of the tests at Monte Bello Islands, Royal Australian Air Force personnel, including decontamination teams, involved in atomic cloud sampling and tracking operations and Aboriginals and other civilians in the general regions of the test sites. (Terms of reference of the Report of the Royal Commission into British Nuclear Tests in Australia, 1985: 2).

Here, ‘Aboriginals and other civilians’ are subsumed into a larger list of groups the Royal Commission would cover, and as Urwin writes, this scope enabled the federal government to ensure ‘their concerns were addressed, but [was] sufficiently limited to avoid questions of Australia’s complicity in the ongoing impacts of colonisation upon Aboriginal peoples.’ (2022: 530).

Though the purpose of this chapter is not to give an extensive political history of the McClelland Commission itself, it is nonetheless necessary to briefly set a scene. In the early 1980s, the Labor government, led by Prime Minister Bob Hawke, was seeking to carve out a progressive identity, an identity which would set his government apart from conservative Australian governments prior, and would cement Australia as its own place rather than an outpost of the British.[25] Against this backdrop, the McClelland Commission has been read by some scholars as an opportunity for the Hawke Government to push a ‘narrative that Australia had been subject to the imperial interests of the British.’ (Urwin, 2022: 525). Thus, by focusing on the role of the British and elevating stories of how non-Indigenous Australians had been kept in the dark or taken for a ride by the British Government, the McClelland Commission can be viewed as an exercise of absolution – releasing white Australia from its colonial complicity by placing blame solely on the British. Primarily concerned as it was by the relationship between Australia and Britain, the relationship between Australia as a colonial power in and of itself and the Indigenous peoples of this country (at the time of the testing and at the time of the Royal Commission), especially concerning land rights, was left unexamined; or as Vincent writes, was ‘submerged under another story’ (2007: 156).[26]

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[25] For detailed readings of the political landscape at the time of the Royal Commission and of nuclear colonialism in Australia, see Jessica Urwin (2022), Graeme Turner (1993) and Heather Goodall (1992).

[26] The ways in which Walter MacDougall, a white Australian Native Patrol Officer charged with travelling through the Central and Western Desert areas to tell Anangu to leave their own lands, is described in the Royal Commission

When turning to the archives of the Royal Commission to explore questions of intergenerational harm, toxic exposures, and colonial attempts to manage borders of both land and bodies, it is important to keep this in mind. In particular, the McClelland Commission's terms of reference and subsequent focus on 'the harmful effects of exposure to ionising radiation' on 'Aboriginals and other civilians in the general regions of the test sites' importantly did not account for the harmful impacts of dislocation and removal from ancestral lands, which as we will see was a primary and fundamental requirement of the testing program. Even at the moment of the Royal Commission being called, we encounter a definition of 'harmful effects' which prioritises a biological/body lens and forecloses any genuine possibility of reckoning with forms of harm that resulted from displacement from and harm upon land itself. As Karina writes, 'our land has been seen by outsiders as nothing but a wasteland, but to Anangu it is our home, our safe place, rich in culture that is so important to us' (Lester, 2021: 24). Throughout the Royal Commission process in 1984, Aboriginal participants figured land as a principal player in discussions of ongoing harm to Aboriginal peoples, refusing to frame issues of harm to land and bodies as separate, as the Terms of Reference of the McClelland Commission attempted to.

The 'Final submission by counsel on behalf of Aboriginal groups and individuals', was compiled by Lawyers Eames and Collett from the 'Aboriginal collation of materials' (RC819). The 'Aboriginal Collation' included transcripts of interviews, reports from anthropologists, video footage, maps, photographs, and letters, all relating to Aboriginal peoples' experiences of the nuclear testing program. The 'Aboriginal Collation' is held in the National Archives of Australia and contains roughly 10,000 documents collectively. It was from these documents that Eames and Collett complied the Final Submission. The cover of the 'Final Submission on behalf of Aboriginal Groups and Individuals' features a photograph of Justice McClelland and Commissioner Fitch at 'an informal hearing at Maralinga on 25 April 1985'. In the photograph (see figure 5), the commissioners are sat in a circle with Anangu people giving testimony, with scrub and trees behind them. The photograph is a striking example of the insistence of Aboriginal participants who gave testimony in the Royal Commission to centre their land in all

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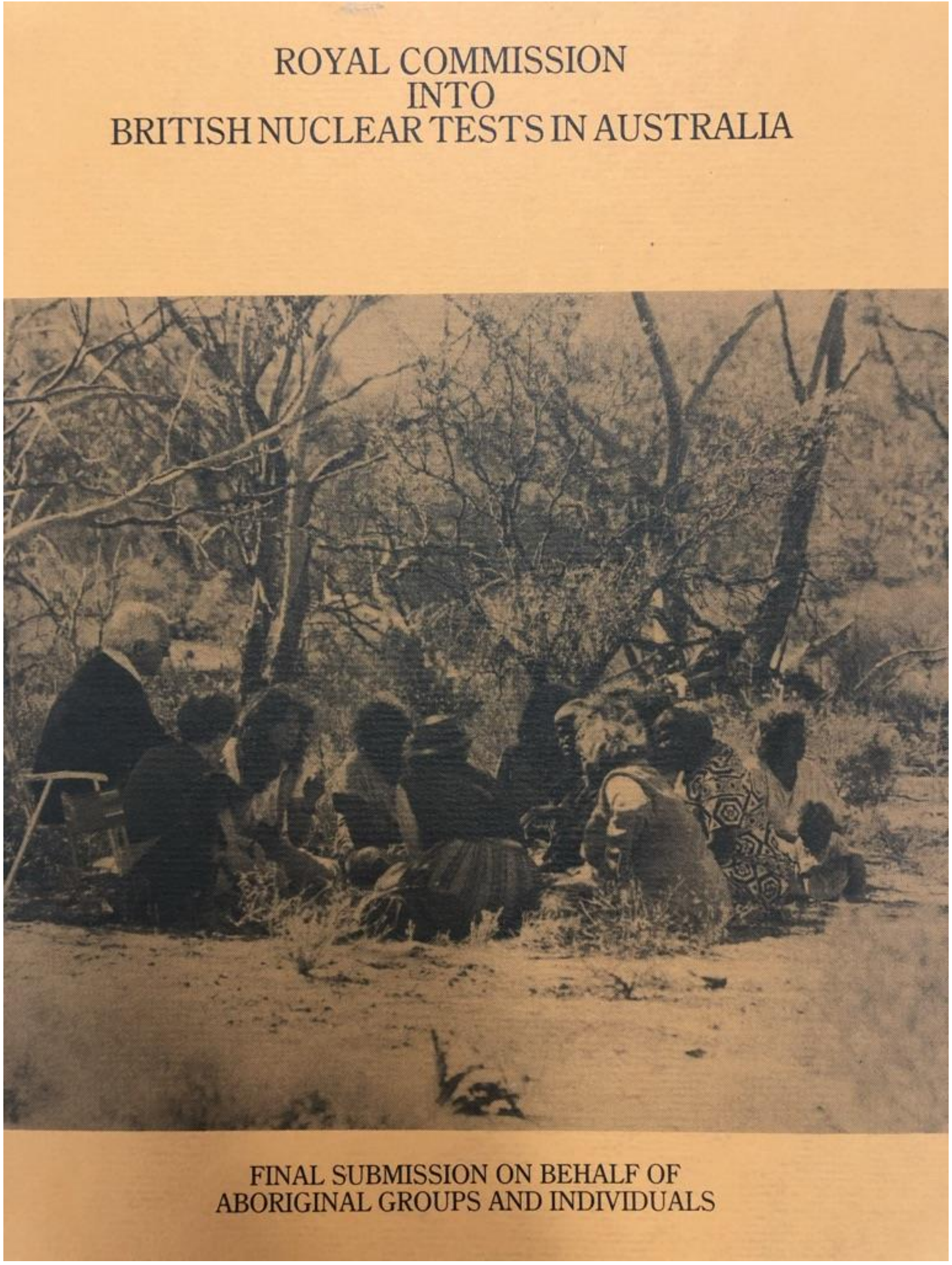
Report are a good example of the blame placed towards the British officials. For example, 'Officials…withheld information from MacDougall, they silenced him, and they discredited him. Such was the relationship between the one person who knew about Aborigines and was concerned with their welfare and those whose main concerns were for the nuclear test program and the British Commonwealth of Nations.' (NAA, RCR: 311) aspects of the process. Hearings were held in Sydney, Brisbane, Melbourne, Adelaide, and London – yet they were also held at Wallatinna, Maralinga, and Marla Bore. Before discussing the contestations that arose during the Royal Commission process, I first provide a brief overview of the areas of country that were implicated in the nuclear testing program.



ROYAL COMMISSION
INTO
BRITISH NUCLEAR TESTS IN AUSTRALIA

FINAL SUBMISSION ON BEHALF OF
ABORIGINAL GROUPS AND INDIVIDUALS

Figure 5: Photograph on the cover of the Final submission on behalf of Aboriginal groups and individuals, September 1985. Reproduced from the report.

Map of South Australia Showing Location of Maralinga

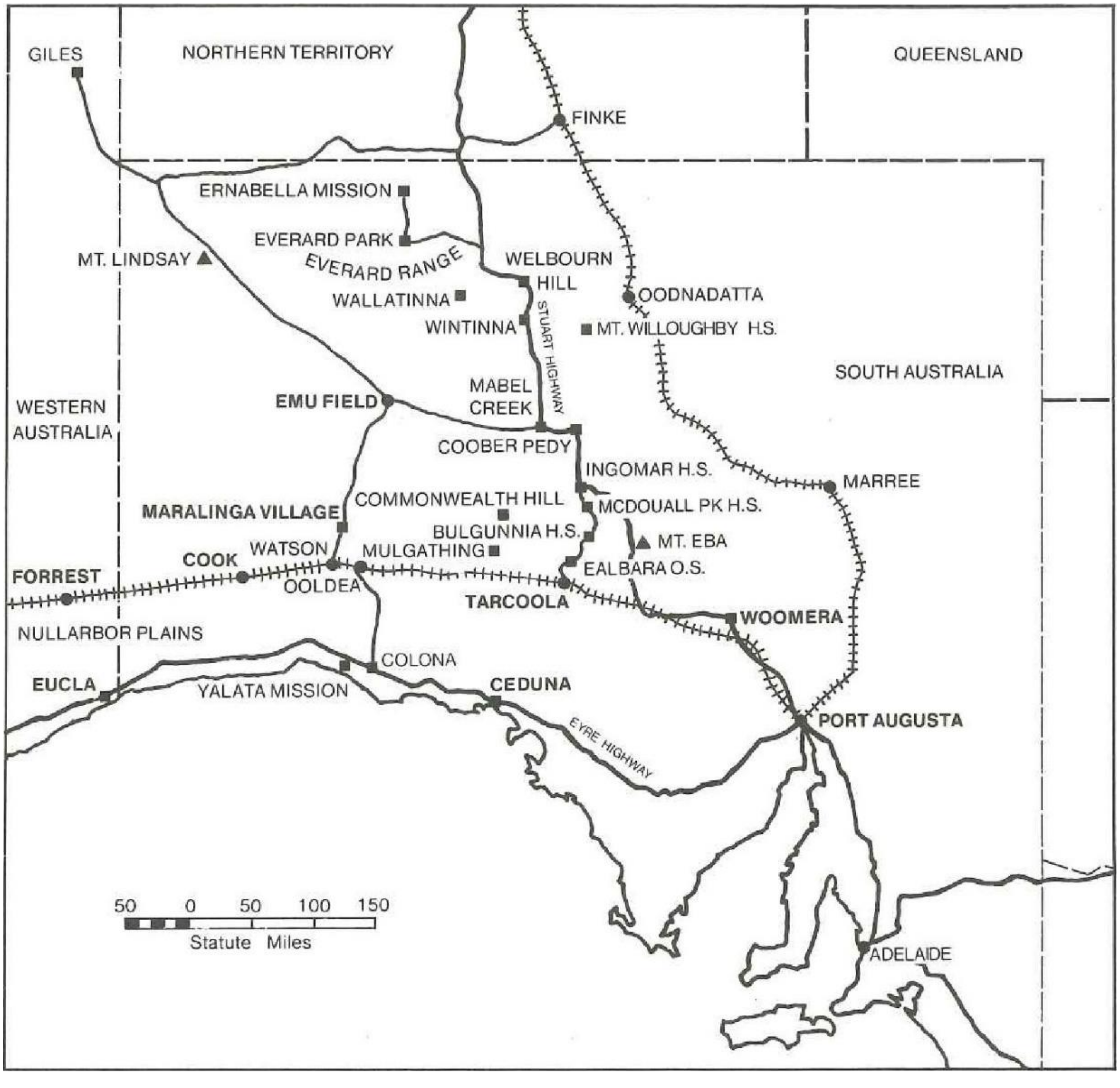


Figure 6: Map reproduced from The Report of the Royal Commission into British Nuclear Tests in Australia, 1985

The Maralinga area: Ooldea, Yalata, and Oak Valley

Ooldea, a freshwater soak close to the former Trans-Australian railway line, as seen in the map above (figure 6), was an important water source, meeting place, and ceremonial area (Gara, 2017: 354). While at Ooldea, Anangu who lived there and travelled to the area had access to sacred sites and visited their home country often. In 1933, Ooldea Mission was established by the United Aborigines Mission (UAM) and was disbanded some twenty years later in 1952 (Palmer, 1990: 197). The search for a new site to relocate the Mission had begun in the early 1940s, however the establishment of the Woomera Rocket Range in 1947 halted these relocation plans for some time (Gara, 2017: 361). In 1952, the South Australian Government purchased leases at Yalata, an area 140km south of Ooldea. Yalata Reserve was controlled by the Lutheran Mission Board, and not the UAM as Ooldea had been (Gara, 2017). When the UAM closed Ooldea Mission and the Lutheran Mission Board established Yalata Reserve, some Anangu travelled west on the train, whereas others travelled north towards Ernabella. Others were forcibly taken south to the new Yalata Reserve in trucks (Gara: 2017: 363). In Ernabella, native patrol officer Walter MacDougall was encouraging people to return south. This move from Ooldea to Yalata displaced people further south, and thus further away from their ancestral lands (Palmer, 1990: 198). The prohibited area which was established later in 1952 covered land ‘westward from Woomera to the Western Australian border and taking in all the desert country north of the railway line, an area of about 15,000 kilometres.’ (Gara, 2017: 366). Having been moved south to Yalata, Anangu were cut off from their desert lands from 1953 onwards, while the purportedly empty land was used for bomb tests and trials. As one Anangu man described in an interview with anthropologists Maggie Brady and Kingsley Palmer in 1985:

> At Yalata we were still thinking about country, but they put a block on you, like a paddock, shut. There were soldiers at Watson [the railway station]…*Piling* [rockhole] no good *kapi* [water] no good. Wiluna rockhole we can’t trust him, we can’t trust water near Maralinga. (Palmer, 1990:199)

Another Anangu woman interviewed by Brady and Palmer said that MacDougall told her ‘*ngura wanti* [leave your country] smoke *panya* [be mindful of smoke]. MacDougall told us you not to go back because danger[ous]’ (Palmer, 1990: 199). Some thirty years later, the *Maralinga Tjarutja Lands Rights Act (1984)* established freehold title for the people of this region.

Maralinga is not a Pitjantjatjara word, whereas *Tjarutja* is a Pitjantjatjara word meaning ‘from’, or ‘south of’ – taken together *Maralinga Tjarutja* translates as ‘people from/of Maralinga’. Palmer writes that the choice to use this term ‘*Maralinga Tjarutja’* to ‘describe their new identity as owners’ of the lands of the former test site was in part derived from a desire to make it clear that ‘their past was tied up with what happened at Maralinga and their present was strongly affected by the consequences of what happened there also.’ (Palmer, 1990: 206). The legacies of displacement, dislocation, and damage that the testing program caused are so embedded in the lands, bodies, and histories of the Anangu of this area that they chose to be known as *Maralinga Tjarutja*.

Although the Maralinga Tjarutja received freehold tile, the Crown retained ownership of particularly sensitive contaminated areas of the former test site, namely a 3000 square kilometre area known as ‘Section 400’, and the question of what to do about the ongoing contamination of these areas of land embroiled the Maralinga Tjarutja in ‘a complex web of interaction’ which remains ongoing (Palmer, 1990: 202). After the passing of the *Maralinga Tjarutja Lands Rights Act (1984)*, the Anangu established an outstation called Oak Valley, located about 160km North West of Maralinga, making it far closer to the test site than either Yalata or Ooldea respectively (Palmer, 1990: 201). The Oak Valley site was chosen precisely because it was closer to ancestral areas and sacred sites than Yalata, however, over the course of the McClelland Commission, the levels of radioactive contamination near the Oak Valley site were called into question. As Palmer writes, ‘radioactive contamination lingers, seeding doubts as to the safety of the land’ (1990: 205). Determining the safety of areas surrounding Oak Valley became a key priority of the Technical Assessment Group (TAG), whose formation I explore below.

‘Seeding doubts’ and knowing lands: The TAG reports and contested forms of evidence

In the second volume of *The Report of the Royal Commission into British Nuclear Tests in Australia* (hereby referred to as the McClelland Report), there is a lengthy Chapter titled ‘Future Management of the Range’ (1985). Within this chapter, previous assertions that the areas surrounding Maralinga and Emu were not and would never be occupied were finally deemed incorrect, opening up detailed questions surrounding how the land should be used moving forward, and by whom. In a report from the UK, it had been asserted that Aboriginal owners of the land would not have any interest in returning after having been denied access for thirty years, because 'there is no water, little firewood, and no ready supply of food in vegetable or animal forms. They [the lands] have the additional disadvantage for Aborigines of having been polluted in a physical, and for them, a spiritual sense' (NAA, RC865: 693).[27] Here, there is an assumption that if the land were damaged due to the testing program it could not possibly be desired. This notion was heavily challenged by the testimonies of Aboriginal witnesses, and in reports from anthropologists and lawyers. In the McClelland Report, it was noted that 'the Royal Commission accepts that the sites and tracks, and the Lands on which they are located, are of the utmost significance to the traditional owners of those lands,' while also acknowledging that 'the possibility that the sites have been and will continue to be unclean must cause considerable anxiety to their custodians' (McClelland Report, Vol 2: 571). The report also noted that the 'traditional owners of the Maralinga lands are eager to re-establish their traditional relationships with their lands and are responding keenly to attempts to make this possible' (ibid.: 573). In a report tendered by Professor Hamilton, an Australian anthropologist, she made it clear that although there was indeed anxiety related to the potential levels of ionising radiation at areas near the testing site, such as Oak Valley, the distress for traditional owners of not being able to access these areas significantly outweighed the anxiety of potential toxicity (NAA, RC819). While the authors of the McClelland report wrote that the 'possibility that the sites have been and will continue to be unclean must cause considerable anxiety to their custodians', Hamilton countered that 'the inability to check on and care for sites is a great source of anxiety' too (McClelland Report, Vol 2: 571; NAA, RC819).

It was hence decided in the McClelland Commission's formal recommendations that 'the aim of a clean-up should be to allow the Aborigines access to the test sites without restriction' (McClelland Report, Vol 2. 567). Of high importance then, were the questions of how to manage the five main identified 'radiological and toxic hazards' in the test areas (particularly in Section 400): plutonium fragments, buried plutonium, uranium, beryllium contamination, and radiation levels (ibid.: 563). The Technical Assessment Group (TAG) was formed to undertake detailed scientific studies of the levels of contamination at these sites and to 'determine possible options

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[27] Archival records are cited within this text according to the National Archives of Australia (NAA) citation policy. For full references of archival records see the Bibliography.

for future rehabilitation of the Maralinga lands' (Brady & Palmer, 1991: 4). The group comprised of radiation scientists, physicists, arial radiological surveyors, anthropologists, and other scientists, whose shared goal was to measure in as detailed a manner as possible the levels of contamination.

Of particular concern to the TAG was measuring possible contamination levels according to the lifestyles of Aboriginal peoples living in desert areas rather than 'Europeans, living in houses and eating food bought from the supermarket' (ibid). To determine this, anthropologists camped at Oak Valley multiple times across 1987 and 1988, capturing data on hunting, food storage and preparation, and 'dust raising activities' that might result in contamination though either inhalation, ingestion, or absorption of dust. Bush foods such as kangaroos were weighed, and their preparation watched. The anthropologists took photos and kept records of where foods were stored and how long for, and dust levels were measured each day that they were at the camp. This fieldwork resulted in a 200-page report titled 'The diet and lifestyles of Aborigines in the Maralinga region, South Australia' (Palmer & Brady, 1988), which informed scientific experiments undertaken by other members of the TAG. For example, during the 'cooking trials', scientists cooked samples of foods (mostly kangaroo and rabbit) in areas known to be contaminated with plutonium according to the food preparation methods observed by Palmer and Brady. After the foods had been prepared and cooked by scientists according to these methods, they were 'shipped to the UK for analysis' of contamination (Giles et al., 1990: 2). Below is an extract from the final radioecology report of the TAG (1990) on the cooking trials:

> Shallow pits were dug and wood from trees growing in the area was burnt in it [sic] for about one hour to heat the soil. Ash and topsoil was then scraped away and the samples to be cooked were placed in the exposed hot lower sand layer. The surface sand and ash previously removed was then scraped back over the carcase. Soil samples were collected.

This radioecology report also details how soil from clothing 'obtained from aboriginal people living a normal camp life' was collected and analysed, 'inhalation experiments' were undertaken at the Taranaki test site by simulating activities that raise dust such as sitting near a track while vehicles drive by and digging animal traps, and air filters were 'set up at breathing height near the heads of sleepers at night' (Giles et al., 1990: 4). In a piece of reflexive writing held at the

AIATSIS archive called ‘Dust monitoring and daily activity: a report on a field trip, November 1989’, Palmer and Brady write that at one point during the TAG studies, these personal air filters were also used to try and measure respirable dust per cubic meter at Oak Valley. They reflect that ‘as researchers responsible to Maralinga Tjarutja we felt there was some indignity in wiring up Aborigines with polythene hoses and air pumps for scientific experiments – the purpose of which remained obscure to those taking part despite our best efforts to explain the work’ (Palmer & Brady, 1989: 11). Reflecting on the Royal Commission process and subsequent TAG experiments, Palmer writes that:

> The Royal Commission raised questions about the extent of the contamination that made Aborigines increasingly uneasy about the land they lived upon. Many stories of contamination were unsupported by fact but the findings of very low levels of radiation at Oak Valley in 1987 tended to confirm a view held by some that the land had indeed been made too dangerous to live upon. While assurance came from many quarters, living at Oak Valley was never quite the same again. (Palmer, 1990: 203)

In Palmers’ description here that ‘living at Oak Valley was never quite the same again’, we can see how a sovereign right of the traditional owners of the Maralinga test areas to return to their lands was eclipsed and complicated by attempts to gather scientific evidence of the extent of damage that those lands had incurred. Further, Palmer also reflects that the process of the Royal Commission more broadly ‘raised Aboriginal people’s expectations but, at the time of writing, no compensation has been paid to individuals. This tended to confirm, for some, that governments promised much but did very little’ (Palmer, 1990: 203). In this case study of the TAG’s investigations at Oak Valley, the process of attempting to establish scientific evidence of contamination at the areas surrounding the Outstation led to anxiety, raised expectations of compensation which were unfulfilled, and made traditional owners feel uncomfortable living on their own lands. My argument here is that when scientific evidence of damage is privileged above other ways of knowing, it becomes a force so large that it can cause harm while trying to measure harm.

Ali Cobby Eckermann is a Yankunytjatjara poet whose 2016 piece, *Thunder Raining Poison*, I first read in the Stanner Reading Room at the AIATSIS archives. The poem is a response to an artwork of the same name by Kokatha and Nukunu artist Yhonnie Scarce (2015). In Scarce's installation, hand blown glass yams hang in a menacing structure, referencing the bomb that was test exploded at the Breakaways site at Maralinga with a heat so forceful that it turned the sand and topsoil into glass on impact. In an excerpt from her poem responding to this work, Cobby Eckermann writes:

> trees dead with arms to the sky. all the birds missing. no birdsong here
> just stillness. like a funeral. two thousand or more
> a whisper arrives. did you hear it?
> two thousand. two thousand or more
> it sounds like glass. our hearts breaking. but we are stronger than that
> we always rise us mob. two thousand. two thousand or more
> you can't break us. we not glass. we are people!
> two thousand. two thousand or more
> our Spirit comes together. we make a heart
> did you see it? in the fragments. it's there in the glass
> two thousand. two thousand or more
> our hearts grow as we mourn for our Land
> it's part of us. we love it. poisoned and all

When Cobby Eckermann asserts 'it's part of us / we love it / poisoned and all', she challenges the story that because her land was exposed to radiation it is not of value – no longer of her. Like Karina, who worried about the dust and the water at Wallatinna station, but also saw its capacity to bring her family strength, Cobby Eckermann resists the colonial binaries of purity and impurity, and rejects the notion that scientific measures of toxicity could ever sever a sovereign relation to land. In the next section, I turn to this question of purity and the fractured boundaries of contamination.

Containment and contamination: constructed boundaries and clean borders

When I visited the National Archives of Australia (NAA) to view items related to the McClelland Royal Commission, I was struck by how often boundaries were evoked. I entered the archives having spent the previous year reading about transgenerational epigenetic inheritance, about traumas that harbour in bodies across generations, about the divisible person and unbounded personhood (Strathern, 1988; Lamoreaux, 2016) and Western science's contemporary embrace of bodily porosity and seepage. As I described in my methodology chapter, I entered the archives for the first time with little idea of what to expect. There I was, then, presented with plastic tubs with my surname written on the side, within which were boxes, within which were folders tied together with soft string, within which were documents about exposure. Everything appeared to be contained, and everything had a place. At the Maralinga testing site, too, things had places. Roads were constructed, a Prohibited Zone marked up, an entire village designed to at once produce and mitigate contamination. One of the individuals responsible for attempting to manage contamination was O.H. Turner, the Senior Australian Health Physicist at Maralinga during the nuclear tests and trials. When questioned during the Royal Commission hearings, Turner said that 'we had two maxims that we followed. One was 'once yellow always yellow', and the other was that yellow and clean never meet or mingle – they meet at the barrier, but they do not intermingle. So this meant that a yellow vehicle had to have its own track, because if it drove on a clean road you could possibly be distributing radio[activity] in a clean area' (NAA, RC140: 38). In a letter titled 'Maralinga – use of Australian personnel in forward areas' written in 1965 by Radiation Safety (also known as the Health Physics team), there are more details of the system of yellow (dirty) and red (clean) areas:

> "Red" fences mark the boundary between "safe" areas and those where there is a risk of "slight contamination". "Yellow" fences mark the boundary between a "Red" area and one in which there is a risk of "serious contamination". Work in "red" areas is not subject to any special precautionary measures; work actually inside yellow areas is always carried out under health physics control, and in these circumstances the risk of injury due to radiation or ingestions of radio-active substances is negligible.

In his testimony to the McClelland Royal Commission, Turner continued:

> Heavier contamination was called a yellow area. A red or yellow area meant that you had to wear protective clothing and undertake an entirely separate system of handling the material. Generally speaking, a red area required less protective clothing than a yellow area. In addition to this there was another area called a blue area where there was no

> loose contamination whatsoever but there was radiation present – external radiation and these generally applied to the laboratory access areas rather than anywhere else. So that one of the first things that needed to be determined at Maralinga following the test were red area boundaries and yellow area boundaries…so it is a simple matter to send out surveyors in and when they reach a 15 counts/second near the ground, you had to have your instrument neat to the ground to measure this, then that became your red boundary. Our control system was such that nobody could enter a red area without physics control of some kind. Nobody could enter a yellow area without being completely fitted out with the special clothing and with the special vehicles. If a person by accident or design should transgress from a red area to a yellow area without authority, they and their vehicle would be confiscated, the personnel would be checked for contamination and reprimanded and their vehicle would be confiscated. In this way some 6 or 8 vehicles were confiscated and transferred to the yellow fleet because they had crossed from one area into the other without authority. It was impossible in the early stages to erect fences over the whole area. You could only have token fences at access points with gates and signposts and signs. (NAA, RC140)

Fences were the primary boundary-markers. Areas where radioactive waste had been buried were referred to as 'cemeteries'. During Turners' 1984 testimony, he gave examples of the burial of radioactive waste. Turner said that 'fallout areas were ploughed to a depth of about 6 inches. Scattered fragments around the test sited were bulldozed into pits. Pits containing plutonium, contaminated soil, and rubbish were capped with a 12 inch layer of reinforced concrete. Chain mesh fences with posts set in concrete were erected around the main burial sites' (NAA, RC140: 8).[28] Here, we are introduced to yellow vehicles and red vehicles, yellow tracks and red tracks, chain-link fences, concrete pits, erected posts, burial sites. Cemeteries. According to Turner, the burial of radioactive materials was 'acceptable to control because the half-life of these isotopes were within the range of human memories and human control could be maintained.' However, Turner's tone shifted when he discusses the addition of Plutonium to these cemeteries: 'you have

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[28] It is important here to note that there have been contemporary plans to put nuclear waste repositories (waste dumps) in remote areas of South Australia, namely near Cooper Pedy and Kimba. These plans are fiercely resisted by Aboriginal groups. The nuclear story is ongoing in South Australia – see the *Irati Wanti* campaign for more information (Kupa Piti Kungka Tjuta, 2005).

got to think in terms of hundreds of thousands of years and we just have no idea of the problems that we would be passing onto those generations.'

The 'Pom Pom Incident'

Perhaps one of the most infamous examples of a futile attempt to mitigate and contain contamination at Maralinga is the 'Pom Pom Incident', or the case of the Milpuddie family. On 14 May 1957, an Aboriginal family was sighted within the testing area at Maralinga. Charlie and Edie Milpuddie, along with their two children, Henry and Rosie, and two dogs, were camping in the crater left by a bomb which had been detonated during Operation Buffalo. As described in the Royal Commission report, a group of engineers first realised that there were 'Aborigines in the 'dirty' area' and alerted Health Control (NAA, RCR: 319). Being found in a 'dirty' area, the family needed to be cleaned. A photograph presented to the Royal Commission in Sydney 1984, taken on 14 May 1957, shows Edie's son standing naked but for a white cloth towel which a worker has wrapped around the boy's shoulders and chest. The photograph has a caption on the back which reads 'Aboriginal boy with Don Small, Pom Pom health control 14/5/57'. The worker, Don Small, dressed in work boots, work pants and a white singlet, leans over the boy in the process of covering him and drying him with the white towel. The boy is looking down at the cloth, arms by his sides. In the left of the picture, behind the boy, one of the dogs looks directly forward. As Turner described the incident:

> The discussion was whether they should shower or not. The hesitation was that it may disturb the people, and the degree of contamination was really not sufficient to demand washing. At the same time health physics practice is usually to minimise the amount of radioactivity present even if its not constituting a hazard no radioactivity is better than some. So I recommended that their hair in particular be washed because it is well known that radioactive dust will stick to hair for a longer period of time than it will to the body. So we decided that we should wash the people if they were amenable to this. Well the boy didn't seem to mind very much and he was the one who did have a small reading, while none of the others had any reading about background. The boy had a small reading on his hair and as I've now seen in my report on the matter it was registering 10 counts per second above the background…now the criterion at that stage was 15 counts per second warranted contamination; if it was less than 15 you needn't bother but in this

> situation we thought it was worthwhile. So we persuaded the boy to wash and apart from a small problem when some soap got into his eyes he was quite happy about this. He'd been out in the desert for some time and a wash like that would have been probably treated as something exceptionally good and as a result of this the father showered and the mother washed her hair. At no stage during these considerations was there any fuss. The Aboriginal family were quite reticent and a little bewildered, I should imagine but they didn't pose any problem. (NAA, RC140: 34).

In a report of the incident written by Turner on 18 May 1957, he describes that the father, mother, son, and daughter were all 'washed' or 'encouraged to wash', and that 'the natives were then handed over to security, who evacuated them from the area' (NAA, RC170). He concludes the report by noting that 'there is no possibility that any of the family could have experienced any radiation injury' (ibid). The two dogs had not been washed though, and were shot as a result, 'in case they had been contaminated' (NAA, RC170: 321).

The evacuation to which Turner refers involved driving the Milpuddies to Yalata. The Milpuddies has been travelling South towards Ooldea when they stopped to camp in the crater. Walter MacDougall, the Native Patrol Officer, wrote in June 1957 that a 'series of incidents combined to suggest a trip to Ooldea. The greatest factor being a North-South road where there had never been a road before' (NAA, RC819: 1346). MacDougall 'expressed irritation' that the north-south road constructed by the authorities had 'encouraged movement by the Milpuddies (ibid). Here MacDougall asserts that if roads had not been built by the authorities to make access to and across the testing sites easier for the workers, the Milpuddies might not have travelled into the area. The road as a boundary here was ineffective: rather than keeping people out, it brought people in. Another worker, Officer Murray, also remarked during the McClelland Royal Commission hearings that 'as time went by and Lenny Beadell put these roads through after the bombs then the natives followed the tracks and came in closer to the prohibited area than I had seen before' (NAA, RC148).[29] Another worker also described how the placement of roads at

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[29] Len Beadell was a surveyor who was employed by Defence Research from 1947 onwards to map out and build roads through desert areas to establish the Emu and Maralinga sites. He spent his entire life building desert tracks and wrote books about his journeys – *Too Long in the Bush, Blast the Bush, Bush Bashers, Still in the Bush, Beating About the Bush,* and lastly, *End of an Era*.

Maralinga intersected through water holes and rock holes, again encouraging movement around the sites rather than deterring entry:

> We had one waterhole in our north-west corner and another one some miles west of the south-west corner meaning that normally the track would traverse our grid survey roads. Apparently when the family reached the first road which would have been West Street they decided to follow it rather than cut through the bush and this brought them around to the area where we were. (NAA, RC140: 136)

In this one example of many in which 'handful[s] of natives' were seen within the Prohibited Zone at Maralinga, there are clear attempts to contain people and control use of land within prescribed boundaries – all of which ultimately fail. The roads which were built ended up drawing Aboriginal people closer to the testing areas, the washing and rinsing of the Milpuddies' bodies and hair was superficial at best – Edie Milpuddie was pregnant when she was stopped, showered, and driven away. She had a stillbirth. As described in the McClelland Report, 'Edie and other Maralinga women believe that this happened because there was poison on the ground where they had been' (NAA, RC321). When interviewed by Brady and Palmer in 1985, with an Anangu interpreter, Edie Milpuddie recalled her memories of being found and taken to Pom Pom Health Control:

> We went through these *kapis* [waterholes] "Mimili, Iliya, Purarra, Wildiyuru", and we heard a grader going, a bulldozer. (This was on the road to Emu from Maralinga).
>
> There was a rockhole this side of Coffin Hill called Ngalyawalka and they graded over it. They broke it and now it's finished. We sat down in the road. We saw the graders north of Emu. (NAA, RC140: 7)
>
> We stopped and after a feed, we came south, and then we met the soldiers. We met them morning time. We had dogs from Ernabella and Ron Footner shot the dogs and Pastor Temme. The soldiers gave us a lot of tucker, plenty feed, and I was sick in the car (*tjuni pulka*), rich food ... After they shot the dogs, the old man was angry because they were his hunting dogs for getting *malu* [kangaroo] and Charlie tried to go back. (NAA, RC 140: 8)

Recalling these memories was a difficult process for Edie, particularly as her husband Charlie had since passed away, and Edie was also being asked specific questions about her medical history that she could not answer. In their submission to the McClelland Commission as quoted in the Final Report, Brady and Palmer write that:

> Whether or not the medical histories associated with this family are found to be significant, their experience and the (somewhat belated) concern about it has made Edie, Rosie and Henry confused and anxious. Edie has a very poor grasp of English and it is unlikely that anyone has taken the time to sit with her and explain with an interpreter, what has been going on. I think it would be true to say that the three remaining members of the family have been subjected to a high degree of stress and unhappiness about the events of twenty years ago. (NAA, AB 15: 19)

Conclusion

Throughout this chapter I have presented archival materials from the Royal Commission into British Nuclear Tests in Australia, particularly materials from the Aboriginal Collation and Final submission on behalf of Aboriginal groups and peoples, the Technical Assessment Group, health physics reports from Maralinga, and the final reports of the McClelland Royal Commission. I have done so to demonstrate that the questions raised in earlier chapters of this thesis – questions of how to measure harm, how to know damage without reducing individuals and communities to only damage, and how to mobilise science without reinscribing its epistemic power – are long standing questions when it comes to environmental exposures in settler colonial Australia. I have also done this to take seriously Karina's challenge to think about what counts as an exposure. By placing this story of the legacies of nuclear testing into conversation with stories of environmental epigenetics in Australia, I have sought to open up the question of what exposures are recognised as legitimate here, who gets to decide, and how they privilege certain forms of evidence to do so.

In the McClelland Royal Commission, scientific evidence of the effects of radiation on lands and bodies was positioned as fundamentally difficult to ascertain, yet it was also pursued as a primary source of evidence when it came to the impacts of the testing program on Indigenous people's lands. This then led to a situation where the Maralinga Tjarutja's right to finally return to their country in the late 1980s was implicated in complex and anxiety-inducing processes of measuring contamination and toxicity, denying their strong desire to live on their land unimpeded, 'poison and all' (Cobby Eckermann, 2016). Further, this chapter explored colonial attempts (and ultimately failures) to construct hard boundaries and seek control over contamination, through making roads, designating 'clean' areas, and trying to rush Anangu people out of their lands while radiation got in.

In their work on alterlives and chemical relations, Murphy writes that it is necessary to seek 'methods that might honour the inseparability of bodies and land, and at the same time grapple with the expansive chemical relations of settler colonialism that entangle life forms in each other's accumulations, conditions, possibilities, and miseries' (2017: 497). The archival materials I cite in this chapter, housed deep in folders tied with string, placed in boxes, and pulled up to the surface for viewing only with permissions and warnings, hide and obscure the inseparability lands and bodies by framing lands as only one thing – only clean or only dirty, only empty, always empty. The work of Yhonnie Scarce, Cobby Eckermann, and Karina demonstrates that it is possible to witness damaged lands, like Murphy writes, while also honouring them. Lands, and the boundaries, stories, and permeabilities they hold, can be many, and can be known through family and through memory. Unlike the long reports and piles of documents in the archives, this knowledge on witnessing and honouring lands even in their damage is not conditional on being picked up and read through, nor is it reliant on scientific frames to make it matter.

Chapter six — Small chemicals of trauma: epigenetics as colonial unknowing

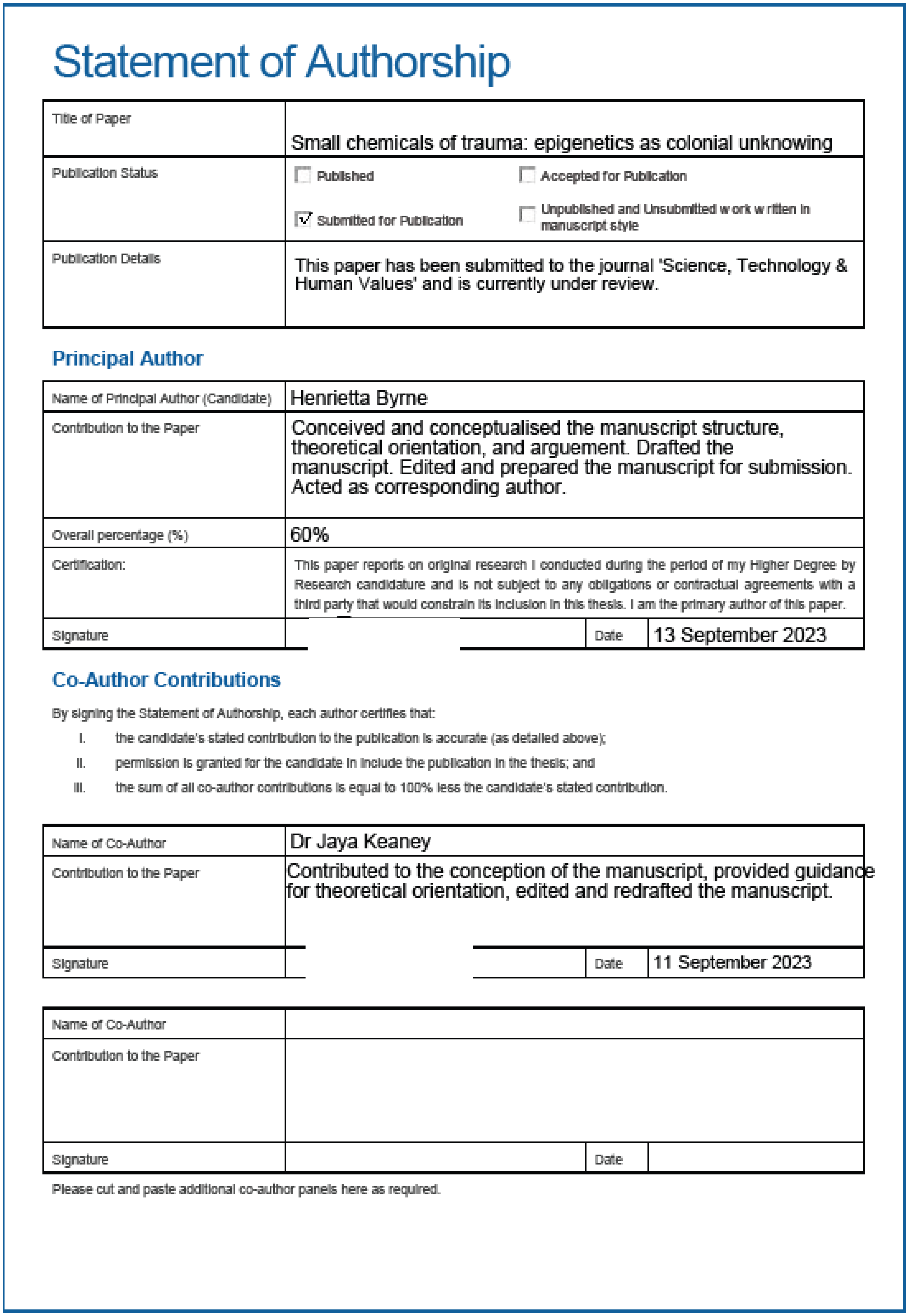
Introduction

This article examines the desire of some study participants to use environmental epigenetics as a form of evidence of intergenerational trauma in Indigenous contexts through the frames of ontological flattening (Landecker & Panofsky, 2013) and colonial unknowing (Vimalassery et al., 2016). The article uses data from semi-structured interviews as well as ethnographic observation from in-person and online conferences to examine the ways in which some participants' position epigenetics as a form of evidence that will be seen by government and policymakers as more powerful than other ways of knowing trauma. Through interview excerpts, we demonstrate how participants view epigenetics as an influential way of representing trauma. However, in evoking epigenetics as a form of evidence, the complex conditions of ongoing colonial violence and trauma are not being merely represented, but are in fact being remade into fixed temporal events. Landecker & Panofsky refer to this phenomenon as 'ontological flattening' (2013: 341). Drawing on Penkler (2022) and Lappé (2018), we explore the reductionism and ontological flattening embedded in the epigenetic study designs proposed by our participants to produce evidence of trauma in Indigenous contexts in Australia.

After exploring how colonial trauma is remade through biological and molecular frames, we then turn to a discussion of colonial unknowing to demonstrate how desires for evidence of a certain form, here epigenetic, reproduce colonial hierarchies of knowledge (Vimalassery et al., 2016). Colonial unknowing describes the ways in which settler colonial states continually define and redefine the terms of what can be known – in other words, the terms of proof or evidence. If certain forms of knowledge are devalued and rendered unintelligible, the state can continue to 'not know', and to demand more evidence of different forms, creating a cycle of perpetual discovery and thus not acting towards addressing inequity. In this article, we argue that a desire to produce epigenetic evidence of trauma can be understood as an appeal to colonial unknowing and to the logics of legibility in a settler colonial state.

Developed and co-authored by myself and Jaya Keaney, this manuscript was submitted to the journal *Science, Technology & Human Values*, a flagship journal in the field of Science and Technology Studies. It is included here in its original submission form (hence the use of anonymised <Author 1> and <Author 2> within the manuscript). I have chosen to include this piece at this point in the thesis as it speaks directly to questions of hierarchy in evidence production that have been building throughout this thesis. Engaging with the critical scholarship of Vimalassery et al. (2016), Watego (2021), and Lorde (1984), this article squarely addresses the hierarchies embedded in evidence production and articulates an Australian example of the colonial logics present in asserting ‘not just *what* counts as evidence but *whose* evidence counts’ (Ehlers and Esselborn, 2023). This article extends these questions by also considering the limits of evidence production when settler colonial states do not listen – who is listening to evidentiary knowledge, and who is choosing not to know?

Statement of Authorship



Statement of Authorship

Title of Paper	Small chemicals of trauma: epigenetics as colonial unknowing	
Publication Status	☐ Published ☑ Submitted for Publication	☐ Accepted for Publication ☐ Unpublished and Unsubmitted work written in manuscript style
Publication Details	This paper has been submitted to the journal 'Science, Technology & Human Values' and is currently under review.	

Principal Author

Name of Principal Author (Candidate)	Henrietta Byrne		
Contribution to the Paper	Conceived and conceptualised the manuscript structure, theoretical orientation, and arguement. Drafted the manuscript. Edited and prepared the manuscript for submission. Acted as corresponding author.		
Overall percentage (%)	60%		
Certification:	This paper reports on original research I conducted during the period of my Higher Degree by Research candidature and is not subject to any obligations or contractual agreements with a third party that would constrain its inclusion in this thesis. I am the primary author of this paper.		
Signature		Date	13 September 2023

Co-Author Contributions

By signing the Statement of Authorship, each author certifies that:

i. the candidate's stated contribution to the publication is accurate (as detailed above);
ii. permission is granted for the candidate in include the publication in the thesis; and
iii. the sum of all co-author contributions is equal to 100% less the candidate's stated contribution.

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Contribution to the Paper			
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Article – Small chemicals of trauma: epigenetics as colonial unknowing

Science, Technology, & Human Values

Science, Technology, &
Human Values

Small chemicals of trauma: epigenetics as colonial unknowing

Journal:	*Science, Technology, & Human Values*
Manuscript ID	ST&HV-2023-03-049
Manuscript Type:	Original Article
Keyword:	epigenetics, evidence, Indigenous, science, colonisation
Abstract:	In Australia, some Indigenous and non-Indigenous scientists, health workers, psychologists and others have identified a resonance between epigenetics and Indigenous scholarship on intergenerational trauma. Epigenetics is a postgenomic science that seeks to demonstrate how environments can 'get under the skin' to shape health outcomes by altering gene expression. Intergenerational trauma is a similar concept, as it describes how past harms such as colonial policies can make themselves felt in the present. Using ethnographic data from interviews with researchers across Australia and observations from scientific conferences, this article critically examines how the normative tools of epigenetic studies are increasingly positioned by scientists and cultural commentators as the route to a valuable form of evidence for addressing intergenerational trauma and health injustice. Through the frame of 'colonial unknowing,' we argue that the settler state functions by valuing certain forms of evidence of trauma over others; namely, epigenetics is positioned as offering objective evidence seen as more valuable than narrative testimony and evidence rooted in Indigenous ontologies. While many participants reject epigenetic knowledge production outright for this reason, others engage with it while simultaneously challenging its growing epistemic power.

Introduction

Over the last 10-15 years, some Indigenous and non-Indigenous scientists and social scientists have identified a resonance between the scientific field of environmental epigenetics and Indigenous scholarship on intergenerational trauma. Epigenetics is increasingly positioned in health, policy and advocacy fields as a useful resource for Indigenous health equity, in part because it resonates with Indigenous ways of knowing. Because epigenetics recognises the impact of context and social environments on health, some researchers believe it to have an affinity with Indigenous understandings of health and disease, where concepts of the body and environment are more relational than in 'Western' concepts of health (Warin et al., 2022). While genetics has long been critiqued as hostile to the agency and personhood of Indigenous peoples worldwide, epigenetics is increasingly positioned in strikingly different terms—as resonant with Indigenous ways of knowing and as a key body of 'evidence' of colonial violence and trauma.[30] In this article, we explore how non-Indigenous researchers place value on epigenetic knowledge production as an 'epistemic environment' (Valdez, 2022: 8-9) of influence, and how they navigate their desire to study the complexities of Indigenous health and social worlds using the normative scientific tools and frames of their disciplines. Further, we turn to interviews and participant observation with Aboriginal medical doctors to explore how they utilize epigenetic knowledge while also challenging the epistemic power and singularity that some scientists place in epigenetic knowledge in contrast to other ways of knowing intergenerational trauma and healing.

Interest in epigenetics has developed rapidly over the past two decades. It emerges from the broader field of postgenomics, where understandings of genetics as 'fixed' or 'set' have been challenged. Recent scientific research in postgenomics has embraced the notion that the body is in fact 'coalesced inseparably with environmental forces (macro and micro) from the moment of conception on throughout life' (Lock, 2015: 163). For the biological sciences, acknowledging that bodies exist in context and are differently impacted by those contexts is something of a conceptual shift. For feminist scholars and social scientists, this is not a ground-breaking

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[30] As many scholars in STS, Indigenous Studies, and Indigenous STS have highlighted, genomic paradigms stabilise biological understandings of Indigeneity that are central to colonial epistemologies. See in particular Kim TallBear (2013), Jessica Kolopenuk (2020). Indigenous communities and other racially marginalised communities have also engaged such knowledge strategically for purposes of advocacy and social belonging – see for example Alondra Nelson (2016).

development. However, in the context of twentieth-and twenty-first-century genomics, it does represent a scientific and popular cultural shift in thinking, as the genome was previously thought to be ‘set in stone’ and unmalleable. As such, many social scientists have embraced postgenomics as a field of scientific research and a generative model of embodiment because of its apparent deconstruction of long-held binaries – body/society, nature/nurture, inside/outside (Roberts, 2017: 594; Rapp 2018). Other social scientists have identified in epigenetics an opportunity for ‘new forms of collaborative biosocial knowledge practices’ (Kenney & Müller, 2017). In our fieldwork, epigenetics has been described to us as ‘progressive’, and as holding significant capacity for achieving social justice and health equity aims.

Social scientific enthusiasm for epigenetics as dismantling binaries emerges in the context of the recent ‘Ontological Turn’ in Anthropology and Science and Technology Studies (STS). The acknowledgement of multiple ontologies and ‘multiple incommensurable worlds’ characteristic of the ontological turn has become an important part of anthropology and STS in recent years – allowing social theory to move beyond social constructionism and towards ‘taking different worlds seriously’ (Pickering, 2017: 135). Another hallmark of the ontological turn (also known by entangled terms such as new materialisms, post-humanisms and cosmopolitics) is the recognition that ‘Western’ worlds centre a dominant ontology that is rooted in dualism (de Castro, 2004). As such, many social scientists have become newly concerned with dismantling dualist thinking and allowing space for multiplicity in their work. However, as Métis anthropologist Zoe Todd makes clear in her piece ‘Ontology is just another word for colonialism,’ positioning the ontological turn as novel can erase Indigenous thinkers and theories (Todd 2016). Reflecting on Bruno Latour’s description of the climate as a ‘matter of common cosmopolitical concern’ at a conference in the United Kingdom, Todd writes, ‘here we were celebrating and worshipping a European thinker for “discovering”, or newly articulating by drawing on a European intellectual heritage, what many an Indigenous thinker around the world could have told you for millennia: the climate is a common organizing force!’

This ‘“aha” ontological moment’ (Todd, 2016: 8) could just as easily be replaced by an epigenetics-inspired revelation: social environments have an impact on and are not separate from human bodies! In both instances, the ‘trendy and dominant Ontological Turn’ (Todd, 2016: 7) risks positioning the nature/culture binary as a universal problem to which Euro-American scholars provide answers, erasing the theories and non-binary ontologies of Indigenous peoples worldwide. Due to deeply inscribed hierarchies within academia, it is possible for this erasure to continue, and for the Euro-Western academy to 'advance and consume arguments that parallel discourses in Indigenous contexts without explicitly nodding to them, or by minimally nodding to Indigenous intellectual and political players' (Todd, 2016: 9). Aboriginal writer Ambelin Kwaymullina terms this approach a habit of non-Indigenous 'discoverers', who 'treat Indigenous lives, cultures, histories, joy and pain, as their source material or their lightbulb moment' (2020: 26). As we argue here, this dynamic is occurring with the discourse of epigenetics – scientists and social scientists have begun to nod to Indigenous knowledge in discussions of epigenetics, but rarely move beyond this when it comes to developing epigenetic studies in practice, including epigenetic studies focused on Indigenous health and wellbeing in Australia and elsewhere. This 'nod' most often happens through a reference to the 'parallel discourse' of intergenerational trauma.

The study

Over the course of 2020-2021, while travel within and between cities in Australia was impossible due to public health measures associated with the COVID-19 pandemic, <Author 1> and <Author 2> conducted 21 interviews via Zoom with lab scientists, psychologists, social workers, medical doctors, and other professionals who engage with epigenetics, intergenerational trauma and/or Indigenous health in their work. These participants were highly skilled in their fields, oftentimes leading large research grants and working in well-resourced labs across major cities in Australia. Given that this was a collaborative project, human ethics approval was received at both the university of <Author 1> and of <Author 2>. After receiving ethics approval, the authors began contacting potential participants via email. Participants who we did not know prior to the study nevertheless responded eagerly to our emails, likely because epigenetics is a field of growing public interest, with many researchers regularly participating in public-facing work. We also employed a chain of referral method that aided recruitment through participants' own networks. The study focuses on the Australian context, due to the understudied nature of epigenetic discourses in Australia, and the specificities of Australian settler colonialism and subsequent Indigenous health frameworks, which warrant focused study.

Of the interview participants, nine were Aboriginal and/or Torres Strait Islander and the remaining twelve were non-Indigenous. Each semi-structured interview lasted between 40-80 minutes. We began recruiting for this project just as COVID-19 was presenting itself in Australia, and as state borders were being closed – a practice which in Australia was termed putting up ‘hard borders’. These hard borders made interstate travel impossible, and state-level lockdowns also prevented us from conducting in-person interviews even with those participants residing in our respective states or working at our universities. While initially concerned about having to rely on Zoom, we found that our participants – all of whom were themselves pressed for time, adapting to work from home conditions and having to integrate caring responsibilities into their paid work lives – were agreeable to participating in a one-hour long Zoom interview in a way that may not have been as likely had we asked to visit their labs for an entire week, for example. Throughout the data collection period, <Author 1> was based in Adelaide, and <Author 2> was based in Sydney, so using Zoom also allowed the authors to collaborate more directly than had been anticipated, and led to a system of co-interviewing. For all but two interviews, both <Author 1> and <Author 2> would both log onto the Zoom call with the participant. Having three people in the Zoom room gave the interviews a conversational feel, as opposed to a direct question/response dynamic, and allowed the authors to interrogate their findings, interpretations, and lines of questioning with one another, adding an iterative component to the interview process.

Following the data collection phase, all interviews were transcribed and analysed collectively using inductive coding methods, with attention to common themes. One key theme which is our focus in this article was the tension between epigenetic science as an alluring form of knowledge with high public and policy traction, and longstanding ways of knowing and addressing the impacts of colonialism through the framework of intergenerational trauma. Participants were offered the choice of being referred to with pseudonyms or their full names for the purposes of publication, and both options were taken up in substantial numbers. Offering participants this choice was motivated by the broader ethical framework of our study, namely, balancing privacy and the capacity for participants to share their thoughts freely alongside the correct attribution of intellectual labour and insights. Providing the option for participants to have their interview contributions cited with their full names is particularly important in a settler colonial context marked by the violent appropriation of Indigenous knowledge and bodies in the service of colonial authority.

Operationalising intergenerational trauma: events and small chemicals

As an increasingly popular discourse for grappling with the legacies of colonial harm, epigenetic science operationalises the notion of intergenerational trauma in particular ways. The concept of intergenerational trauma encapsulates how past harms from colonisation and resulting racist policies have long-standing, intergenerational, and ongoing impacts on the lives and health of Indigenous peoples. Since the development of the Social and Emotional Wellbeing (SEWB) framework by Indigenous scholars from the early 2000s onwards, intergenerational trauma has become a key intervention in Australia, and has shifted thinking and policy responses around how past harms make themselves known in the present (see Atkinson, 2002; *Working Together*, 2010). More recently, the established role of intergenerational trauma as a concept has been critical to the popular uptake of epigenetics, often presented as providing a molecular explanation for how intergenerational trauma is transmitted between generations.

As a concept and paradigm for understanding health, intergenerational trauma has some resonance with environmental epigenetics in that it ties social environments to bodies across generations. The strong knowledge base around intergenerational trauma among Indigenous communities and health services is thus often presented as a basis for engagements with epigenetics. For example, in a series of interviews with researchers who work in Indigenous health in Australia, which formed a pilot project for the current study, participants said that "Aboriginal peoples have known for years" that past injustices are embodied collectively and passed on through generations, and that epigenetics is "consistent with Indigenous knowledge systems" (Warin et al., 2020: 94). One of our participants, an Aboriginal doctor, concurred: discussing how quickly a group of incarcerated Aboriginal men connected to the concept of epigenetics, he described that "honestly, the older guys got it. I was trying to explain, basically, epigenetics and transgenerational trauma and ACEs [Adverse Childhood Experiences] and stuff like that in a pretty rough kind of way. They understood it really fast…I think it fits consistently with Aboriginal approaches" (Interview 12).

This framing of epigenetics as building on a long conceptual trajectory of intergenerational trauma was also echoed by some non-Indigenous scientists interviewed for the ethnographic study that informs this article. One participant, a white geneticist, described the importance of acknowledging prior understandings of intergenerational trauma when devising epigenetic studies:

> Really, we have to be humble and say the ideas have already come before us, we're just offering a mechanism of how to measure it or one way to measure it. Of course, you could measure it by measuring someone's wellbeing, physical or psychological or spiritual. But epigenetics just offers a way to (a) understand the mechanisms, and (b) to actually measure it if we know where to measure. (Interview 4)

This participant positions epigenetics as part of a longer tradition of assessing and measuring the effects of intergenerational trauma. Emphasising the importance of humility as an ethical practice for non-Indigenous scientists, he acknowledges the deep knowledge of Aboriginal people about the deleterious impacts of racism and colonialism on environments and bodies. Yet, the initial positioning of epigenetics as one among diverse measurements of wellbeing—physical, psychological, or spiritual—begins to slip into a hierarchy, with epigenetics later positioned as a more legitimate or strategic form of measurement, through the word "actually." This slippage highlights the growing legitimacy and political efficacy afforded to molecular and genetic forms of evidence when it comes to the impacts of historical and ongoing violence on Indigenous and other marginalized communities. The notion of epigenetic studies as conferring a more efficacious form of evidence was also echoed by another white participant, a psychologist with significant experience working on trauma and post-traumatic stress in both therapeutic contexts and epigenetics-informed research studies. For her, epigenetic studies might form part of the "hard data" needed to back up anecdotal and narrative accounts of the embodied effects of trauma on individuals. As she described of her collaborative work on trauma with geneticists,

> I have to tell you, nothing I have found has remotely surprised me, but now I can say, hey, that CPG site tells me this. I can see the methylation or the expression from epigenetics that confirms what we already knew. People have known these things for many, many years but science… holds a place where people would go, "Oh, I can see it.

> If I can see those brainwaves, if I can see the data around epigenetic expression then it must be true.

For this participant, the development of an epigenetic evidence base serves the aim of convincing sceptical parties, in order to agitate for better policy responses. As she went on to describe, "For me it's just providing images of something that others have known for a lot longer than any of us have been around. You won't surprise any First Nations people with the things that you find about their people."

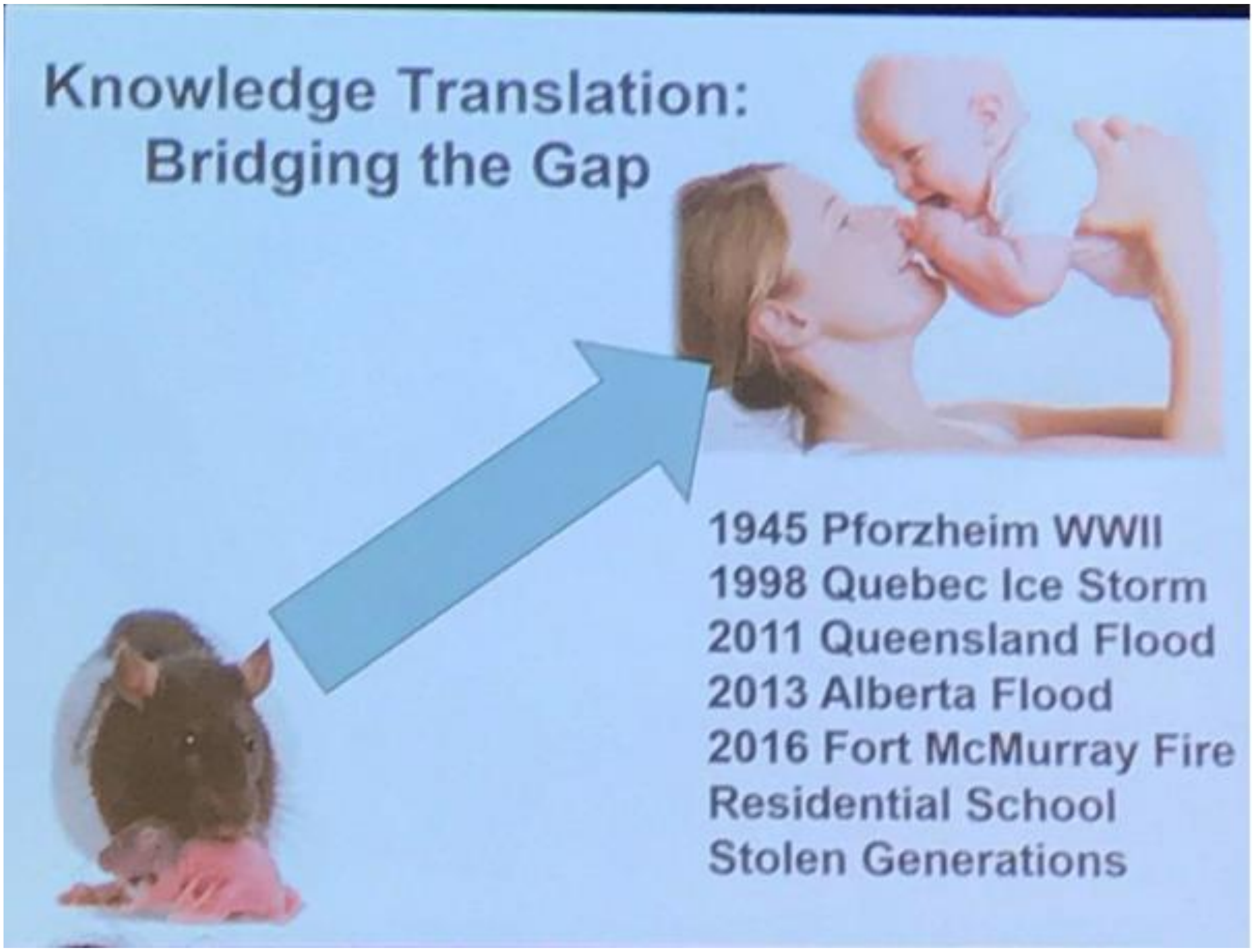
While intergenerational trauma and epigenetics are frequently positioned as corollary terms in such interviews, and at times employed as synonyms, their parameters and strategic efficacy vary significantly in different enactments. In order to achieve the more legitimate measurements that epigenetic studies are seen to confer, intergenerational trauma first has to be operationalised as an object of scientific enquiry. As the geneticist quoted above further described, the efficacy of epigenetics is strategic: "If we get some molecular evidence there as well to kind of back us up, that stress can get under the skin and literally change the genes." For him, the molecular evidence assembled via epigenetic studies may provide indisputable truth for policy makers: "I think it's a concept maybe that will help again for policy, that we say, well, this is not just all in someone's mind. It's literally small chemicals running around the body that are actually triggered by that stress and changing the genes." (Interview 4). The epigenetic study as it is imagined here does not simply attest to the impacts of intergenerational trauma; rather, it operationalises and re-invents trauma through a range of scientific protocols and experimental procedures that imagine it as "small chemicals" produced by stress, running round in a body distinguished from them.

Chief among the experimental protocols by which intergenerational trauma is made into epigenetics in such scientific imaginings is reductionism, in order to fix the complexities of intergenerational trauma into data points to be studied. STS scholars such as Martine Lappé (2018) and Michael Penkler (2022) have highlighted the tendency of DOHaD and epigenetic research to reduce and bind what counts as the environment when operationalising complex social contexts in scientific studies. Lappé conducted ethnography in a laboratory in the United States that used model organisms to examine the impacts of 'early-life adversity' on mental health behaviours later in life. As she writes, the researchers in this lab both ‘acknowledge the impacts of experience on the body, but simultaneously limit what kinds of experiences can matter in the production of epigenetic knowledge’ (2018: 700). In the lab in which Lappé conducted her fieldwork, the researchers removed some pups from their mothers (dams) as a means of operationalising the ‘early-life adversity’ they sought to study. The pups were monitored for ‘anxiety-like’ and ‘depression-like’ behaviours, and then the brains of the pups were studied to investigate whether the separation from mothers led to epigenetic as well as behavioural changes (Lappé, 2018). As Lappé (2018: 707) critiques, this process articulates the complex social phenomenon of early-life adversity through a highly gendered prism of mother separation, a reduction somewhat characteristic of the scientific protocols at play. In order for epigenetic studies to ‘document the *molecular materiality of experience*,’ she writes, ‘the complexities of social life are therefore purposefully constrained’ (2018: 710, original emphasis).

At times, reductionism is bound up not only with scientific protocols but also with pragmatic considerations in institutional research contexts. In Penkler’s interview-based study of two large DOHaD institutes in Europe, for example, researchers reflected actively on how the interventions used in their cohort studies were often simpler than was ideal, due to considerations of cost and pragmatics, along with the conventions of the life sciences (Penkler 2022: 6). For example, Lifestyle advice targeting individual participants, and the administration of nutritional supplements to individuals was preferenced as it was able to be readily conceptualised and enacted, unlike broader changes to social structures (Penkler 2022: 6). Of this study, Penkler writes that, like all life sciences, DOHaD (the broader field of which environmental epigenetics is a part) ‘needs to be reductionist in order to articulate, and thus bring into being, its research objects. The question, then, becomes *what* is reduced *how,* and with what effects’ (Penkler, 2022: 8).

In both Penkler and Lappé’s fieldsites, the *what* is early-life adversity and the *how* is through monitoring individual pregnant people or mothers and modifying their behaviours. In our study, reductionism is at play in the translation of long histories of colonial violence and intergenerational trauma into experimental conditions. Here, the *what* is the trauma and entangled adverse health impacts resulting from decades of colonial violence. The *how* is the monitoring of Aboriginal bodies and the imagining of trauma through particular bodily sites and temporal horizons. In the words of the participant quoted above, trauma is enacted as "small chemicals" – a microscopic, molecular optic from which to reduce the complexity of colonial violence into a 'visible' object to be studied.

The reduction of intergenerational trauma into epigenetic markers was further evident at the 'Developmental Origins of Health and Disease' World Congress Conference in 2019, at which <Author 1> conducted participant observation as part of the broader ethnographic study. The slide pictured in Figure 1 was shared by a settler Canadian researcher. It depicts their plan to translate their work on rats and stress exposure to human populations who have experienced trauma (represented in the slide by the happy white mother and her baby). Examples of trauma events and resulting traumatised populations spotlighted by the researcher include the 1998 Quebec Ice Storm, the 2011 Queensland Floods, and Residential Schools in Canada, and Stolen Generations in Australia. Here, the complex and ongoing history of colonisation in Australia is translated into the trauma event of the Stolen Generations, a set of explicit government policies in the twentieth-century that removed Indigenous children from their families with the aim of assimilation. The Stolen Generations was conceptualised in this research presentation as a single bounded trauma 'event' equivalent to other phenomenon such as the Queensland floods, despite the fact that it not only occurred over decades, but that child removal continues today at staggering rates.



Knowledge Translation:
Bridging the Gap

1945 Pforzheim WWII
1998 Quebec Ice Storm
2011 Queensland Flood
2013 Alberta Flood
2016 Fort McMurray Fire
Residential School
Stolen Generations

<Figure 1: Image of conference slide presented at the Developmental Origins of Health and Disease World Congress, Melbourne 2019>

The reduction of colonial violence to a single event to be studied is embedded in the scientific methods employed by scientists researching epigenetics. Another non-Indigenous scientist who works on epigenetics and Post-traumatic Stress Disorder in Vietnam War Veterans discussed the issue of how to measure trauma through the metaphor of "clean" outcomes. When asked why they worked with Veterans, they explained:

> Because it's like a trauma that can be clearly identified. So lots of people work on PTSD, but it's not a defined trauma. So obviously the fewer variables you have, the cleaner outcomes you're going to see. So, yeah, obviously what I'd like to look at is Indigenous

> trauma and Stolen Generation.[31] But if you can just look at one type of trauma, it definitely helps I think with the analysis later on down the track. (Interview 2)

During another interview, a non-Indigenous scientist was describing their work with paramedics and paramedic students. Their team has been leading a large cohort study on how the 'acute' traumas that paramedics and paramedic students are exposed to change their epigenomes. Again, they are also interested in working with Indigenous populations, and expressed some concern about how to measure trauma in such a population. They then asserted that "obviously when we look at the different populations, the types of stressors that we're looking at would change, but in the end we think stress is stress is stress, which means it should not matter" (Interview 21). Another participant, a non-Indigenous scientist and stress researcher, remarked that in research with different populations, including First Nations peoples, "it's culturally a very specific environment, but the brain biology is the brain biology" (Interview 16). For scientists who are concerned with measuring 'stress' at a molecular level, 'stress is stress is stress' expresses the necessary reductionism required to achieve consistent and translatable scientific outcomes. But what is being obscured in this reductionist operation? How is the specificity and irreducibility of settler colonialism in Australia, the place from which we write, being obscured in the hope of translatability and universal molecular models of stress?

In the creation of equivalences that sees colonial violence enacted as a temporally-bounded exposure, a truism of settler colonial studies is upended. In a canonical work, Australian historian Patrick Wolfe (2006) theorized settler colonialism not as an event—an instantiating instance of invasion and land seizure—but as a structure of relation that embeds white possession and dissolves Indigenous sovereignty and connection to land at every level. Epigenetics, as much as its supporters might want it to do otherwise, might only ever be able to construct settler colonialism as an event, due to the reductionism inherent to scientific ways of seeing. For epigenetics to be applied to something as complex as ongoing settler-colonial trauma, it needs to reduce and flatten it into something discrete and measurable, something with a beginning and an end. Epigenetics, as a theory, provides a biosocial opportunity to elaborate more processual and

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[31] As Gilbert notes (2019: 226), the use of pluralization in 'Stolen Generations' is deliberate and represents the long time-scale of this policy. The interviewee not pluralising the term here can be seen as further example of attempts to flatten ongoing trauma into a singular frame.

open-ended models of personhood and the inter-relation of biology, psyche, and trauma (Blackman 2016). Yet, when translated to experimental conditions in practice, epigenetics often reinforces tired nature/culture bifurcations through the 'more molecularized conceptions of the body and embodiment' that take centre stage (Blackman 2016: 269). Landecker & Panofsky refer to this phenomenon as a tendency to 'ontologically flatten' whichever complex conditions the life sciences are attempting to represent (2013: 341). In our study, the complex legacies and reverberations of colonisation are enacted through "small chemicals" and singular exposure events. While often motivated by the goal of social justice and addressing health equity through policy change or health interventions, the desire of scientists such as those participants described here to locate trauma through epigenetics can flatten the embodied experience of trauma in a way that perpetuates what Vimalassery and others (2016) call "colonial unknowing." Kolopenuk and other Indigenous scholars have demonstrated how modern sciences and technologies often work 'in tandem (and, at times, in tension) with other institutionalized fields, [and] operate through power relations that tend to rescript Indigenous peoples' knowledges of their existence as peoples.' (2020: 3). Similarly, epigenetics risks rescripting Indigenous peoples' knowledge of their own trauma by reducing intergenerational trauma to discrete exposures which can lead to 'clean outcomes' in scientific studies. While epigenetics is routinely positioned as a synonym for intergenerational trauma – a method of scientific validation for what Indigenous and other marginalized communities already know – in practice, epigenetics does not just uncover or validate; it reassembles trauma, transmission, and its subjects.

Epigenetics as Colonial Unknowing

Colonial unknowing is concerned with the ways in which colonial states and systems rely upon a 'colonial insistence on epistemic mastery and refusal of heterogeneous ways of knowing otherwise' (Vimalassery et al., 2016: 2). As part of this 'epistemic mastery,' some forms of knowledge are privileged while others are rendered unintelligible. As Vimalassery and coauthors (2016: 2) write, 'colonial unknowing establishes what can count as evidence, proof, or possibility – aiming to secure the terms of reason and reasonableness – as much as it works to dissociate and ignore'. Through the practices of reductionism that are core to epigenetic ways of knowing intergenerational trauma, the broad-scale scientific and popular enthusiasm for epigenetic knowledge is part of this colonial project of 'epistemic mastery'. Even if studies are concerned with questions of colonial harm and trauma, they cannot be decolonial or aligned with Indigenous sovereignty while simultaneously upholding epistemic mastery and colonial unknowing through defining what counts as ‘evidence, proof, or possibility’.

Similarly, Stoler’s writing on ‘colonial aphasia’ in France describes the ways that histories of imperialism ‘repeatedly come in and out of focus, [and have] more than once been represented as “forgotten” and then rediscovered’ (Stoler, 2016: 133). This forgetting and remembering only occurs through the frames of evidence, proof, and possibility of the coloniser. As a concept, aphasia invokes ‘a difficulty in retrieving both conceptual and lexical vocabularies and, most important, a difficulty in comprehending what is spoken’ (2016: 128). These ‘colonial productions of illegibility’ render certain stories, histories, and realities of colonisation incomprehensible. Such productions ‘precondition the normative and curative promise of discovery/recovery’ (Vimalassery et al., 2016: 2). Effectively, if certain knowledge is continually rendered incomprehensible, there is a continual need for more knowledge of a different form, a continual need to ‘create’ knowledge which appeals to the logics of legibility in a colonial state. Further, having to continually explain and justify one’s existence and one’s needs is an effect of colonial unknowing. It is ‘an old and primary tool of all oppressors to keep the oppressed occupied with the master’s concerns’ (Lorde, 1984: 113). Ruha Benjamin offers an example of this in regard to the increasing number of studies on telomere length and ageing amongst African American populations: ‘*Who exactly needs convincing that racism and other stressors are deadly?* Whose skepticism requires that we pour more time and resources into pinpointing exactly how it errodes *our fuckin’ telomeres?’* (2022: 34, original emphasis).

Epigenetic studies of ‘Indigenous trauma’, as one of our non-Indigenous participants called it, can be understood as a form of knowledge production that appeals to this ‘wilful ignorance’ of colonial states (Vimalassery et al., 2016: 1). Attempting to make ‘trauma’ or ‘early-life adversity’ intelligible in the terms of an epigenetic study in a colonial context obscures the way that the colonial state in which such studies take place continues to exist through its very refusal to know. The desire for more measurement of the impacts of intergenerational trauma on Indigenous bodies, at a deeper molecular level, gains traction through an appeal to colonial unknowing—‘reinscrib[ing] the colonial regimes of knowledge/power’ that are intrinsically linked with projects of recognition and visibility in a settler-colonial context (Vimalassery et al., 2016).

One of the epigeneticists quoted earlier in this article recognised this concern himself, saying, “One of the dangers, of course, is the idea of rediscovery of a concept. So, in a way, it could be an insult to say, oh yeah, we know that it's real stuff that you're talking about here, you're not just telling us this, we're adding a molecular explanation.” (Interview 4). Yet ultimately, the potential strategic efficacy of epigenetic studies — the persuasive power of “hard” biological data — is worth the risk for many life scientists and geneticists interested in questions of Indigenous health and intergenerational transmission. Yet it is in this very remaking of narrative accounts into biological data that colonial unknowing can take root.

Reflecting on her degree in Indigenous health, Indigenous theorist Chelsea Watego writes, ‘In my desire to correct the record, I naively thought that if I just produced the evidence base on their terms in their house, then maybe things could change’ (Watego, 2021:37). Later, she writes, ‘[But] time and time again, I was proven wrong – not via the evidence base I provided, but the strategy of thinking it was all a matter of evidence. Such a strategy was premised upon the idea that the coloniser just didn’t know, and that if they heard our account or saw the evidence, they would accept it and act accordingly’ (Watego, 2021: 67). Here, Watego is drawing on the work of Audre Lorde in the mid-1980s. In a now classic text for feminist theory, which explores the continual denial by white women of the role of racialized difference in American feminism, Lorde asked, ‘what does it mean when the tools of a racist patriarchy are used to examine the fruits of that same patriarchy? It means that only the most narrow perimeters of change are possible and allowable’ (1984: 110). Further underscoring this point, she urges that ‘the master’s tools will never dismantle the master’s house. They may allow us to temporarily beat him at his own game, but they will never enable us to bring about genuine change. And this fact is only threatening to those women who still define the master’s house as their only source of support’ (Lorde, 1984: 112).

Watego also writes that the evidence base she was taught to produce was that of measuring and surveilling the ‘ailing Black body’. Here we are reminded that it is not just the tools which are limited, but the research questions that they serve as well. If scientific research questions are continually predicated on capturing, measuring, and surveilling the ailing Black body, the capacity of those findings to enable change will always be narrow, as they are calibrated to colonial frames of 'Black dysfunction and supposed white benevolence' (Watego, 2021: 207). Similarly, Benjamin (2022: 35) refers to this constant production of scientific data as the 'datafication of justice', and cautions that it can be used by states as a stall tactic to avoid acting on root causes of inequity. A paradigmatic Australian example is the 'Closing the Gap' strategy, which since its inception has been a process of constant data collection – data on dysfunction – that has been 'dressed up as strategy' (Watego 2021; see also Bond and Singh, 2020).

In a settler colony like Australia, the master's tools are those of epistemic mastery, continually defining which knowledge counts as evidence, and in what ways. The case for epigenetic science as a more persuasive evidence base can thus be viewed as a master's tools argument. While the policy and popular appeal of biological data is a fundamental basis for present-day epigenetic enthusiasm, this data does not simply add a deeper layer to understandings of colonial legacy; it reduces and prescribes how those legacies are apprehended within the colonial terms of epistemic mastery. While epigenetics can be enrolled in processes of colonial unknowing, however, this is not inherent to the theory of epigenetics itself, but rather how it is enacted, by whom, and the channels of reductionism employed. As we explore in the following section, the cautious engagement of epigenetics by Aboriginal scientists and doctors may offer one alternative.

Epigenetics as Trojan horse

At another conference, in a series of sessions on DOHaD and Indigenous health, an Aboriginal medical doctor and researcher gave a presentation on epigenetics during which they showed a slide that said precision medicine (including epigenetics) was "reductionism gone mad." They put up another slide which showed a graphic of a funnel with a double helix sitting at the smallest part of the funnel (the point of the V). This was a visual representation of how genomics squishes everything down, and zooms everything in, until the entire context, history, and complexity of social and human life is all fixated upon the gene. They then showed another slide where the funnel had become an hourglass – there was an opening up of the 'V', with a question mark alongside it. The following is an excerpt from a talk by the same researcher in 2020, which

<Author 1> also attended, and which used the same graphic and slide. The researcher began joking about “the omics of everything”:

> Your genomics, your epigenomics, your transcriptomics, your metabalomics ... I’m just gonna make up some stuff – we've now got the Indigenomics. We’re gonna Indigenize genomics. Why? Because we [Indigenous people] can recapitulate the whole. We’ve always understood what it means to be broader than the small, tiny pieces that make us up. Who’s gonna do that for us? We’re gonna understand the sub-molecular understandings of how our body works – who’s gonna understand how this operates within an ecosystem? Aboriginal people can help you.

Here, the reductionist issues with epigenomics and post-genomics more broadly are acknowledged and critiqued (“reductionism gone mad”), but the researcher does not reject epigenetics because of this, and instead contends that Aboriginal people can push back against reductionism – they can open the funnel back out again. Writing on the research stream of ‘precision public health’ or PPH, Martha Kenny and Laura Mamo report on the use of a similar aspirational metaphor; ‘PPH, when fully realised, will ‘telescope down’ into the genome, microbiome and epigenetic profiles of individuals and then ‘telescope back out’ to look at family, community and larger social/environmental contexts’ (2020: 192). In both contexts, the intention to telescope back out to the larger social context is positioned as an antidote to reductionism, and in the Aboriginal researcher’s talk, it is positioned not only as a necessary step to counter reductionism, but one which Indigenous peoples are well-versed in and ready to enact, as seen in the phrase “Aboriginal people can help you”. If epigenetic studies are designed and communicated in ways that counter reductionism, as this researcher suggests, could epigenetics ‘allow us to temporarily beat him [the master] at his own game,’ to extend Lorde’s metaphor?

Another interview participant and Aboriginal doctor, who had extensive experience engaging with policymakers, highlighted the question of timescales. In our interview, he said, “I don’t think epigenetics has really been picked up a lot in policy, et cetera, yet. I mean I don’t think it’s going to be that – I don’t think governments particularly like long-term kind of solutions and these kinds of approaches” (Interview 12). This doctor talked about epigenetics as something that can make a difference, not in regard to scientific studies and scientific knowledge production necessarily, but in regards to making immediate and hopefully longer-lasting changes in the contexts in which he works. For example, he described how his own research and interest in environmental epigenetics, toxic stress, allostatic loads, and the ACE's study helped him to reorient the programs being offered at an Aboriginal Medical Service. He said,

> So, look, the hard thing here was like, you know, I was a senior medical officer there, and so I was running quite a few doctors and specialists and a whole lot of RNs (Registered Nurses), a big antenatal program. But what I did there - and, honestly, most people there didn't know what I was talking about. So it wasn't a matter of convincing anybody. It was just a matter of reshaping things. So what ended up there was that we kind of had a very big early childhood kind of antenatal approach. It was much bigger than the chronic disease and everything else, you know. So it looked a bit out of whack in that sense, but that was the way that I wanted it to go. So in some ways you just kind of design programs around people. They might not know exactly that they're involved, but they're involved. It's sometimes easier to do that than trying to convince everybody about doing things a certain way. (Interview 12)

Here, *existing* scientific knowledge about potential epigenetic mechanisms and the importance of early life was satisfactory enough for this doctor to make important changes to the Aboriginal Medical Service, even though "most people there didn't know what I was talking about". What is important here, is his further comment that he was not invested in "convince[ing] anybody", but rather his commitment was much more pragmatic. Does this represent a push against colonial unknowing? As Watego writes on Black living as survival, 'it is a survival that demands we re-arm ourselves not with new knowledge, but the old knowledges grounded in our ways of knowing, being and doing' (2021: 210). Similarly to Watego's focus on survival, the doctor quoted above is not trying to convince anyone of epigenetic 'facts.' He is not advocating for more research studies of Indigenous peoples' epigenomes, and is not even particularly hopeful that epigenetic knowledge will make its way into policy any time soon. But he is doing work and making changes in his community of practice anyway, changes that are influenced by the conceptual frame of epigenetics and early development, and motivated by what he knows to be conducive to survival, not motivated by the making of new knowledge. He is not placing hope in or importance on scientific knowledge *production* (this idea of perpetual rediscovery), but rather in scientific knowledge *application*.

For Audre Lorde, the notion of minimal change when using the master's tools is only frightening 'to those [people] who still define the master's house as their only source of support' (1984: 112). This illuminates a key difference in relation to our diverse participants' orientations to epigenetic knowledge as something which can bring about change. Those whose 'source of support' is primarily the lab, the scientific research community, or the university seem most enthusiastic about the potential of epigenetics. Those whose sources of support come from health services, lived experience, and/or community engagement seem to take a much more pragmatic or strategic approach to what epigenetics could do for Indigenous peoples, and how. In previous work, we have highlighted how many Indigenous researchers and health workers forge a postcolonial postgenomics by weaving epigenetic theories with Indigenous ontologies of personhood, to emphasise the circular temporalities and expansive notions of personhood that characterise both knowledge traditions (Warin et al. 2022). The trojan horse approach considered here represents another strategy by which Indigenous researchers engage epigenetics to the ends of survivance, twisting a logic of rediscovery to focus on application, and continually telescoping out to broader environments and ongoing racism.

Conclusion

This article has explored the complexities that arise through a scientific desire to capture complexity itself. As an increasingly popular prism through which to view intergenerational trauma among Indigenous communities, epigenetics operationalises the complex social histories and embodied experiences of trauma through particular optics and temporalities. Namely, the trauma of colonisation is imagined through a molecular or chemical prism, and with reference to the bounded temporality of 'events' that can be studied. Such reductionism has implications not only for methods of epigenetic knowledge production, but also for the positioning of such knowledge as a persuasive form of evidence that may confer additional legitimacy to forms of knowledge already established via non-genetic means. The result can be the perpetuation of forms of colonial unknowing, by masking the productive force of epigenetic knowledge production, as something that does not simply reiterate accounts of intergenerational trauma, but remakes these accounts via biological and molecular means. The practices of Aboriginal medical doctors represent one alternative: here, acknowledging the risks of predominant epigenetic research methods while seeking to apply such knowledge strategically is a trojan horse strategy, selectively drawing on the desire for biological evidence while maintaining a focus on Indigenous accounts of survival.

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Conclusion

For many years now, life scientists and social scientists have been asking similar questions of environmental epigenetics and transgenerational epigenetic inheritance in humans – Is it even a real thing? Is it full of change-making postmodern potential, or it is the latest form of neoliberalism and biological determinism in disguise? People have asked me variations of these questions at conferences, after seminar presentations on my PhD, on Zoom calls and at house parties when I am asked what my PhD research is about. When I'd reluctantly give an answer, 'It's about epigenetics', I'd usually be asked two questions – is it real? And is it good or bad? Throughout the course of my research, however, I realised that my thesis isn't really about epigenetics, and these aren't really the questions to be asking. This is not a thesis about epigenetics and trauma, rather it is a thesis about how epigenetics is made intelligible as evidence of trauma. And the questions to be asking are not 'is this thing real?' but 'what are the conditions under which this thing is becoming knowable as evidence? And for what reasons? To serve what purposes?'

In Australia at least, starting from this position and asking these questions can take us much further than starting with transgenerational epigenetic inheritance and asking if it is real, or good, or bad. I argue that starting with evidence and asking questions about how it is made, who is doing the making, who is invested in this making and who is contesting it, can take us closer to a 'somewhere', to echo Smith and Bolnick's provocation of how we might, as STS scholars, 'centre situated perspectives and embodied knowledges as a way to get "somewhere"?' (2019: 465). Informed by Mol's ontological politics (2002) and Lancaster and Rhodes' conceptualisation of evidence as a 'situated achievement' (2022), throughout this thesis I have approached trauma, environmental epigenetics, and biological evidence of harm in bodies and in lands, as objects that are always in-the-making through different practices and enactments. Rather than positioning intergenerational trauma as a stable object onto which environmental epigenetics can be mapped, I have sought to open up the enactments, contestations, and tensions that occur when these objects push up against each other. I argue that the primary tension is that while biological evidence of trauma and harm can make the impacts of colonial histories visible in the present, it can also render them invisible by reducing complex and ongoing social and political processes to molecules in bodies. While making trauma legible through biology can lend it epistemic legitimacy, mobilising knowledge on colonial harm only through biology can reify biological harm as the only form of evidence that has validity in a settler colonial state. Can this be done differently? Can science and biology be used as evidentiary tools to demonstrate legacies of colonial harm without reductionism, without ontological flattening, and without reinforcing deficit discourses? Some participants of this study have pointed to ways in which they can – through reframing epigenetic study designs through hope, and through strategically applying current epigenetic knowledge without calling for further, perpetual research – while other participants of this study have turned away from the allure and pull of epigenetic evidence altogether, and ask not how future epigenetic research can be done differently, but why it is needed at all when other forms of knowledge are not only available, but also readily applicable in the present? At the heart of these tensions are questions of what counts as evidence in a settler colonial state such as Australia, and whose evidence is made to matter. For social scientists and life scientists who engage with epigenetics and trauma, especially in relation to intergenerational transmission and notions of inheritance, deeply considering how their work contributes to hierarchies of evidence production in settler colonial settings is an important and necessary step. Asking ourselves if our research is engaging with knowledges around trauma and inheritance in ways that are reductive, and considering why, could lead to research that is more respectful of diverse knowledges and that is expansive instead of reductive. I have attempted to demonstrate throughout this thesis that the process of asking questions about how evidence is made, across time and across different epistemic communities, makes the work expansive.

To explore these questions across this thesis, I first detailed my methodological approach in chapter one. I used a multi-object and patchwork ethnography approach, bringing collaborative online interviews, online observation of scientific conferences, ethnographic fieldwork, and archival research into conversation with each other to form an archive of emergent knowledges (Günel, Varma & Watanabe, 2020; Yates-Doerr, 2015). In the midst of border closures and restricted movement during COVID-19, I also incorporated questions of boundaries and borders into my research, and was led by conversations with Karina to study concepts of exposure, trauma, biology, and inheritance through a longer and more expansive lens than just the contemporary emergence of environmental epigenetics. I thus folded a study of radiation exposure from Australia's history of British nuclear testing on Anangu lands into my study of environmental epigenetics, in order to demonstrate that the privileging of the biological has long been intertwined in matters of evidence production when it comes to Indigenous health in Australia.

In chapter two, I traced how trauma came to be known as an important yet complicated concept in Indigenous health spaces. From PTSD to complex trauma, historical trauma to collective trauma, and intergenerational trauma and the development of the Social and Emotional Wellbeing model, I argue that while concepts of trauma were originally and explicitly used as forms of evidence that could make the collective impacts of colonial violence visible, they have increasingly become decontextualised and individualised, rendering the colonial conditions of harm they originally made visible invisible instead. Trauma, as I demonstrate in this chapter, is a complex and multiple object, and this needs to be kept at the forefront of engagements with biological models of trauma such as epigenetics. In chapter three, I introduced environmental epigenetics as related to trauma, highlighting particular concepts that participants named as unique to epigenetics – plasticity, reversal, and transgenerational epigenetic inheritance. These key concepts are intimately linked to the rise in popularity of environmental epigenetics as an explanatory model for intergenerational trauma in Indigenous contexts. In this chapter I traced how different actors, including social scientists, enact epigenetics in multiple ways through hype, fascination, and assertions that environmental epigenetics is uniquely different to other forms of knowledge on inheritance.

In chapter four, I examined how the key concepts of epigenetics introduced in the previous chapter, particularly reversal, are crucial to some participants' understandings of epigenetics as a hopeful and expansive form of evidence, despite it being bio centric. I first used ethnographic observation from a Developmental Origins of Health and Disease conference to demonstrate how three different presentations approached the question of measuring harm in the body in ways that moved from damage-centred research (Tuck, 2009; Fogarty et al., 2018) to strengths-based research. Noting that some participants were concerned about the focus on damage in epigenetic studies, I detailed how they engage concepts of reversal and change to orient their studies towards measuring 'positive' protective factors, such as resilience, which they believe will provide hope. However, in this chapter I also raised tensions around the limits of this hopeful construction of epigenetics, as some participants challenged the narrative of epigenetics as uniquely positioned to provide hope, and instead reinforced that the interventions that they understand as being most crucial to supporting Indigenous livelihoods in the present are already well-known, well documented, and are not in need of validation through epigenomic frames.

In chapter five, I returned to Karina's family's experience of radiation exposure during the British Nuclear Testing Program in Australia, and used archival material from the 1984-85 Royal Commission into British Nuclear Testing in Australia to extend my research on what happens when legacies of harm in the body are made to matter through biological evidence to also explore what happens when land is understood through similar frames. In this chapter, I connected the recent valence that biological evidence has taken on in relation to intergenerational trauma and epigenetics to a longer history of attempts to mobilise biological evidence to make the legacies of colonial harm in Australia known. During the Royal Commission process, scientific evidence was both highly privileged and highly elusive. I demonstrate in this chapter that when the lands on which nuclear testing occurred were understood solely through damage, it reinforced rather than challenged colonial views that these desert homelands were uninhabitable and undesirable, opening up a recursive situation in which making lands and bodies known through scientific evidentiary frames of harm can be used to deny capacities for healing and recovery, and can uphold the epistemic power of such evidence.

In chapter six, an article manuscript co-written with Jaya, we used the concept of colonial unknowing (Vimalassery et al., 2016) to interrogate some participant's understandings of epigenetic evidence as a form of evidence that will be listened to in ways that other knowledges on trauma have not been. We demonstrate in this chapter that some participant's understandings of epigenetics as something that simply uncovers or reveals biological evidence of trauma does not pay adequate attention to the ways in which epigenetic studies, in their current forms, remake and reassemble trauma through narrow frames of a singular, 'clean' trauma 'event'. In this chapter, we demonstrate that rather than revealing evidence which was ready to be 'picked up and used' (Lancaster and Rhodes, 2022), epigenetics studies are bringing evidence of a certain form into being. We argue that perpetually producing more evidence of certain, desired forms, can be understood through colonial unknowing as a process of repeatedly appealing to the concepts of evidence that the settler colonial state deems valid, and thus allowing the state to retain the power to reject this evidence all the same.

Moving across sites and across evidentiary spaces, this thesis has extended current scholarship on trauma, environmental epigenetics, and the production of scientific evidence by telling stories grounded in Australian histories and Australian presents. When I was first encouraged by Karina to include a study of the legacies of British nuclear testing into my research on contemporary knowledge production in environmental epigenetics, I was unsure of how these two stories could speak to each other. However, when I went to Wallatinna, and walked through the sand dunes where her father lived when the first mainland bomb was test exploded, and sat with her at night with my tape recorder, and listened to her talk about her land and her family, it all became clear. What I was experiencing in Wallatinna was a form of storytelling about the impacts of harm on Indigenous bodies and communities across time. And environmental epigenetics too, is a form of storytelling. These stories, these knowledges, both present narratives of inheritance, of porous bodies and borders, of exposures to harms and forms of violence that become known and felt under the skin. Yet both of these stories, in their telling, also invite a questioning of the focus on narratives of damage in Indigenous bodies and Indigenous health spaces. In Wallatinna, this questioning was represented to me by the orange tree in Karina's yard. This tree, whose leaves had once shrivelled upon exposure to radiation, was now bearing fruit, and Karina was moved by how well her land had healed. In epigenetic knowledge production in relation to Indigenous health, this questioning is represented by the participants I spoke with who challenged the privileging of the idea of epigenetic inheritance of suffering, and instead spoke of the importance of community action in the present in order to make knowledges of survival and resistance more known, more felt, in the future.

By working in collaboration with other scholars and with research participants from diverse disciplinary fields – lab science, medicine, psychology, social work, therapy, midwifery – and by working with Karina's provocation to bring an examination of the legacies of nuclear testing in Australia together with an examination of the contemporary emergence of environmental epigenetics research in this place, I have presented a collaborative and interdisciplinary piece of work which does not shy away from complexities, contestations, and tensions, but rather uses these sites of ambiguity as avenues through which to explore the production of evidence on, and the knowability of, colonial harm in Australia.

Appendices

Appendix 1: Participant information sheet

PARTICIPANT INFORMATION SHEET

PROJECT TITLE: Exploring epigenetics in response to intergenerational trauma in Indigenous Australia
HUMAN RESEARCH ETHICS COMMITTEE APPROVAL NUMBER: H-2020-086
PRINCIPAL INVESTIGATOR: Professor Megan Warin
STUDENT RESEARCHER: Henrietta Byrne
STUDENT'S DEGREE: PhD candidate in the Department of Sociology, Criminology and Gender Studies

Dear Participant,

You are invited to participate in the research project described below.

What is the project about?
This project will explore the recent rise in interest in epigenetics in Indigenous Australian contexts. It will explore the social, cultural, and political implications of using discourses of epigenetics to understand and try to respond to intergenerational trauma in Australia. This research will further understandings of how discourses of epigenetics are intersecting with concepts of trauma, wellbeing, and healing amongst Aboriginal and Torres Strait Islander peoples in Australia. The growing popularity of 'epigenetics' – a relatively new scientific concept which blurs the boundaries between DNA and environment – raises vital questions surrounding how trauma, healing, and race intersect with scientific and bodily understandings of suffering. The expected outcomes of this work include greater awareness of the impact that epigenetic discourses may have on conceptions of race and settler colonialism in Australia, and an informed understanding of the potential policy implications of epigenetics.

Who is undertaking the project?
This project is being conducted by Henrietta Byrne. This research will form the basis for the degree of PhD at the University of Adelaide under the supervision of Professor Megan Warin, Dr Georgina Drew, and Dr Bastien Llamas.

Why am I being invited to participate?
You are being invited to participate in this project as you are a researcher or service provider involved in the life sciences, Developmental Origins of Health and Disease, and/or Indigenous healing and trauma research/advocacy in Australia.

What am I being invited to do?
There are two activities which you are being invited to do – you do not have to give consent to do both as you may prefer to do one and not the other. The first is to consent to the student researcher undertaking ethnographic observation. This means observing at an event/conference/work space where you are working with and talking about trauma and epigenetics. This will not change your usual routine at all, as the research student will just be observing. During observation the researcher will take handwritten notes.

The second activity is a semi-structured interview with the research student. This interview will take approx. 30-60 minutes of your time. The interview can be in person, or via video call if you prefer. It can take place in a location of your choosing. The interviewer will take detailed notes of the interview, and will also record the interview with an audio recorder if you give consent for this (it does not have to be recorded).

How much time will my involvement in the project take?
The ethnography component of this study will not impact your usual routine. If you choose to participate in an interview, this will take between one to two hours of your time. The student researcher may request some more time to ask you some follow-up questions further on, but again this would not take more than 30-60mins of your time.

Are there any risks associated with participating in this project?
The researchers do not foresee any risks associated with the ethnographic observation component of this project. However, as the interviews will cover discussion of intergenerational trauma, it is possible that you might experience emotional distress or discomfort when talking about this. Should you experience any distress before, during, or after an interview, we encourage you to refer to the possible support contacts at the end of this information sheet.

What are the potential benefits of the research project?
This research may have benefits for researchers, practitioners, and policy makers working to understand the potential uses and risks of using epigenetic discourses to respond to intergenerational trauma in Indigenous Australian contexts. The project will offer a detailed analysis of the implications of epigenetic science for Aboriginal and Torres Strait Islander peoples experiencing collective trauma as this science emerges, not afterwards. Given that interest in epigenetics is growing so rapidly, this is timely research which may help policy makers and researchers to engage with epigenetic discourses in an informed way in the future. The researchers note that there are no immediate benefits to you specifically if you choose to participate.

Can I withdraw from the project?
Participation in this project is completely voluntary. If you agree to participate, you can withdraw from the study at any time up until the verification of transcripts for interviews, or up until the completion of data analysis from the ethnographic observation.

What will happen to my information?
Confidentiality and privacy: Unless you want us to use your name, your participation in the project will be anonymous. While all efforts will be made to remove any information that might identify you, as the sample size is small, complete anonymity cannot be guaranteed. However, the upmost care will be taken to ensure that no personally identifying details are revealed.
Storage: The researchers will store paper and electronic materials in the University of Adelaide's secure network system. They will be stored for a minimum of five years after completion of this project, and will

only be accessible by the principal investigate and research student. Publishing: Findings from this project will be published in the research students PhD thesis, and may also lead to publications such as journal articles and conference presentations.
Sharing: You can request to review the materials pertaining to your participation at any time, such as transcripts from interviews, and the student researcher will arrange this. If you give 'extended consent' to participate in this project, the data collected may be used to inform future research and publications by the same researchers on similar themes.

Your information will only be used as described in this participant information sheet and it will only be disclosed according to the consent provided, except as required by law.

Who do I contact if I have questions about the project?

You can contact any of the researchers listed below at any time to talk or ask for more information about the project.

You can reach **Professor Megan Warin** at
megan.warin@adelaide.edu.au
(08) 8313 4864

You can reach the student researcher, **Ms Henrietta Byrne** at
henrietta.byrne@adelaide.edu.au

You can also contact the co-supervisors for this project:

Dr Georgina Drew
georgina.drew@adelaide.edu.au
(08) 8313 5095

and **Dr Bastien Llamas**
bastien.llamas@adelaide.edu.au
(08) 8313 0262

What agencies could I contact for possible support?

Blue Knot: 1300 657 380
Free helpline for supporting recovery from past trauma.

Employee Assistance Program: https://eapassist.com.au
Connects employees with immediate counselling support
Nunkuwarrin Yunti Health Service: (08) 8406 1600
RECEPTION will be able to refer the participant for
long term counselling and support (SA based)

You can also contact the researchers (contact details above) who will assist with directing you to relevant local support agencies.

What if I have a complaint or any concerns?

The study has been approved by the Human Research Ethics Committee at the University of Adelaide (approval number H-2020-xxx). This research project will be conducted according to the NHMRC

National Statement on Ethical Conduct in Human Research 2007 (Updated 2018). If you have questions or problems associated with the practical aspects of your participation in the project, or wish to raise a concern or complaint about the project, then you should consult Professor Megan Warin at megan.warin@adelaide.edu.au or on (08) 8313 4864.

If you wish to speak with an independent person regarding concerns or a complaint, the University's policy on research involving human participants, or your rights as a participant, please contact the Human Research Ethics Committee's Secretariat on:
Phone: +61 8 8313 6028
Email: hrec@adelaide.edu.au
Post: Level 4, Rundle Mall Plaza, 50 Rundle Mall, ADELAIDE SA 5000
Any complaint or concern will be treated in confidence and fully investigated. You will be informed of the outcome.

If I want to participate, what do I do?
If you would like to be involved in this project, please talk to the research team about completing an informed consent form. The researchers will talk you through the consent form and answer any questions you might have.

Yours sincerely,

Professor Megan Warin
Ms Henrietta Byrne
Dr Georgina Drew
Dr Bastien Llamas

Appendix 2: Consent form

Human Research Ethics Committee (HREC)

THE UNIVERSITY of ADELAIDE

CONSENT FORM

1. I have read the attached Information Sheet and agree to take part in the following research project:

Title:	**Exploring epigenetics in response to intergenerational trauma in Indigenous Australia**
Ethics Approval Number:	**H-2020-086**

2. I have had the project, so far as it affects me, and the potential risks and burdens fully explained to my satisfaction by the research worker(s). I have had the opportunity to ask any questions I may have about the project and my participation. My consent is given freely.

3. Although I understand the purpose of the research project, it has also been explained that my involvement may not be of any benefit to me.

4. I agree to participate in an interview as outlined in the participant information sheet
☐ Yes ☐ No

5. I agree to be audio recorded ☐ Yes ☐ No

6. I understand that I am free to withdraw from the project at any time until the verification of transcripts for interviews.

7. I have been informed that the information gained in the project may be published in a journal article/thesis/conference presentations.

8. I have been informed that while I will not be named in the published materials unless I wish to be named, it may not be possible to fully guarantee my anonymity given the nature of the study and/or small number of participants involved.

9. I request and give consent to be named in published materials ☐ Yes ☐ No

10. I agree to my information being used for future research purposes by the same or other researchers in the project team Yes ☐ No ☐

11. I understand my information will only be disclosed according to the consent provided, except where disclosure is required by law.

12. I am aware that I should keep a copy of this Consent Form, when completed, and the attached Participant Information Sheet.

Participant to complete:

Name: ______________________ Signature: ________________________ Date: __________

Researcher/Witness to complete:

I have described the nature of the research to _______________________________________

(print name of participant)

and in my opinion she/he/they understood the explanation.

Signature: ___________________ Position: _________________________ Date: __________

Appendix 3: Interview schedule

Indigeneity & epigenetics project: interview questions
Hetty & Jaya 2020

1. Can you tell us about your current work and your career trajectory?
2. What do you understand by the term DOHaD and/or epigenetics? How do you engage with epigenetics in your work?
3. How do you think epigenetics is perceived by others in your field or related fields? How about the public appeal?
4. How do you navigate the significant interest in epigenetics research? Public interest? Commercial interest?
5. Do you think that DOHaD and/or epigenetics have any connection to Aboriginal and Torres Strait Islander knowledges/ways of being
6. How did you first get interested in the applications of epigenetics research for Indigenous communities? Do you think this has broader interest among your peers?
7. Is trauma an important concept in your work? What does the concept mean to you?
8. What to you are the similarities and differences between epigenetics and intergenerational trauma?
9. Do you think resilience has a role to play in studies on epigenetics?
10. Do you think research on epigenetics with Indigenous communities would look different to your previous work with different cohorts? Would it change the way that research is done with Indigenous communities?
11. How might epigenetics be explained in a meaningful way to community members?
12. Do you think there is a positive story to use with epigenetics – in that epigenetic processes could counteract the effects of trauma?
13. Do you see any negative consequences around epigenetics (e.g. biological essentialism)?

Appendix 4: Coding index

Agency
Bodies
- Biological samples
    - Blood
    - Saliva
    - Sperm
- Markers
    - DNA methylation markers
- Bodily memory

Behaviour/lifestyle
Blame
Blood
Care
Chronic disease
- cardiovascular disease
- diabetes

Children
- Adverse childhood experiences
- Education
- Grandchildren

Colonisation
- Child removal

Country
Culture
- and well-being

DOHaD
- low birth weight
- development

Environments
- As exposures
- In-utero
- as place
- enrichment of

Epigenetics
- Affecting the brain
- And environments
- Commercialisation
- Communicating epi
- Determinism
- Disagree with epi
- Don’t know what it is
- Epigenetic hype
- as distraction

Intervention
- environment
- as emerging
- as harmful
- Representations of:
    - Another language
    - As validation
    - Too complex
    - Needle in a haystack
    - Plasticity
    - Popular representations
- Reversal
- Stress

Ethics
- Biological samples
- ELSI implications
- Sensitivity of epigenetics
- HREC protocols

Evaluation of epigenetics
Evidence
Exposures
- Colonial histories
- Child removal
- Smoking
- Diet and exercise
- Social environments
- Socioeconomic status
- Stress
- War

Family/ies
- Strengthening families

Fathers
Genetics
- Detriment
- Distrust

Healing
- Healing our spirit

Healthcare system
- Birth

History
Holocaust
Hope
- No hope
- Reversal as hope

Incarceration
- prison

- Inheritance
  - Trauma ‘passed on’
- Knowledge
  - Emerging
  - Hierarchy of knowledge
  - Different kinds of knowledge
  - Indigenous wisdom
  - Medical knowledge
- Media
- Measures
  - Psychological measures
  - Epi hard to measure
  - Epi as a measure
- Memory
- Mothers
  - Blame
  - Maternal effects
- Nutrition
- North America
  - US
  - Canada
- New Zealand
- Potential
  - Hope
- Policy
- Power
  - Feeling helpless
  - agency
- Pregnancy
  - pre-natal
  - antenatal
  - post-natal
- Programs/practice
  - Epi ‘hard to sell’
- Rachel Yehuda
- Racism
  - And health
  - Internalising racism
- Research
  - as service delivery
  - as increasing information
  - researcher as novice
  - researcher as activist
  - Importance of inclusion
  - Importance of Indigenous leadership
- Resilience/Strength
- Responsibility
- Reversibility
- Risk
  - Environment as risk factor
- Science
  - fundamental
  - applied
  - as proof/evidence
- Social emotional wellbeing
  - mental health
- Stress
  - cortisol
  - Toxic stress
  - Allostatic load
  - HPA axis
- Suicide
- Temporality
- Tension
  - Explaining and improving
  - Individual and social context
  - biological vs social
- Trauma
  - Accumulation of
  - Affecting the brain
  - Collective trauma
  - Complex trauma
  - PTSD
  - Adverse childhood experiences
  - Everydayness of trauma
  - Intergenerational trauma
  - Trauma-informed
  - Layers of trauma
- Transmission
  - of trauma
  - Intergenerational
  - Transgenerational
  - Historical memory
- Violence
  - Lateral violence

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