100% toxic: A review of the environmental history of toxins and toxicity in Aotearoa New Zealand

ANTON SVEDING

Over the last three decades, scholars have produced a large body of work showcasing how people have engaged with the environments of Aotearoa New Zealand culturally, politically, intellectually, and economically. This diversity in perspective is perhaps best exemplified by the 2002 anthology *Environmental Histories of New Zealand* edited by Eric Pawson and Tom Brooking, and of which a new edition, *Making a New Land: Environmental Histories of New Zealand*, was published in 2013.[1] Nevertheless, there remain perspectives largely absent in New Zealand environmental historiography. Foremost among them are matters of toxins and toxicity. Indeed, while the Waitangi Tribunal has shed light on the impacts of toxins in some of its reports, for example how sewage discharge and industrial waste have polluted traditional fishing grounds, scholarship conducted outside the Waitangi Tribunal has been largely limited to expose the hypocrisy of marketing slogans like "100% Pure New Zealand" by showcasing how agricultural and industrial practices have polluted and continue to pollute lands, lakes and rivers.[2]

In contrast to the limited research on the history of toxins and toxicity in New Zealand, the field is flourishing internationally. This includes studies of the uses and risks of pesticides, the global circulation of toxins, most notably dichlorodiphenyltrichloroethane, commonly known as DDT, attempts at defining toxicity and regulating toxic exposure, questions of expertise and the role of various agencies such as corporations, state departments and international institutions as well the injustices suffered by people unknowingly exposed to toxins.[3] Drawing upon international trends and scholarship, this review article brings together different sources in conversation and outlines directions to investigate toxins in New Zealand following British colonisation in 1840, up to the present day. Because of limited space, this review article will primarily focus on the environmental history of toxins. However, it is important to note that scholarship on toxins, like the toxins themselves, transcends boundaries and often overlaps several disciplines, including environmental history, legal history, history of science, and medical history.[4] Second, the article does not discuss the use of toxins or poisons in mātauranga and tikanga Māori, partly due to the author's lack of knowledge, but most notably because the subject deserves its very own article.

This review article is divided into three parts. The first segment covers 1840 to 1945, examining how rising toxicological concerns expanded investigations of the harmful effects of toxins to include matters of pollution as well as food adulteration and contamination. The second section covers the postwar period, showcasing how the rise of new synthetic pesticides, together with new ideas and understandings of the environment, resulted in new toxicological practices as well as new perceptions of toxicological risks. The final part, in turn, explores some of the methodologies scholars have developed to approach toxins and their effect on humans, more-than-humans, and different environments.

Pollution, adulteration, and contamination in New Zealand, 1840-1945

During the nineteenth century, toxic substances such as arsenic, mercury and lead, served a variety of purposes in the British Empire, including New Zealand. Arsenic, for example, was employed by farmers, doctors, and taxidermists, among others. Lead, particularly white lead or lead carbonate, constituted a standard ingredient in paint while mercury (quicksilver) was

Journal of NZ Studies NS40 (2025), 36-49 https://doi.org/10.26686/jnzs.iNS40.10441

used in mining. The circulation of these and other toxins sparked real and imagined public scares of succumbing to poisoning. Toxicological concerns had previously been limited to the courtroom, with toxicologists playing a major role as experts in cases of suspected poisoning, David Arnold notes how the prevalence of toxins resulted in "a new language of toxicity" which, in addition to homicide and suicide, came to encompass "adulteration, contamination and pollution".[5] Although Arnold focuses on India, a similar development occurred throughout the British Empire, with James C Whorton describing the nineteenth century as the "arsenic century" due to the prevalence of the substance and which fuelled fears of poisoning through contamination and adulteration.[6] By drawing upon these expanded languages of toxicity, future research may add to the long history of toxicological concerns in New Zealand.

At the start of the industrial revolution, puffing chimneys heralded prosperity and urbanisation. Ben Schrader notes how the expression "the big smoke", a term used for London, became a common expression for New Zealand cities as they "grew to better resemble the imperial metropolis".[7] According to Schrader, this description was either "aspirational – or ironical."[8] Regardless of which, both suggestions ignore concerns such as those expressed by the anonymous "Carbon", a Londoner-turned Aucklander in a letter to the editor in 1870: "The air is poisoned by the foul sulphurous vapour, the dwellings are disfigured, and as it insinuates itself through every crevice, and pours into every opened window".[9] Complaints such as those voiced by "Carbon" may serve as a useful example of how settlers carried with them urban "environmental anxieties", to use a term developed by James Beattie. As Beattie shows, spurred by romantic ideas, and perceiving farming as the key to human and economic progress, victims as well as beneficiaries of the new coal-fuelled economy migrated to New Zealand and other colonies and countries, only to encounter woes of the old world again in wake of the increasing urbanisation from the 1870s.[10] Whereas Beattie focuses on environmental and health anxieties in relation to deforestation and theories of diseases, his concept can easily be expanded to studies on the smoke nuisance.

By the turn of the century, the anxieties of "Carbon" had become a common concern among public health advocates. "That the emission of smoke from the factory and other chimneys is not only undesirable, but in a measure antagonistic to health will be admitted by most, but it is when we come to suggest a remedy that the difficulty begins" reported Chief Health Officer James Mason in 1904. As a potential means of alleviating the smoke nuisance, Mason recommended either the creation of certain industrial zones or that New Zealand cities adopt similar legislation as cities like Manchester and London which limited how much "black and brown smoke" could be released each hour.[11] The concerns "Carbon" carried with them, and the use of British regulations by Mason as models for New Zealand towns may serve as examples to weave New Zealand into a global history of smoke pollution, with research by Peter Torsheim and Frank Uekötter being particularly valuable. Examining the changing perception of smoke from a sign of progress to an environmental concern in Britian, and the United States and Germany, respectively, Torsheim and Uekötter show how anti-smoke movements transformed ideas of the environment in their campaigns to address smoke emissions through the nineteenth and twentieth centuries, a time marked by rising coal consumption to satisfy domestic and industrial demands for heat and power.[12] While Eric Pawson has discussed smoke pollution in early twentieth-century Christchurch, there is potential for comparative smoke histories during the postwar period through associations like the Clean Air Society.[13] In an interview with the *Press* in 1966, one of its organisers suggested that Christchurch exhibited worse smog than London due to the domestic use of coal rather than wood or coke.[14]

As Pamela Wood shows in her excellent work *Dirt: Filth and Decay in a New World Arcadia*, pollution in nineteenth-century New Zealand was not limited to smoke but extended to physical and moral matters, too. To protect public health, doctors, local authorities and other experts implemented reforms, passed laws and employed poisonous baits, the last to combat rats which were seen as evidence of dirt, germs, and poor living conditions. Insects, however, seldom featured in discussions on health, at least until the turn of the twentieth century and which is where Wood concludes her study.[15] By then, the acceptance of germ theory had resulted in health officials perceiving flies as a menace to the public health, with the Auckland district medical officer warning in 1910 that the common house fly carried diseases such as typhoid, infantile diarrhoea, cholera, and anthrax, to mention but a few.[16] Magazines such as the *Ladies' Mirror*, in turn, carried articles on the dangers of insects and advertisements for flit guns.[17] To uncover how new understandings of insects went from harmless to a public enemy, Dawn Day Biehler's *Pests in the City: Flies, Bedbugs, Cockroaches, and Rats* offers a great introduction to the subject, detailing how entomologists and urban reformers in the United States advocated and propelled the use of pesticides inside the home.[18] By doing so, Dawn Day Biehler adds to the steadily growing body of scholarship on more-than-human histories.[19] Indeed, studies of efforts to combat rats in Dunedin, flies in Auckland, or cockroaches in Wellington are bound to present new perspectives on urban New Zealand and its entanglement with the "wild" which so far have tended to focus on swamps and malarial carrying insects.[20]

From the 1860s to the early 1900s, New Zealand parliaments passed several food adulteration laws and amendments, reflecting the widespread concern of adulterated foods and drinks.[21] However, only recently has food adulterated with toxic substances received scholarly attention with Greg Ryan's work on beer and brewing and an MA thesis by Pauline Ireland-Kenny on milk supply, both of which briefly discuss the topic.[22] Here, future investigations may draw upon international scholarship showcasing how the use of chemicals by farmers, grocers, and manufacturers led to the establishment of regulatory bodies to ensure pure food, or at least food free from dangerous chemicals.[23] Studies of specific foods, like milk, may also present new knowledge into the relation between science, ideas of health, and pure food legislation.[24] Another possible venture is placing New Zealand food adulteration laws in an imperial or global context, with food adulteration potentially an exciting field for comparative studies.[25]

Closely related to adulteration was the matter of contamination, with the question of what constituted safe levels of contamination in food, but also other areas of life, becoming subjects of inquiry by toxicologists. As a large body of research has showcased, during the early decades of the twentieth century, toxicologists and various reformers increasingly shifted from focusing on acute toxicity to long term exposure in a range of issues from occupational health to food consumption.[26] In addition to highlighting changing perceptions of toxicity, studies of contamination also offer a window into everyday uses of toxins. For example, in 1925 a family in England succumbed to arsenic poisoning after eating American apples sprayed with arsenic pesticides, an incident which generated headlines even in New Zealand.[27] Questioned about the danger of consuming apples sprayed with arsenic, the government orchard inspector doubted that the sprays were at fault given the strictness of the manufacturing process. More importantly, he advocated for the continuous use of arsenic pesticides since they were the only reliable tool against pests like the codling moth.[28]

As Michael Roche notes in his study of the early twentieth-century apple industry in Nelson, arsenic pesticides were readily employed by orchardists to combat pests.[29] Thus, drawing upon fears of contamination enables the study not only of toxicological concerns, whether voiced by the public or scientists, but also how some scientists and organisations defended the use of,

even arguing for, the safety of toxins. Like with food adulteration laws, spraying may also be placed in an imperial context with one New Zealand-based entomologist proposing the exclusion of American apples in the United Kingdom to promote apples from Australia, New Zealand, or other corners of the Empire.[30] Indeed, there are possibilities to expand upon the recent *Selling Britishness: Commodity Culture, the Dominions, and Empire* by Felicity Barnes which examines how Australia, Canada, and New Zealand constructed a shared British identity in marketing their produce.[31]

Toxic risks and the New Zealand environment, 1945-1980

During the postwar period the word 'environment' developed into a concept detailing the interconnection of life as well as how human actions affected it. Accompanying the notion of the environment was the environmental movement.[32] Born out of social and political movements, early postwar environmentalism largely shifted from focusing on scenery preservation to how humankind's attempt to control the environment with technology exposed humans and non-humans to new toxic risks.[33] In New Zealand, the emergence of the environment as a concept and the rise of environmentalism is deeply entwined around forest preservation and the expansion of hydropower, an issue epitomised in the Save Manapouri Campaign in the 1960s. As David Young notes, the campaign served as a catalyst for "a new breed of conservationists" fuelled by domestic and international social issues, among them the country's involvement in the Vietnam War and the antinuclear movement.[34] Environmentalism saw the emergence of the Values Party in 1972, and then the Greens in the 1990s.[35] Yet, these and other environmental concerns have so far received limited attention in New Zealand historiography which remains occupied with hydropower and forest preservation and to a lesser extent nuclear energy.[36] Focusing on toxic risks relating to pesticides, nuclear fallout, and pollution, allows for a more comprehensive insight into the emergence of the ideas of the environment and environmentalism in New Zealand and addresses the all too common gap on activities between 1945 and the Save Manapouri Campaign.

While experts and practitioners sought to portray the spraying of arsenic pesticide as safe, it constituted a known toxin with any suspected cases of illness of death causing public alarm as illustrated by reports of the poisoned apples in 1925. During the Second World War and its immediate aftermath, scientists developed and honed an array of synthetic insecticide seemingly harmless to humans but lethal to pests. The most famous of these substances was DDT. Introduced by the United States during the war to halt a typhus epidemic in Naples following its liberation in 1944 and to protect Allied soldiers in the Pacific, DDT excelled in destroying insects. "It was the atomic bomb of insecticides, the killer of killers, the harbinger of a new age in insect control", Thomas Dunlap notes in his study of the pesticide and the controversy which followed Rachel Carson's 1962 *Silent Spring*.[37] Although Dunlap's description has received criticism for overlooking other insecticides, most notably pyrethrum, it does capture the spirit of optimism among scientists of the possibilities offered by DDT in eradicating insect borne diseases and increase crop yields.[38] Indeed, during the early postwar decades farmers across the world used DDT.[39]

In New Zealand, DDT quickly captured the imagination of scientists, with Ross Galbreath showing how the Department of Industrial and Scientific Research regarded it as a prominent tool against grassland pests during the 1950s. The potential of DDT was echoed and reinforced through articles and advertisements in the *New Zealand Journal of Agriculture*, as one advertisement for Trimort Wettable DDT informed potential customers in 1953. "Here is a new garden spray that is certain death to insect pests. Easy to prepare, safe and economical. Just half a tablespoon makes a full gallon of most effective spray." Indeed, the company noted that

Journal of NZ Studies NS40 (2025), 36-49 https://doi.org/10.26686/jnzs.iNS40.10441

its product could be used against grass grubs, white butterflies, caterpillars, green vegetable bug, diamond back moth, brown beetle, codling moth and citrus leaf roller, to mention but a few. Adding scientific authority to its claims, the company noted that its product was certified by the Plant Diseases Division.[40] However, the indiscriminate destruction of insect life, including species perceived as valuable, together with an increasing resistance to the insecticide among pests, resulted in entomologists abandoning DDT in the 1960s in favour of integrated pest management.[41] Drawing upon Galbreath, Lesley Hunt expands the story of DDT in New Zealand by showing how residual concerns resulted in the Meat Producers Board and the Agricultural Chemicals Board imposing several regulation on DDT in the 1960s and 1970s before its ban in 1989.[42] These two works offers a great starting point for further research on DDT and the advent of synthetic chemicals in New Zealand, in particular regarding the portrayal of science and science communication in journals such as the *New Zealand Journal of Agriculture*. Hunt's article, which detail an incident of a New Zealand meat shipment being rejected by the United States in the early 1960s, also offers a window into further research on how chemical regulations and spraying practices impacted trade. Here, there is potential to combine burgeoning research on the history of chemical residues in food and the work by Felicity Barnes and Jim McAloon on the idea of what "made in New Zealand" entails.[43]

While research on DDT may serve as an excellent case study to highlight the chemicalisation of New Zealand agriculture it was but one of many agrichemicals used during the postwar period. Two other agrichemicals widely employed by New Zealand farmers were the phenoxy herbicides 2,4,5-T and 2,4-D, the main ingredients in Agent Orange. Despite playing a major role in the postwar grassland revolution, during which the numbers of sheep rose from around 30 to 70 million with limited increase in the area farmed, the two herbicides have so far only received nominal attention.[44] This is even more surprising considering that New Zealand manufactured 2,4,5-T until 1988, which by then had been banned in several countries due to the presence of dioxins in the herbicide. As for 2,4-D, it remained in use until 1997.[45] Thus, by moving beyond DDT a focus on other agrichemicals will give a broader understanding of the prevalence of agrichemicals in New Zealand and the toxic heritage of the grassland revolution.

However, it must be emphasised that pesticides, such as DDT, 2,4,5-T and 2,4-D constituted but one element in the success of New Zealand postwar agriculture. As Tom Brooking and Vaughn Wood demonstrate, the grassland revolution also relied on the application of fertilisers.[46] Indeed, contrary to late eighteenth century beliefs that lush vegetation, in particular the height of trees, correlated to fertile soil, New Zealand farmers soon discovered the theory erroneous.[47] Following the acquisition of the phosphate rich islands of Nauru and Banaba, the former from the German Empire in the aftermath of the Great War, New Zealand, together with Australia and Britain, stripped the island to produce superphosphate to fertilise their grasslands while destroying Nauru in the process.[48] To distribute the pesticides and fertilisers, in turn, aviation came to play an ever-increasing but largely overlooked role to which David D. Vail's *Chemical Lands: Pesticides, Aerial Spraying, and Health in North America's Grasslands since 1945* offers a great introduction. Albeit primarily focusing on the United States, Vail briefly discusses aerial spraying in New Zealand and its roles in improving soil fertility and eradicating weeds, with mixtures often containing superphosphate combined with agrichemicals like DDT, 2,4,5-T and, 2,4-D.[49] Thus, there exist possibilities to expand upon Vail's work by investigating how the practice of aerial spraying in New Zealand farming has contributed to the pollution of waterways with dairy intensification. Studies may also examine the role of aerial spraying in other sectors, too, most notably forestry, on which there is a growing body of scholarship in postwar North America and Scandinavia, allowing for comparisons in terms of application, knowledge, and public responses to aerial spraying.[50]

Farmers were not alone in adopting chemicals such as DDT, 2,4,5-T and later Roundup (glyphosate) from the 1970s. Whereas some studies have suggested Roundup as safe, others have drawn links between the herbicide and cancer, neurological diseases and negative effects on the ecosystem. As Matt Morris notes in *Common Ground: Garden Histories of Aotearoa*, the postwar period was "a time of high chemical use in New Zealand's home gardens", with gardeners drawing upon an arsenal of insect- and herbicides influenced by ideas of gardening with the assistance of science. However, there were gardeners who stuck to manual labour or traditional methods to remove unwanted species. Based on oral testimonies, Morris claim that "few New Zealand gardeners caved in to guilt-inducing inducements put forward by horticultural and beautifying societies and industries keen to sell new products."[51] This, he attributes to a general disbelief in the promise of advertised products, their high cost and concern of the risks posed by chemicals to the environment and humans alike, especially among members of the Soil and Health Association and its previous incarnations.[52] At the same time, Morris recognises how Derris Dust, whose safety to humans remains contested with potential links to Parkinson's disease, continues to be heartily employed by New Zealand gardeners.[53] The popularity of Derris Dust may offer a New Zealand perspective on the love story between humans and pesticide, a metaphor employed by Michelle Mart in *Pesticide, a Love Story: America's Enduring Embrace of Dangerous Chemicals* to illustrate how users are smitten by pesticides and how what may appear as love at first sight can turn into a tragedy.[54]

In the history of environmentalism, few people and works hold such prominence as Carson and *Silent Spring*.[55] Indeed, because of its canonical status, scholars have sometimes uncritically emphasised the publication and subsequent translation of *Silent Spring* as a key moment for environmentalism, particularly in Europe.[56] This narrative, however, is increasingly questioned with research highlighting the role of local actors, disasters, and knowledge networks, with scholarship on Carson in New Zealand suggesting that neither the author nor book left a major imprint beyond experts and gardeners.[57] According to Justine Philip, "*Silent Spring* hardly received a review in the local New Zealand papers in the 1960s".[58] However, as Morris shows, Carson's message resonated particularly well among members of the Soil and Health Association who shared the concerns about DDT and other chemicals.[59] The book also caught the attention of advocates of agrichemicals, with research by Hunt, Bruce Wildblood-Crawford as well as Tom Brooking and Vaughn Wood revealing how the book met with dismissal in in agricultural periodicals and by the herbicide manufacturer Ivon Watkins Ltd (from 1964 Ivon Watkins-Dow, and today Corteva Agriscience).[60] This, of course, does not mean that people were unaware of the book: "Certainly those of us who were adolescents in the 1960s knew about *Silent Spring* and had a developing environmental awareness, but we did not know about DDT use in our own country unless we were on farms ourselves", Hunt says.[61] Though anecdotal, Hunt's remarks warrant further exploration on the influence of Carson and *Silent Spring*. Here, future research on major commercial gardening magazines of the period, like *New Zealand Gardening*, which would give further insight into how pesticides were advertised. The value of such magazines is well-exemplified by May-Brith Ohman Nielsen's work on Scandinavian gardening magazines, showcasing how they functioned as arenas for experts to promote the usage of pesticides. Since the finances of these magazines depended on advertisements from pesticide manufacturers—whose products were endorsed by the experts—the journals seldom published any criticism of pesticide usage, such as that voiced by Rachel Carson in *Silent Spring*.[62]

In addition to further research on the impact of Carson and *Silent Spring*, investigations into organisations such as Royal Forest and Bird Protection Society of New Zealand and branches

of international organisations like Friends of the Earth and Greenpeace, is bound to give a deeper insight into of whether and how toxicological concerns emerged in New Zealand.[63] In 1980 the Auckland branch of Friends of the Earth published the booklet *2,4,5-T and 2,4-D: The Case Against Phenoxy Herbicides*, which met with outrage from some farmers who regarded them as safe and imperative to their operations.[64] The ensuing debate on what constituted scientific evidence saw local evidence competing against references to trials in the United States and the effects of sprays in the Vietnam War. A year earlier, amid French nuclear testing in the Pacific, Greenpeace New Zealand published *A Nuclear Free Pacific: Act Now, Tomorrow – is too late*.[65] These publications, together with newsletters and bulletins issued by the associations may allow placing the rise of toxicological concerns in New Zealand a larger context of environmentalism and the notion of a global environment.[66]

Aside from organisations, like Greenpeace New Zealand which may give great insights into global counterculture, individuals may serve as case studies to illuminate emerging ideas about toxicological risks, too. A case in point is Matt Morris' biography of Bob Crowder, who held a long career as lecturer at Lincoln University where he launched the Biological Husbandry Unit in the 1970s which functioned as an education and research facility dedicated to organic food production, where visitors marvelled at the quality of the produce and crops accomplished without pesticides. Crowder, through his involvement in the International Federation of Organic Agricultural Movements, also situates the New Zealand organics movement in a larger context.[67] Another example is Jennifer Robin Hodge's dissertation on Périne Moncrieff, best known for her work for the protection of native birds from the interwar period until the 1970s. However, as Hodge shows, Moncrieff's environmental concerns extended far beyond avians. Together with Ernest Valentine Sanderson, one of the co-founders of the Native Bird Protection Society in 1923 (today the Royal Forest and Bird Protection Society of New Zealand, more commonly known as Forest and Bird), she expressed toxicological concerns about DDT almost two decades before Rachel Carson wrote *Silent Spring*, illustrating how synthetic insecticides early sparked environmental concerns.[68]

Among individuals of interests for further studies are John and Guy Salmon, a father-and-son-duo who were involved in national and international conservation and environmental debates through much of the second half of the twentieth century. Individuals offer a great window into the at times paradoxical relationship people held to poisons due to their importance in preserving indigenous species as illustrated by John Salmon, who, in his influential *Heritage Destroyed: The Crisis in Scenery Preservation in New Zealand*, published in 1960, feared that the poison 1080, intended to target invasive pests, could accumulate in food with disastrous consequences:

> If total extermination could be safely achieved using the poison 1080 there would seem to be no valid reason why such a campaign should not be proceeded with without further delay. However, at present there is insufficient knowledge about the action, hazards and after-effects of 1080 on food chains and other biological sequences to enable this substance to be utilised with confidence.[69]

Sixty-five years later, the environmental effects of 1080 remains a topic of intense debate as advocates and opponents of the pesticide employ conduct and interpret studies to bolster their stance, with recent scholarship by Courtney Addison and Justine Philip highlighting some of the complexities of the pesticide.[70] However, though New Zealand may be the largest consumer of 1080, there remain many other poisons employed against species considered pests, for example picloram which saw extensive usage in the Vietnam War as one of the main ingredients in Agent White and is today commercially available in Tordon, and whose role in

New Zealand conservation remains to be written.[71] Here, future work may draw on research investigating how toxins and chemical contamination of the environment intersect with scientific, technological, political, and social matters.[72]

Contaminated land, contaminated people

In *Ngā Uruora*, first published in 1995, ecologist Geoff Park evocatively blended the ecology and history of New Zealand with his own observations as he travelled across the country. Among the sites Park visited was Petone beach, a place which he and his grandfather returned to for weekly outings in the 1950s. To the young Park, the "stinking grey shore of concrete and rust" offered a stark contrast to "smells of the mānuka scrub" at home.[73] Twenty years later conditions had worsened to such a degree that Lower Hutt had become "synonymous with urban pollution", partly due to dumping of industrial waste into the Waiwhetū river which recorded some of the highest lead levels in the world. "What would [Thomas] Shepherd feel, what would [Charles] Heaphy say. If they could visit their landfall now? Oily sludge. Toxic solvents. Pathogenic chemicals. 'Most interesting and picturesque'?"[74] Park ponders, wondering how the two early settlers, a gardener and a draughtsman respectively, would react to the transformation of a site they once praised for its scenery.

As Park's account of Lower Hutt, and especially the Waiwhetū river shows, toxic legacies are not confined to sites linked to infamous chemical catastrophes such as Bhopal, Seveso, or Minamata.[75] Rather, toxic legacies can be found everywhere. Over the last decades, scholars have developed new approaches to uncover toxic legacies of places and how they affect poor and marginalised communities disproportionately. These include concepts like slow violence developed by Rob Nixon, Thom Davies' idea of slow observation, which builds upon the former, and, adding to the number of -cenes, the Wasteocene proposed by Marco Armiero.[76] All of these may be used with great advantage to bring forward social, cultural, political and environmental injustices of toxic exposure in New Zealand. While few historians, so far, have focused on environmental injustices of toxic legacies in New Zealand, Wildblood-Crawford's dissertation on how Ivon Watkins Dow, government bodies, and local actors have rejected, conceptualised, and understood the health effects of dioxins in the herbicide 2,4,5-T is a notable exception.[77]

The impact of toxic legacies vary. However, it must be emphasised that even within the groups affected by toxins, the harm they cause may differ widely. For example, a ninety-year-old person is less likely to develop illnesses or suffer from consuming fruit sprayed with DDT compared to a foetus. Indeed, depending on the stage of our lives, our vulnerability to toxins varies. Furthermore, as suggested in the case of the foetus, toxins can transfer from one generation to the next. Therefore, it is imperative when studying toxic legacies to also consider what Ohman Nielsen calls "generational timescapes".[78] Perhaps one of the best examples of the generational effects of toxins is how soldiers and civilians exposed to Agent Orange during the Vietnam War later had children with disabilities or suffered miscarriages. In New Zealand historiography, and public memory as well, the Vietnam War is shrouded in a sentiment of let us forget rather than lest we forget, with the Crown not acknowledging how veterans were exposed to Agent Orange until 2008.

Through our life, we are exposed to a variety of toxic chemicals and substances, as such pinpointing the responsible chemical for later health effects is not always as straightforward in the case of Agent Orange. Indeed, since the postwar period, toxins have become an imperative tool in agriculture and horticulture, putting farmers and workers as well as non-human species at risk.[79] As a recent article in the *New Zealand Medical Journal* suggests, knowing which

pesticide, some of which have been banned since the 1970s, is responsible for farmers suffering increased risks of different forms of cancers, including leukaemia, brain, lung, as well as prostate and ovaries, to mention but a few, is a difficult task.[80] While history cannot diagnose diseases, historical research may help shed light on how people are exposed to dangerous chemicals throughout their lives.

Histories of toxic legacies, like environmental history in general, can easily become filled with declensionist narratives of poisoned food, polluted land, and humans and non-humans suffering from diseases resulting in early deaths. However, it does not have to be so. As Christof Mauch argues, environmental history can also showcase "stories, visions and actions that work quietly towards a more hopeful future" and which he seeks to highlight by telling stories of slow hope.[81] In 2009, local and regional bodies together with the Manatū Mō Te Taiao/Ministry for the Environment began a clean-up project for the Waiwhetū river which a year later had resulted in the removal of 56 000 tonnes of toxic waste. To protect, and to continue to restore the river, a local community group, Friends of Waiwhetū Stream, was formed in 2011. Since then, the group has worked tirelessly to eradicate invasive species like cape pond weed, which it accomplished in 2023. As the efforts by the Manatū Mō Te Taiao/Ministry for the Environment, regional and local bodies, as well as Friends of Waiwhetū Stream show, toxic legacies do not have to be permanent. Unfortunately, with sewage currently discharged into the river because of poor water treatment infrastructure, much of it in dire need of maintenance, one is, just like Geoff Park was thirty years ago, left to wonder how Shepherd and Heaphy would react to the toxic legacies that followed colonisation – to say nothing of the view of tangata whenua with Te Āti Awa having had their land around the stream confiscated and traditional food source polluted and contaminated.[82]

Conclusion

The environmental historiography of Aotearoa New Zealand following British colonisation consists of a rich body of works on how people have perceived, altered, and responded to its many environments. Yet, bar the pollution of rivers, the toxic legacies of colonisation have received limited attention. Likewise, there is little scholarship on how people in Aotearoa New Zealand have adopted and responded to various toxic substances. Drawing upon international scholarship, this article has set out some possible directions for future research set to cast further light on the complexities and roles of toxins in New Zealand history. Indeed, toxic histories may help bust popular modern myths of a clean, green, and 100 percent pure New Zealand, but also how toxic legacies have shaped and continue to shape our health.

Acknowledgement

I would like to thank Jim McAloon, James Beattie, the Environmental Humanities Research Group at University of Agder, and the anonymous reviewer for their insightful comments and much helpful feedback.

[1] Eric Pawson and Tom Brooking, eds., *Environmental Histories of New Zealand* (Melbourne: Oxford University Press, 2002); Eric Pawson and Tom Brooking, eds., *Making a New Land: Environmental Histories of New Zealand* (Dunedin: Otago University Press, 2013). See also Tom Brooking, Eric Pawson, et. al., *Seeds of Empire: The Environmental Transformation of New Zealand*, new edition (London: Bloomsbury, 2020).

[2] See, for example: Jonathan West, "Mirrors on the Land: Histories of New Zealand Lakes," *Journal of New Zealand Studies* NS30 (2020): 2-37; Catherine Knight, *Beyond Manapouri: 50 Years of*

Environmental Politics in New Zealand (Christchurch: Canterbury University Press, 2018); Catherine Knight, *New Zealand's rivers: An Environmental History* (Christchurch: Canterbury University Press); Terry Hearn, "Mining the quarry," in *Making a New Land: Environmental Histories of New Zealand*, ed. Eric Pawson and Tom Brooking (Dunedin: Otago University Press, 2013), 106-121; Tom Brooking and Vaughan Wood, "The grassland revolution reconsidered," in *Making a New Land: Environmental Histories of New Zealand*, ed. Eric Pawson and Tom Brooking (Dunedin: Otago University Press, 2013), 193-208; Nicola Wheen, "An updated history of New Zealand environmental law," in *Making a New Land: Environmental Histories of New Zealand*, ed. Eric Pawson and Tom Brooking (Dunedin: Otago University Press, 2013), 277-292; Michael J. Stevens, "Ngāi Tahu and the 'nature' of Māori modernity," in *Making a New Land: Environmental Histories of New Zealand*, ed. Eric Pawson and Tom Brooking (Dunedin: Otago University Press, 2013), 293-309. For instances where the Waitangi Tribunal have studied the impact of toxins, see, for example Waitangi Tribunal, *The Report of the Waitangi Tribunal on the Motunui-Waitara claim (Wai 6)*, second edition (Wellington: The Tribunal, 1989) and Waitangi Tribunal, *Report of the Waitangi Tribunal on the Manukau claim (Wai 8)*, second edition, (Wellington: The Tribunal, 1989).

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