Messing with Nature? Environmental Ethics and the Challenge of Geoengineering

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Abstract

This thesis argues that at least some forms of large-scale intentional modification of the climate (geoengineering) are compatible with core environmental ethics perspectives. Though environmental ethics has typically presumed against drastic alterations of the natural world, I argue that many core positions within the environmental ethics discipline do not provide grounds for a blanket rejection of geoengineering. Additionally, I argue that perspectives which do categorically reject geoengineering lack compelling reasons for acceptance. Recognising this allows environmentalists (those who would accept environmental ethics arguments) greater scope to participate in geoengineering project design; allowing them a seat at the table which they can occupy without a fundamental breach of their core ethical beliefs. I end with a discussion of principles that could govern a specifically environmentalist geoengineering.

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Introduction

1.0 Why is Geoengineering a Topic of Interest?

Readers of this thesis will no doubt be grimly aware of the dangers of the changing climate. Anthropogenic emissions of CO_2 and other greenhouse gases (GHGs) have altered the composition of the Earth's atmosphere in such a way that a lower proportion of the solar radiation entering the atmosphere is able to escape back into space. The result of this is an increase in average temperature globally – the extent of which is yet to be seen – which in turn threatens to disrupt and damage both human and non-human life in myriad ways. Preventing this warming, or limiting it as far as possible, is thus essential for minimising harm and there is a strong moral impetus towards finding and implementing methods for arresting climate change.

How then to go about this? The primary way is, of course, by limiting our emissions – to stop adding any more greenhouse gases to the atmosphere! In practice this might mean a transition from fossil fuels to non-emitting energy sources such as solar, wind, or nuclear power; where this is not possible, switching to more energy efficient technologies so that less is emitted to do the same work; or, wherever switching is impossible and efficiency gains too difficult to reach, a reduction in those activities altogether – perhaps including a reduction in overall production or 'degrowth'.[1] Collectively we can refer to efforts to limit current and future emissions as 'mitigation'. This is one way we might try to stop climate change.

However, emissions mitigation is not the only way of responding to climate change. Reducing our greenhouse gas emission (to zero) helps by not adding to the 'blanket' of greenhouse gases that trap heat from escaping into space and in turn cause planetary warming. But there are other ways to adjust this equation. One way it has been proposed that we might do it is to try and remove CO_2 from the atmosphere. This could be through methods as simple as planting more trees that will absorb CO_2 as they grow. But it might also be done in less conventional ways: by stimulating algae blooms in the ocean, by applying basaltic sands that react with ambient carbon dioxide to our crops and letting them wash out to sea, or even by constructing specially designed machines to 'suck' the carbon from the air before storing it safely underground in the very wells it was extracted from originally. Collectively we call these techniques Carbon Dioxide Removal (CDR).

Another way we might try to alter the temperature is by making the planet more reflective, so that more of the sun's energy is reflected away from the planet without getting trapped in the atmosphere. Anyone who has suffered a summer's day in a black shirt understands this principle – darker colours absorb more of the sun's heat; lighter ones reflect more of it away. Thus, if we can make the Earth brighter, we can keep it cooler. This might be done as simply as by painting buildings and surfaces brighter colours. However, attention has mostly been focussed on injecting reflective aerosols of Sulphur-Dioxide high into the upper atmosphere to deflect the sun's rays away.[2] Other options include stimulating the formation of bright white clouds over the ocean by spraying them with sea-salt, or even positioning 'solar-shields' in stable positions in the Earth's orbit to act as a gigantic parasol. Collectively we can call these techniques Solar Radiation Management or SRM. All together we call CDR and SRM technologies 'geoengineering'.

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[1] Keyßer, L.T., Lenzen, M. (2021) 1.5 °C Degrowth Scenarios Suggest the Need for New Mitigation Pathways. *Nature Communications.* Vol.12. Is.2676. pp. 1-16.

[2] Hulme, M., (2012) Climate Change: Climate Engineering Through Stratospheric Aerosol Injection. *Progress in Physical Geography: Earth and Environment.* Vol. 36. Is. 5. pp. 694 – 705.

Geoengineering might seem like science fiction, but the possibility of it playing a role in the global response to climate change is growing. While once discussions of geoengineering were scientific taboo, in the past ten years geoengineering has become increasingly prominent in climate change strategy. Carbon Capture especially has moved beyond any taboo; public companies already operate carbon removal facilities, although the total emissions removed each year are currently negligible compared to emissions. Nonetheless, almost all modelled pathways to keeping warming under 1.5 °C now imply the use of carbon capture to a greater or lesser extent, especially through the use of BioEnergy Carbon Capture and Storage (or BECCS).[3] While Solar Radiation Management has yet to move into policy recommendations, there is a very real possibility that it will move closer to acceptability the longer serious emissions reduction takes. SRM offers the potential to affect temperature directly without changing the amount of GHGs in the atmosphere. If either mitigation or CDR fails to deliver its promises on time, it's plausible to imagine calls for SRM to be deployed to buy time for decarbonisation to be scaled up. There are however still important questions about the *extent* to which geoengineering will play a role in responding to climate change. It is still highly contested whether SRM will/should be deployed, and the extent to which CDR should play a role compared to aggressive mitigation efforts. Moreover, in either case there is still a discussion to be had over which forms or methods of geoengineering should be prioritised.

Geoengineering is also philosophically interesting, and it raises important justice related concerns. I briefly list a few of these here. The possibility to alter the climate raises important questions over international governance. Who should pay the costs of geoengineering? Can paying for geoengineering be reconciled with the 'Polluter Pays Principle'? Who has the final say over whether geoengineering, especially SRM, will be deployed? For some, the deployment and maintenance of a geoengineering program will require novel mechanisms for international governance. Whose hand will be on the 'global thermostat'? Different states and actors at all levels might have different preferences for global temperature, and different states will have different levels of tolerance to climate effects where they think geoengineering must be employed. In this context the prospect of conflict over geoengineering is a worrying possibility. There is a procedural justice worry too – who is at the table making decisions over the implementation of geoengineering and who is excluded? Geoengineering research and decision making is largely confined to an insular community of scientists and policy makers in the global north - hardly a democratic or egalitarian affair, especially considering that those discussing geoengineering as a solution to climate change are the ones by and large the least likely to experience the effects of climate change first hand.[4] Another major fear is that the prospect of geoengineering is a driver of 'mitigation deterrence'. Both carbon capture and solar radiation management, if they could be successfully deployed, offer a means for delaying mitigation to a future point (or potentially never), by offering a way to 'control' climate without needing to reduce reliance on fossil fuels.[5] Thus, even researching or considering geoengineering techniques as an option presents a form of 'moral hazard' that increases the chance we will continue

[3] IPCC., Rogelj, J., Shindell, D., Jiang, K., Fifita, S., Forster, P., Ginzburg, V., Handa, C., Kheshgi, H., Kobayashi, S., Kriegler, E., Mundaca, L., Séférian, R., Vilariño, M.V., (2018) Chapter 3: Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development. In: Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I., Lonnoy, E., Maycock, T., Tignor, M., Waterfield, T., (eds) (2018) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Cambridge, Cambridge University Press. pp.175-313.

Note that the lack of an institutional taboo over carbon capture does not evidence that it is no longer publicly controversial, much less, ethically beyond question.

[4] The term 'geo-clique' from: Kintish, E., (2010) *Hack the Planet*. New York, Wiley.

[5] McLaren, D., Markusson, N., (2020) The Co-Evolution of Technological Promises, Modelling, Policies and Climate Change Targets. *Nature Climate Change*. Vol 10. pp.392-397.

to pursue the risky activity of combusting fossil fuels feeling secure in the fact geoengineering insures us again the risk.

The worries I list above are focussed on the effects geoengineering deployment might have on human persons, through its side-effects, or its implementation in a world that is already fractured and unequal. But this is not the only set of reasons we might have to be morally troubled by the possibility of geoengineering. Geoengineering envisions a program of intentional environmental modification – the large-scale alteration of global climate systems, the cycling of carbon, and the degree of insolation - for whose scale there is only scant precedent.[6] This also makes it a concern for those interested in our obligations to the natural world. We might fairly ask: is it right to try and alter some of the Earth's core biogeochemical forces? Is there any kind of moral cost to expanding human control into areas of the natural world which were previously untouched? Does making these kinds of changes violate any kind of obligation we might have to try and preserve certain parts of the natural world in a pristine or natural state? These and questions like them form a class of worries that I term Environmental Ethics based concerns, and it is around these that the thesis is structured.

2.0 Why is 'Messing with Nature' a Concern?

2.1 Evidence for a Folk Concern

The idea that new technologies can disturb the perceived correct order between the human and the non-human is not new. Sjöberg argues that debates about the correct relation between humans and nature often revolve around new technologies, because it is through technology that humans interact with the natural world.[7] Geoengineering is therefore not alone in sparking such concerns: similar debates are sparked around genetic modification, in-vitro fertilisation, and nanotechnology.[8]

Indeed, several studies have shown that when lay members of the public are confronted with the idea of geoengineering, the worry that it would disturb our relationship with nature is frequently brought to the fore. In a 2010 series of workshops titled 'Experiment Earth', conducted by the market research organisation IPSOS-MORI, informed participants were more likely to favour geoengineering methods according to the extent they were seen as 'natural' or how much they were perceived to be 'interfering with nature'.[9] MacNaghten and Szersynski report similar findings – the greater the degree to which particular geoengineering technologies were perceived as natural, the higher level of public support they garnered.[10] Carr and Palmer too found that in a survey on Solar Radiation Management, a concern that implementation would 'mess with nature' was a prominent

[6] There are some useful parallels: experiments in weather control, and large-scale hydrological modifications might be relevantly similar, and the artificial fixation of nitrogen also makes major intentional changes to atmospheric chemistry.

[7] Sjöberg, L., (2003) Perceived Risk and Tampering with Nature. *Journal of Risk Research*. Vol. 3. pp.353-367.

[8] Davies, S.R., Macnaghten, P., (2010) Narratives of Mastery and Resistance: Lay Ethics of Nanotechnology. *Nanoethics*. Vol.4 pp. 141-151.

[9] Ipsos-MORI (2010) *Experiment Earth? Report on a Public Dialogue on Geoengineering*. Natural Environment Research Council. Swindon, Ipsos-MORI.
Note that Corner et al (2012) raise concerns over the methodology of this paper, arguing that discussion facilitators may have implanted the notion that certain techniques were more natural than others. Whether this is true or not, this may vindicate the importance of naturalness as a framing.

[10] Macnaghten, P., Szerszynski, B., (2013) Living the Global Social Experiment: An Analysis of Public Discourse on Solar Radiation Management and its Implications for Governance. *Global Environmental Change*. Vol. 23. pp. 465-474.

theme.[11] In a 2013 paper, Corner and Pidgeon conducted a series of workshops with members of the public in the UK that conformed with these earlier findings – a worry that geoengineering 'messed with nature' continually emerged in participant responses.[12] In a more recent survey of views from both the US and the UK, Cox et al continued to find that 'messing with nature' is a salient worry amongst participants, especially when they are asked to consider the scale techniques need to operate on, and when they imagine them in unfamiliar contexts such as in tropical regions.[13] Wolkse et al similarly finds that perceptions of how much a technology is seen to 'tamper' with nature is a strong factor in how willing US audiences are to support any CDR technology.[14]

Moreover, similar conclusions may be drawn from the apparent preference the public holds for forms of geoengineering which can be perceived as natural. In another set of UK deliberative engagements, Bellamy notes that the importance of perceived 'naturalness' of a geoengineering technology was a persistent and overarching theme in the discussions of geoengineering despite not being mentioned by the researchers themselves.[15] Again here, perceptions of how much a technology could be understood as natural, or imitating already existing natural processes, was a major factor for evaluating support for it. Bellamy notes that this often led to conflicting beliefs over the same technologies (stratospheric aerosol injection was seen as unnatural when framed as spraying particulates into the atmosphere, but in other groups it was seen as natural when expressed as mimicking the eruption of a volcano). This is attested to again by Wibeck et al, in their review of Swedish public lay opinions – there was a strong sense that certain forms of geoengineering were 'unnatural' or even 'played God', implying a kind of moral transgression in the relationship with the natural world.[16] Similar responses were found by Carvalho and Riquito in their discursive sessions with members of the Portuguese public and experts, both groups expressed concerns about a changing relationship with the natural world that was envisioned by geoengineering, as well as a preference for the 'natural' CDR vs the 'unnatural' SRM.[17] In an experiment with the members of the public from the UK, Corner tested the extent to which framing geoengineering as analogous to natural processes determined public support. In general, his results show that the extent to which both CDR and SRM could be framed as (for instance) 'like artificial trees' was a significant determinant of support for the project. However, notably both those audience who had geoengineering pitched to them as natural, as well as the control, responded affirmatively to the question 'Humans should not be manipulating nature in this way'. This seems to be strong evidence of a folk ethic against large-scale environmental modification, that can be applied as a critique of geoengineering.[18]

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[11] Carr, W., Mercer, A., Palmer, C., (2012) Public Concerns About the Ethics of Solar Radiation Management. In: Preston, C.J., (ed). *Engineering the Climate: The Ethics of Solar Radiation Management*. Lahham, Lexington Books. pp 169–186.

[12] Corner A.J., Parkhill, K., Pidgeon, N.F., Vaughan, N.E., (2013) Messing with Nature? Exploring Public Perceptions of Geoengineering in the UK. *Global Environmental Change*. Vol. 23. Is. 5. pp.938-947.

[13] Cox, E., Spence, E., Pidgeon, N., (2020) Public Perceptions of Carbon Dioxide Removal in the United States and the United Kingdom. *Nature Climate Change.* Vol. 10**.** pp.744–749.

[14] Wolske, K.S., Raimi, K.T., Campbell-Arvai, V. et al*.* (2019) Public Support for Carbon Dioxide Removal Strategies: The Role of Tampering with Nature Perceptions. *Climatic Change*. Vol. 152. pp.345–361.

[15] Bellamy, R., Chilvers, J., Vaughan, N.E., Lenton, T.M, (2012) A Review of Climate Geoengineering Appraisals. *Wiley Interdisciplinary Review Climate Change.* Vol. 3. Is. 6. pp. 597-615.

[16]Wibeck, V., Hansson, A., Anshelm, J., (2015) Questioning the Technological Fix to Climate Change - Lay Sense-Making of Geoengineering in Sweden. *Energy Research Social Science*. Vol. 7. pp.23–30.

[17] Carvalho, A., Riquito, M. (2022) 'It's just a Band-Aid!': Public Engagement with Geoengineering and the Politics of the Climate Crisis. *Public Understanding of Science*. Vol. 31. Is. 7. pp. 903-920.

[18] Corner, A., Pidgeon, N., (2015) Like Artificial Trees? The Effect of Framing by Natural Analogy on Public Perceptions of Geoengineering. *Climatic Change*. Vol. 130. pp. 425–438.

What this research suggests is that there is a widespread belief that geoengineering involves a transgression of the proper relationship with nature. After all, 'tampering with' or 'messing with' are statements which entail a normative judgement. The question that we as philosophers must ask is whether this normative judgement is accurate. Does geoengineering 'mess with nature', and if it does, does that give us reasons not to do it?

2.2 How to Understand 'Messing with Nature'

The evidence indicates that when lay-persons are introduced to the concept of geoengineering, they express concerns about 'tampering' or 'messing with' nature. This may be understood as a concern with how geoengineering changes the relationship between humans and the natural world. However, important questions remain about how we should interpret this worry, and how we might respond to it.

One interpretation might be that worries over 'tampering with nature' reflect a wariness over our ability to make such large-scale alterations to nature safely and effectively. After all, historic precedence shows us that intentional alterations of the natural world rarely yield environmentally beneficial results. Well-meaning interventions to try and manage or alter the functioning of environmental systems often seem to produce unintended consequences. Moreover, of all environmental systems, climate and meteorological systems seem to be highly complicated and especially resistant to management – the existence of a climate crisis caused by our unintentional actions seems to attest to this.[19] In this context of uncertainty over the ability to accurately/safely/competently do the kinds of intervention geoengineering envisions – we might well interpret the charge of 'tampering' as indicating a pragmatic concern over the wisdom of such an ambitious program of environmental modification. Tampering with the climate has got us into this mess, and further tampering will not extradite us from it! On this account, 'messing with nature' is a pragmatic concern over human ability to make the changes geoengineering envisions without dangerous, unexpected, or otherwise undesirable consequences.

However, a second, and more philosophically concerning interpretation is to wonder to what extent lay-opinion might be an expression of ethical beliefs about making dramatic ecological changes. A belief that geoengineering would mess with nature might reflect a belief that there are obligations owed to the natural world which it would violate: perhaps a duty to preserve certain parts of nature in an unmodified state, or to limit rather than expand our control over nature. This is one kind of concern that the discipline of environmental ethics is concerned with. We might then read the worry about 'messing with nature' as an expression of a belief about the demands of treating the natural world ethically.

The philosophical discipline of environmental ethics can help us make sense of the second interpretation. environmental ethics as a discipline developed near simultaneously in Norway, Australia and the USA around the late 1960s and '70s. In general, it sought to answer questions concerning the moral implications of the human relationship with nature, and especially questions concerning justifications for expanding the so-called sphere of 'moral considerability' beyond just human beings (and some non-human animals) outwards to 'the natural world' itself.[20] Much like debates around the moral considerability of animals that preceded it, many philosophers in the field worked on establishing which properties entities must possess to become the ends, rather than just

[19] Schubert argues that the move of geoengineering into scientific taboo was caused in part due to the doubt the discovery of climate change caused in sciences ability to accurately understand climate process. Schubert, J., (2022) Science-State Alliances and Climate Engineering: A 'Longue Durée Picture'. *WIREs Climate Change*. Vol. 13. Is. 3. pp. 1-13.

[20] Goodpaster, Kenneth E., (1978) On Being Morally Considerable. *Journal of Philosophy.* Vol. 75. Is. 6. pp. 308-325.

factors in, moral calculations. While in traditional human-centric moral philosophy this was most often the possession of reason (or some other uniquely human trait), environmental ethicists often tried to establish alternative sources of 'intrinsic value' that would show that we had obligations towards natural non-human entities too.[21]

Christopher Preston conducted a review of a range of environmental ethics perspectives and considers their likely responses to geoengineering. He concludes that despite their theoretical differences on the sources, and precise nature of, our obligations to the natural world, each supported a 'presumption' that geoengineering would not be acceptable.[22] Similar conclusions are reached in a brief review by Scott.[23] The existence of this 'presumption 'was based on the fact that, in general, the environmental ethics perspectives reviewed cautioned against large-scale modifications of environment. Preston ultimately believed that these arguments were defeasible – that faced with the threat of climate change, forgoing our obligations not to make large scale modifications was the lesser of two evils. Nonetheless, the assumption reached by Preston and Scott is that various environmental ethics positions contain an explanation of why we ought not 'Mess with Nature' via geoengineering.

3.0 Chapter Overviews

This thesis challenges the idea that traditional environmental ethics positions will reject geoengineering out of hand. I agree with Preston that many of the perspectives I analyse in this thesis will rule out many, or perhaps most, forms of geoengineering. However, I maintain that at least some forms of geoengineering will be morally permissible in the ethical systems of many core environmental ethics perspectives.

Chapter One gives an account of the development of geoengineering as a means of handling the effects of a warming climate. It describes a number of proposed geoengineering methods so that we can be familiar with them for the forthcoming discussions, and to situate the discussion of the ethics of different methods of geoengineering within the political, technological, and material context of the actual progress of geoengineering development.

Chapter Two argues that considering the environmental ethics literature can help us shed light on the worry that geoengineering messes with nature. It begins with a brief introduction to the discipline, before proceeding to analyse in detail Preston's 2011 claim that there is a widespread agreement across various perspectives in the field of environmental ethics that geoengineering violates our obligations to the natural world. It finishes with a brief review of some of the environmental ethics perspectives included in Preston's review which do not receive full chapters. I argue that, contrary to Preston's conclusions, many of these perspectives can allow some forms of geoengineering.

From this point on, I turn to evaluating core environmental ethics perspectives that might seem to presume against geoengineering. Chapter Three looks at a what I term 'Respect for Nature' perspectives. I challenge Preston's claim that a presumption against geoengineering can be found in the works of Paul Taylor and Tom Regan. Respect for Nature arguments, characterized by Taylor and

[21] For instance: 'Capacity to Suffer' in Singer, P., (1973) *Animal Liberation*. New York, Random House. 'Subject of a Life' in Regan, T., (1983) *The Case for Animal Rights*. USA, University of California Press. 'Teleological Biocentrism' in Taylor, P., (1981) The Ethics of Respect for Nature. *Environmental Ethics*. Vol. 3. Is. 3. pp. 197-218. 'Having a good of its own/of its kind' in Rolston III, H., (1988) *Environmental Ethics*. Philadelphia, Temple University Press.

[22] Preston, C.J., (2011) Re-Thinking the Unthinkable: Environmental Ethics and the Presumptive Argument Against Geoengineering. *Environmental Values*. Vol. 20. Is. 4. pp.457–479.

[23] Scott, D. (2012) Geoengineering and Environmental Ethics. *Nature Education Knowledge*. Vol.3 Is.10. p.10.

Regan's work, attempt to show that moral obligations towards non-human entities arise due to particular properties held by nature. These property holders demand obligations from us, including that we treat them with an 'attitude of respect'. Crucially Taylor and Regan envision 'respecting nature' involving adopting certain negative duties towards it, including, what they term the 'Duty of Non-Interference' and 'The Preservation Principle' respectively. These are imagined to be general limitations on human influence in natural systems, and it is from here that Preston sees a presumption against geoengineering. I argue that Preston is correct that Taylor's 'Attitude of Respect' will often rule out intentional climate modifications. However, Taylor's own inclusion of moderating principles to his ethics mean that they cannot rule out geoengineering completely and in every instance. I also challenge both Taylor and Regan on their inability to identify what property it is that natural entities have that demands the attitude of respect. I argue that both Taylor and Regan are unable to sufficiently exclude important edge cases from being included within their bounds of moral considerability. Failing to identify the source of obligations to nature means that they also fail explain why geoengineering would treat nature immorally.

In Chapter Four I go on to explore the work of Eric Katz. Katz's work purports to explain harms done by transforming nature in terms of domination. For Katz, unmodified nature maintains a form of 'autonomy' from persons. Moreover, nature's value (i.e., what makes it worth preserving) is a factor of this autonomy. Katz's argument is positioned to establish why 'preservation' of nature is the only way to maintain nature's value, unlike nature 'restoration', which through the intentional work of human restorers breaks the 'autonomy' of nature and thus strips it of its value. While Katz developed these views as an antidote to restoration in conservationist strategy, his argument also would seem to explain why geoengineering would be wrong. As geoengineering operates by intentionally transforming aspects of nature (the carbon cycle or the earth's albedo balance), it acts only at the cost of undermining nature's autonomy and thus 'dominating' it. Crucially, if successful. Katz's project would show why all instances of geoengineering will be wrong, thus succeeding where Taylor and Regan failed.

I offer two rebuttals to Katz's argument. Firstly, that he inadvertently proves too much. His definition of 'nature' is too constrained, so much so that I argue it may contain no examples. If this is true, we must conclude that, tragic while nature's demise might be, Katz's theory no longer has the ability to guide actions. If the world is already fully artificial, what argument is Katz able to present to show us why we must not further transform our artifacts? Secondly, I argue that even if we dismiss my first argument, Katz still fails to sufficiently explain the moral cost of violating nature's autonomy. While Katz couches his normative claims in the language of 'domination', I argue that he stretches the concept beyond credibility – beyond the essential point that, as Pettit puts it, domination is a complaint. I argue that there are many cases where nature, or at least the thinking parts of nature who are in a position to complain, stand to benefit from transformation. This, I believe, is enough to open the door to at least some forms of geoengineering.

While Chapter Four considers the notion of dominating nature in the work of Katz, his understanding of this concept differs substantially from its usage in other environmental ethics works. The idea that certain societies and practices can 'dominate' the natural world is commonplace within environmental philosophy, and its usage is more than simply rhetorical flourish. Chapter Five considers an alternative explanation of 'dominating nature' found in the work of Adorno and Horkheimer. I look at three ways that Adorno and Horkheimer might explain the wrongness of 'dominating' nature. I conclude that they succeed at showing there is a plausible anthropocentric explanation of why geoengineering will be wrong. However, I argue that this still does not provide the necessary grounds for a prohibition of geoengineering. Rather I contend that even those who accept Adorno and Horkheimer's account of dominating nature might still think geoengineering is permissible in some circumstances.

The final chapter (6) tries to consolidate the lessons that have been gathered from the previous chapters. Given the investigation in the prior chapters has shown that environmentalists do not need to reject geoengineering out of hand, it tries to develop advice for ethical geoengineering development. It begins with a review of past efforts to develop governance criteria for just and ethical development and implementation of geoengineering programs and argues that on the whole these have failed to substantially include environmental ethics considerations. I then turn to the ethics literature on geoengineering and look in detail at two suggestions of principles that must be met for a geoengineering program to be morally permitted. The first of these is a 1993 article from Dale Jamieson. The latter, the 2017 'Tollgate Principles'. I then consider how the lessons drawn from the arguments in the preceding chapters could be used to inform, interpret, and improve two principles that Jamieson and the Tollgate principles both considered necessary. The first of these being a requirement that geoengineering be reversible, and the second that geoengineering 'respect' or 'live with' nature.

I conclude (chapter 7) that there is no general case to be found in the positions reviewed why geoengineering will necessarily 'mess with nature'. While it may be true that certain kinds of geoengineering will violate environmental ethics notions of the proper treatment of nature, this is not universally the case. In the plausible theories of environmental ethics this thesis has assessed, in each of them it was possible – at least occasionally – to advocate for intentional climate modification as an ethical option, rather than just a necessary or lesser evil. I argue that this is an important discovery for environmentalists. The future is still not written for geoengineering, and there is still time and space to contest both the kinds of geoengineering which are promoted, and the extent to which geoengineering will play a role in our climate strategy. Recognising that their ethics do not rule out geoengineering, environmentalists should feel emboldened to voice and advocate for their own geoengineering vision.

Chapter 1 – What is Geoengineering?

This thesis is a work about geoengineering, and whether it would violate any of our moral imperatives to treat the Earth in a particular way. It is important then that we get to grips with precisely what geoengineering is. While in the introduction to this thesis I gave a quick overview of geoengineering, this chapter aims to give a fuller account of it. I do this by first (Section 1) explaining two non-geoengineering strategies for ameliorating the harms of climate change: 'mitigation' and 'adaptation'. Then in Section 2 I explain the third strategy for handling climate change: geoengineering. Working through a typical definition, I look at and discuss the essential features of what makes geoengineering. While these clusters of strategies (mitigation, adaptation, and geoengineering) might not be a philosophically robust categorisation, it does makes sense to consider them together as a starting point on our investigation into geoengineering. I do propose some notable alterations to important definitions and characterisations on the way, though. I conclude with a summary definition for geoengineering. What becomes clear is that what unites and distinguishes geoengineering proposals is that they attempt, in disparate ways, to intentionally modify the Earth's climate through technological interventions. Then in Section 3 I give an explanation of some key geoengineering proposals, their histories, development, and key characteristics. I divide geoengineering methods into three groupings (carbon capture, solar radiation management, and energy transport), based on how each method intends to produce a climate altering effect. This is done to situate the discussions in the forthcoming chapters within the material and political reality of geoengineering development.

1.0 Mitigation and Adaptation

To better understand what geoengineering is, it's helpful to understand it alongside two other strategies we have for handling the threat of climate change. First though, a quick recap: anthropogenic climate change is caused by an increasing volume of 'greenhouse gases' – predominately carbon dioxide – accruing in the Earth's atmosphere that are released by human activity. Those greenhouse gases prevent the energy from the Sun escaping from Earth, creating a warming effect. This increase in average temperature poses a serious threat to human and non-human life: directly through instances of extreme heat, but also through sea level rise and polar ice melts, an increased likelihood and severity of extreme weather events, and through the disruption of patterns of weather and climate leading to disruption in the global food system, amongst many other things. So how do we go about trying to stop this harm from occurring?

1.1 Mitigation

Perhaps the most widely discussed and obvious strategy is to stop releasing any more greenhouse gases. If the bathtub is going to overflow, the first thing we must do is turn off the tap. This means switching away from greenhouse gas releasing industrial processes: switching from fossil fuel powered facilities to ones powered by wind, solar, or nuclear power. In areas which cannot be fully 'decarbonised' such as cement manufacture, steel making, and in agriculture, efforts must be made

to reduce emissions.[24] This might be through efficiency gains – more product produced per emission. But it also might come from substitution of these products for 'greener' alternatives. In cases where no substitution is possible and no route to decarbonisation exists there may be a need to abandon that product or practice entirely or attempt to change the demand for it so that fewer people use it – again resulting in less greenhouse gas emissions (GHGs).

This strategy can be termed 'Emission Mitigation' or simply 'Mitigation'. It is one of three climate strategies recognised by the IPCC. They offer a definition of Emissions Mitigation as:

> Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce greenhouse gas emissions and enhance sinks.[25]

Mitigation, in essence, works to stop climate change by reducing emissions as far as is possible to decrease the amount of resultant warming. Reducing the amount of GHGs released will reduce the amount of warming experienced, thus mitigating the harms of climate change. The end goal of mitigation might be a reduction of emissions to a point where the carbon being released into the atmosphere is equal to that which is naturally sequestered by carbon 'sinks'. 'Sinks' or 'carbon sinks' are used variably to mean either reservoirs where GHGs can be stored, for example, in forests, the oceans, or in wetlands; or the processes by which GHGs in the atmosphere arrive in those reservoirs.[26] If the total CO_2 emitted matches that sequestered by sinks, the whole system is considered to be 'carbon neutral', or at 'net-zero'. Returning to this idea of sinks, as the definition given above makes clear, enhancing the capacities of those sinks to sequester carbon is also considered to be under the remit of mitigation. This could mean planting more forests and making sure existing forests do not get chopped down.

1.2 Adaptation

Mitigation of greenhouse gas emissions is likely to be difficult, perhaps technically, and certainly politically. Given that we are already experiencing the effects of climate change, it is clear we have not mitigated quickly enough to avoid harm altogether. But we might be able to reduce the amount of harm that these changes cause by *adapting* to them: changing our social and built environs in such a way as to minimise the harm that climate change causes us. Thus, where mitigation fails, adaptation is a secondary strategy for handling climate change.

This may involve technological changes, and changes to the built environment. For example, the harms of sea level rises might be at least partially alleviated through the construction of seawalls and

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[24] There is some potential for cross over here with geoengineering – point-source/direct Carbon Capture and Storage (Discussed in 2.1) seems like it could be equally understood as reducing the emissions from an industrial process or as geoengineering carbon capture.

[25] IPCC., Edenhofer, O., Pichs-Madruga, R., Sokona, Y., Field, C., Barros, V., Stocker, T.F., Dahe, Q., Minx, J., Mach, K., Plattner, G-K., Schlömer, S., (eds) (2012) *IPCC Expert Meeting on Geoengineering: Report.* Potsdam. IPCC Working Group III Technical Support Unit, Potsdam Institute for Climate Impact Research. p. 3.

[26] 'Sinks' in: Masson-Delmotte, V., Zhai, P., Pörtner, H.O., Roberts, D., Skea, J., Shukla, P., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I., Lonnoy, E., Maycock, T., Tignor, M., Waterfield, T., (eds) (2018) *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. Cambridge, Cambridge University Press. pp. 541-562

other flood defences. Genetic modification might yield new varieties of drought resistant crops. Homes and other buildings might be retro-fitted with insulation or air-conditioners to better cope with new temperatures. This is reflected in the IPCC definition of adaptation, as:

> initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects. Various types of adaptation exist, e.g., anticipatory and reactive, private and public and autonomous and planned. Examples are raising river or coastal dikes, the substitution of more temperature-shock resistant plants for sensitive ones etc.[27]

Adaptations might also have non-technological components. People are harmed less by flood or fire if they are adequately insured for instance. People might need expanded access to healthcare provision. In some situations, they may need to be relocated as their homes become unliveable. This will likely often be harmful, but its harm can be at least somewhat mitigated by making sure climate refugees are supported and welcomed. Adaptation is therefore characterised as reactive efforts to minimise the harms a changing climate may bring, but without making a proactive effort to prevent said change from occurring.

2.0 Geoengineering

Alongside Adaptation and Mitigation, geoengineering is a third strategy that might be employed to prevent or reduce the harms of climate change. Geoengineering techniques resemble 'mitigation' techniques because they work by trying to prevent warming from occurring. However, unlike 'mitigation' they do not attempt to do this by reducing emissions. Rather, geoengineering is normally understood as techniques which do this in two other ways: through employing Carbon Dioxide Removal (CDR) techniques to capture and safely store GHGs which have already been emitted,[28] or by altering the reflectivity of the Earth to reflect incoming solar energy away (Solar Radiation Management, or SRM). The precise methods for achieving this will be discussed in the following Section 3.

A somewhat typical geoengineering definition is provided by the Oxford Geoengineering Program, as *'*the deliberate large-scale manipulation of an environmental process that affects the earth's climate, in an attempt to counteract the effects of global warming.*'*.*[29]* Many similar examples exist, and the precise origins of this definition are difficult to track down. A very similar definition appears, for example, in the 1992 National Academy of Science report which first introduced geoengineering as a solution to climate change to a major scientific forum.[30] Notably it appears in the influential Royal Society report, as well as in the Oxford Principles on geoengineering. It also clearly influences the IPCC's understanding of geoengineering as:

> [A] broad set of methods and technologies that aim to deliberately alter the climate system in order to alleviate the impacts of climate change. Most, but not all, methods seek to either

[27] IPCC., (2012) *IPCC Expert Meeting on Geoengineering*: Report. p. 3.

[28] Note though that CO2 is not the only greenhouse gas, and methods to remove other forms of greenhouses would still be geoengineering according to my typology. CO_2 is the greenhouse gas that removal efforts typically focus on. That being said, there is at least some interest in the possibility of capturing atmospheric methane. See: Jackson, R.B., et al. (2021) Atmospheric Methane Removal: a Research Agenda. *Philosophical Transactions of the Royal Society.* Vol. 379. pp. 1-17.

[29] Oxford Geoengineering Program (2018) *What is Geoengineering?* Oxford, University of Oxford.

[30] N.A.S defines geoengineering as: 'large-scale engineering of our environment in order to combat or counteract the effects of changes in atmospheric chemistry'. See: National Academies of Sciences, Engineering, and Medicine., (1992) *Policy Implications of Greenhouse Warming: Mitigation, Adaptation, and the Science Base*. Washington DC, The National Academies Press.

> (a) reduce the amount of absorbed solar energy in the climate system (Solar Radiation Management) or (b) increase net carbon sinks from the atmosphere at a scale sufficiently large to alter climate (Carbon Dioxide Removal). Scale and intent are of central importance. Two key characteristics of geoengineering methods of particular concern are that they use or affect the climate system (e.g., atmosphere, land or ocean) globally or regionally and/or could have substantive unintended effects that cross national boundaries. Geoengineering is different from weather modification and ecological engineering, but the boundary can be fuzzy.[31]

Today this standard definition is near unanimous, typically differing in only minor aspects of the wording. To help get our heads around geoengineering, it can be helpful to think about the components of this definition in order. Note that each of these conditions are thought to be necessary, but not sufficient alone. I do not differ substantially from the typical definition; however, I argue that at least one aspect of the typical definition (the requirement that geoengineering be a response to climate change) is unnecessary and should be dropped.

2.1 Deliberate

Geoengineering is deliberate. It is an activity which *intends* to modify the climate. This contrasts it of course to *unintentional* climate modification; the most notable example of which is anthropogenic climate change by way of carbon emissions and the greenhouse effect i.e., the very thing geoengineering is proposed as a solution to. The carbon dioxide that we emit modifies the climate, but since that is not the *intended* consequence of the activity, it is not geoengineering. If the Earth was cooling rather than warming, we might instead decide to emit CO_2 in order to create a warming effect. We may even do it in the same way we do now (via the combustion of fossil fuels). Even though the methods are the same, only the latter would be geoengineering.

Occasionally commentators refer to 'accidental geoengineering'.[32] According to the standard definition however, such a thing is not actually possible – as intentionality is central to understanding whether something is geoengineering or not. This may be an issue where common language use differs from technical definition. We can talk in common terms about the accidental application of a geoengineering technique (in this instance, accidently doing something akin to marine cloud brightening by using high sulphur fuel oil in cargo ships), however strictly speaking this is not geoengineering proper. Accepting that geoengineering can be done unintentionally would mean admitting anthropogenic climate change into our definition of geoengineering.[33] My belief is that it is preferable to be able to discuss geoengineering as separate from the climate change it is being positioned as a response to, and to me it seems that intentionality is an important factor in explaining the difference between the two.

The deliberateness or intentionality of geoengineering also seems to have implications regarding how we evaluate it ethically. We need not go into detail on this point, but it is worth recognising that it is commonplace within standard theories of ethics to recognise the importance of intentions in making assessments of the morality of an action (cf. strongly consequentialist ethics). For instance, we typically think that premeditated murder is worse than manslaughter, and that this tracks the difference in the intentions of the perpetrator. A possible argument in favour of

[31] IPCC., (2012) *IPCC Expert Meeting on Geoengineering*. p. 3.

[32] For instance, see: Green, H., (@hankgreen) (2023) Massively under-reported science story because there's so much going on right now but… it turns out that we might have figured out what's causing this very scary spike. Quick thread, on how WE'VE BEEN ACCIDENTALLY GEOENGINEERING FOR DECADES… but then we stopped: . Twitter. Aug 4th. (emphasis original).

[33] Though we ought to note that this is at least a point of contention: while we certainly started changing the climate unintentionally, you might reasonably argue that now we know that burning fossil fuels results in climate change it is no longer unintentional – it's just a cost-benefit assessment.

geoengineering may be that since the climate has already been altered (by fossil fuel emissions), geoengineering represents no additional wrongdoing. By distinguishing geoengineering by its intentionality, and thereby contrasting it with *unintentional* changes (potentially including climate-change) we are better able to grasp the distinct moral character that it has.

2.2 Large-Scale

Geoengineering attempts to alter the climate on a large scale. The greenhouse on my allotment intentionally modifies the climate, but only does so on a small-scale; thus, it is not geoengineering.[34] Intentionally injecting Sulphur Dioxide into the stratosphere would alter the climate globally: it is therefore geoengineering.

How do we decide what counts as large scale? There is very evidently a great deal of difference between my allotment and the entire planet and there may very well be some marginal cases too. For instance, my city might decide to plant trees along its streets to mitigate the heat island effect and manage the area's microclimate.[35] An idea gaining traction is to use shading techniques to protect delicate corals on the Great Barrier Reef from the harmful effects of warming coastal waters.[36] There are also occasionally calls for 'local scale' geoengineering: a seeming contradiction in terms.[37] Any attempt to decide what counts as 'large scale' is bound to a certain degree to be arbitrary.

A possible way of resolving the issue of scale might be to think about the object that geoengineering acts on – namely, climate. Climate is understood by the IPCC as the average weather (including temperature) over a period of time (typically 30 years). Climate can be a global average, i.e. the average temperature, precipitation or wind of one thirty-year period as compared to another, but it can also be regional.[38] The IPCC understands a 'Region' to be a large-scale land or ocean area that is characterised by its specific geographical (topographic, land use, water-bodies etc) and climatic conditions.[39] Since the 5th assessment report, the IPCC has used 33 standard regions as its units for analysis in predicting climate trends. These regions are typically very large, ranging from 2-5 'regions' per continent. We can infer then from the IPCC's understanding of geoengineering, climate, and regions that they are open to the possibility that geoengineering can be interventions that affect climate on a less than global level. This is reflected in the definition given in the IPCC 2011 Expert Meeting Report on Geoengineering, where they write that 'Scale and intent are of central

[34] There are limits to this fun analogy – especially if we think 'climate' is defined in some way as large-scale. I use it here illustratively.

[35] Dimoudi, A., and Nikolopoulou, M., (2003) Vegetation in the Urban Environment: Microclimatic Analysis and Benefits. *Energy and Buildings*. Vol. 35 pp. 69-76.

[36] Seitz, R. (2011) Bright Water: Hydrosols, Water Conservation and Climate Change. *Climatic Change*. Vol. 105. Is. 3. pp.365-381.

[37] For instance: Galaz, V., (2012) Geo-engineering, Governance, and Social-Ecological Systems: Critical Issues and Joint Research Needs. *Ecology and Society*. Vol. 17. Is.1. pp. 24.
Olson, R., (2012) Soft Geoengineering: a Gentler Approach to Addressing Climate Change. *Environment: Science and Policy for Sustainable Development.* Vol. 54. Is. 5. pp. 29–39.
Martindale, L., (2015) Understanding Humans in the Anthropocene: Finding Answers in Geoengineering and Transition Towns. *Environment and Planning D: Society and Space*. Vol. 33. Is. 5. pp. 907-924.

[38] As an aside here, recognising that 'climate' is a function of average weather entails that (contrary to usual separation) weather modification techniques such as cloud-seeding could also be geoengineering techniques if deployed on a sufficient scale.

[39] IPCC, (2013) *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, Cambridge University Press.

importance… geoengineering methods… use or affect the climate system… globally or regionally.'[40] This clearly indicates the IPCC at least do accept that geoengineering can be sub-global if its effects are at least of 'regional' scale. For the purposes of this thesis I treat this issue as somewhat open ended – that the large-scale requirement is an essential component of understanding geoengineering, but precisely what qualifies as large-scale is up for debate, with the IPCC standard regions might be a good rule of thumb.

2.3 Manipulation of an Environmental Process

This element of the definition captures the idea that geoengineering involves material modification of external nature. This is usually implied to be with some kind of technology or technological technique – after all geoengineering is a form of *engineering* – though this is not, we should note, strictly in the definition. A clear example is direct air capture CO_2 removal, which would involve building specially designed devices which can physically remove unwanted greenhouse gasses from the atmosphere and in doing so alter the balance of inputs and outputs in the natural carbon cycle.

We should also ask whether the intervention needs to be technological, or whether we could have something along the lines of 'social geoengineering'. Emissions mitigation for instance can be achieved through social change – adapting our lifestyles in such a manner that we emit less e.g. by vacationing closer to home, making dietary changes, reducing waste etc. Some commentators have described social changes as being geoengineering too. Kim Stanley Robinson, for instance, argues that an expansion of women's rights, leading to a lower birth rate should be seen as being a form of geoengineering.[41] Robinson's point here, I take it, is that once we acknowledge the role that even seemingly un-climate related activities (expanding women's rights) have on the climate, and if we consider those climate effects when we chose to pursue those actions, we are intentionally modifying the climate and are therefore geoengineering. Robinson's broader claim is not specifically about women's rights being a form of geoengineering per se, but that geoengineering is a much broader project of environmental management that encompasses all activities done with their climate effects in mind: whether they are education about birth control or direct air capture machines.

I am sympathetic to this view, but nonetheless think that we have practical reasons to reject it, at least within this thesis. Accepting a Robinsonian view of geoengineering would entail that all 'mitigation' activity is also geoengineering. After all, if emissions regulation is geoengineering in the women's rights example, so must be more traditional mitigations too: switching to renewable energy, reducing energy demand, using energy more efficiently etc. Accepting Robinson's thesis means we cannot meaningfully talk about these separately. While I do think there might be some value in de-sensationalising geoengineering by bringing it into more direct comparison with other ways of dealing with climate change (i.e., traditional mitigation), I think this would be, for our sake's here at least, to ignore what is importantly different about geoengineering; namely that geoengineering involves ways of modifying the climate that are not limitations on emissions. For our purposes here it is sufficient to think that 'intervention' in the Earth's natural systems implies activities that induce climactic effects by producing material changes in the world which would not have occurred naturally, and which are additionally not emissions reductions.

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[40] IPCC., Edenhofer, O., Field, C., Pichs-Madruga, R., Sokona, Y., Stocker, T., Barros, V., Dahe, Q., Minx, J., Mach, K., Plattner, G.K., Schlömer, S., Hansen, G., Mastrandrea, M., (eds) (2012) *IPCC Expert Meeting Report on Geoengineering.* Potsdam, IPCC Working Group III Technical Support Unit, Potsdam Institute for Climate Impact Research. p.7

[41] Robinson, K.S., O'Keefe, D., (2020) Imagining the End of Capitalism with Kim Stanley Robinson. *Jacobin*. Oct 22nd. Note of course that a smaller human population is a material change.

2.4 To Counteract Climate Change

I believe that this requirement is the weakest element of the common definition, so weak that I will drop it entirely. Current interest in geoengineering technologies evolved in response to the awareness that anthropogenic emissions of GHGs are causing an increase in the planet's average temperature. This has meant that far and beyond the lion's share of geoengineering discussions today focus on the role it might play in ameliorating the harms of said warming. There are two reasons why we should reject the claim that this is a defining or necessary feature of geoengineering.

Firstly, I believe that including this requirement over-psychologises the motivations of geoengineers. Do we really need to know why anyone is proposing to alter the climate to know whether it is geoengineering? They may have no interest in stabilising the Earth's temperature at all, but instead see geoengineering as an important means to some other end. One major concern around the development of geoengineering technologies for instance is the fear that they could be employed as weapons of war – perhaps as a way to destabilise the climate of an enemy nation, hamper the movements of their troops or materiel, or disrupt their harvests etc.[42] If climate altering technology was employed in this way, the current definition would mean that it was not, strictly speaking 'geoengineering' since it was not employed for the correct motivation. If you follow the original definition of GE, to talk about GE being used as a weapon you would be saying 'Large scale intentional modification of the climate *to counteract climate change* as a weapon' - which is plainly nonsensical. Likewise, Parker, Horton, and Keith consider 'counter-geoengineering' responses that could be deployed to counteract the cooling effects of a unilateral geoengineering deployment. Included in these methods is the hypothetical use of a 'countervailing… warming agent' – i.e techniques that could be used to intentionally *heat* the planet as a reaction to efforts to cool it.[43] Again, this is certainly intentional climate modification, but it is not deployed to counter-act climate change. In light of this, I argue it is better to remove this requirement all together.[44]

Secondly, and linked to this: while modern geoengineering has focussed on anthropogenic climate change, the historic antecedents of 'geoengineering' pre-date the widespread understanding of this problem. Nonetheless, since the 1950's scientists in both the USA and the former Soviet Union researched extensively means for intentional modification of the Earth's climate – including many of the methodologies which are today proposed as means of handling climate change. The reasons these programs were developed were varied, but as crucially since they pre-dated the modern understanding of anthropogenic climate change, few were proposed for this reason. Restricting geoengineering just to programs to mitigate climate change would create an artificial distinction between modern and historic interest in climate modification.

[42] This is not a counterfactual – the earliest serious investigations into the possibilities of climate control were made precisely with this capability in mind. The authoritative exploration of this is: Hamblin, J.D., (2013) *Arming Mother Nature*. Oxford, Oxford University Press.

[43] Parker, A., Horton, J.B., Keith, D.W., (2018) Stopping Solar Geoengineering Through Technical Means: A Preliminary Assessment of Counter-Geoengineering. *Earth's Future*. Vol. 6. pp. 1058 – 1065.

[44] Note that this does not dispute the centrality of intentions – we need to know that a proposal aims to change the climate intentionally, but we do not need to have a specific reason why that was the intended effect.

2.5 A Definition of Geoengineering

I can now sum up my discussion and present a working definition of geoengineering to use throughout this thesis. I have argued that we should adopt a slightly modified version of the standard:

> the deliberate large-scale manipulation of an environmental process that affects the earth's climate, in an attempt to counteract the effects of global warming.

Geoengineering is deliberate: only intentional activities count. It is large-scale, which we interpreted as being, as a rule of thumb, active in an area somewhat similar to the IPCC 'standard regions' of which there may be several over a continent. It intervenes in/manipulates environmental processes: which we read as implying making changes, via technology, that would not have occurred naturally. The final part of the definition 'to counteract the effects of global warming' we suggested be dropped entirely. Thus, I will be defining geoengineering as:

> Methods to alter the climate over a large-scale through the intentional application of technologies or techniques to alter the functioning of the Earth's biogeochemical systems.

We should be aware of potential crossover between geoengineering and what is typically understood to be Mitigation. Geoengineering is typically thought to include carbon capture. However, as we have seen, the IPCC also included carbon capture, through the process of 'Enhancing Sinks', within its definition of mitigation. On this incongruence there is no resolution within the IPCC themselves, carbon capture can be both geoengineering and mitigation. How might we resolve this? A potential resolution might be to see carbon capture (as geoengineering) as carbon being removed *in addition* to an implied baseline carbon removal perceived to be 'natural', i.e., the total that occurred in pre-industrial times perhaps (although that too would have been variable). The 'sinks' being enhanced are perhaps 'natural' sinks for carbon which have by human activity become denuded. For instance, allowing a forest to reseed and grow larger then might be the 'enhancement' or a natural sink. Carbon Capture geoengineering is perhaps then assumed to be all removal on top of an assumed baseline. This interpretation of the IPCC is defended by Honeger *et al*, who argue that this understanding best fits with the Vienna Convention on the Law of Treaties requirement that UN treaty provisions be interpreted with their 'ordinary meaning'.[45]

Similarly, there may be some cross-over between adaptation and geoengineering too. Surface albedo modification efforts can play an adaptation role – for instance, brightening the built environment will cool the local area making it more pleasant for residents as temperatures rise. Similarly, marine cloud brightening and microbubble shading can be used to make large-scale climate significant changes, but they could also be used to protect corals and other ecosystems that are sensitive to ocean temperature changes. Afforestation can also play a role to play in flood management, so again this seems to be a dual- geoengineering/adaptation project. I take it that there is no inherent contradiction between geoengineering and adaptation in the way there is between geoengineering and mitigation. For any given project, provided it meets the definition of geoengineering given above, it may also have an adaptation role if it also ameliorates the specific harms of climate change (such as higher local temperatures, increased risk of flooding etc).[46] This is in keeping with the special role 'intentions' seem to play in deciding whether something is or is not a geoengineering intervention.

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[45] Honegger, M. et al. (2021) Is Carbon Dioxide Removal 'Mitigation of Climate Change'? *Review of European Community & International Environmental Law*. Vol. 30. Is. 3. p.328.

[46] Of course, some geoengineering methods may have other co-benefits that do not ameliorate the 'specific harms of climate change'. Direct Air Capture technologies could be sited near manufacturing districts and play a dual role in reducing harms from industrial pollution.

3.0 Geoengineering Methods

Having now provided a definition of geoengineering it is worth considering what geoengineering looks like practically. What is the state of the field of geoengineering innovations? How, practically speaking, might we choose to modify the climate? This section offers a brief review of the many proposals (recent and historic) for ways through which intentional climate modification might be achieved. There are several ways that we might group and categorise proposals. A taxonomy proposed by David Keith for instance sorted proposals into 'energy balance' (those that alter the quantity of energy from the sun that enters and leaves the Earth) and 'energy transport' modifications (those which move the energy around the Earth surface in novel ways).[47] However, this taxonomy has never gathered much traction due to the fact almost all proposals gaining any sort of interest today (SRM and CDR) are energy balance modifications. Typically, geoengineering is subdivided into two categories: Solar Radiation Management and Carbon Capture. This division is relatively recent, and possibly reflects the gradual move of carbon capture further into mainstream climate policy and away from the controversial reputation associated with the geoengineering terminology. Nonetheless I still find geoengineering a useful umbrella term for all intentional climate modification proposals. Energy transport modifications do not neatly fit the SRM/CC binary but nonetheless warrant some discussion due to their historical importance. I discuss them at the end of this section.

2.1 Carbon Capture

Carbon Capture, or more generally Greenhouse Gas removal, is probably the most widely discussed and most mainstream form of geoengineering. Almost all pathways to keeping warming below 1.5 °C now include some greater or lesser amount of carbon capture. In the following subsection I examine the most popular carbon capture methods being proposed and give a brief account of their history, development, and technological readiness, along with any other details that may be useful in a consideration of their ethical acceptability.

2.1.1 Biological Carbon Capture

Perhaps the simplest way to capture and store carbon from the atmosphere is through biological means. Carbon dioxide is naturally sequestered by natural processes, particularly biological processes such as the photosynthetic processes of plants. For this reason, several methods for carbon capture involve increasing the volume of plant growth. Most commonly this is done through forestry management – this being the development of new (afforestation), or renewal of previous (reforestation). Afforestation is currently the only method of geoengineering operating at scale, and it is currently governed and incentivised via the trading of carbon-credits as provided for by the Paris Agreement Article 6.4, and previously by the Kyoto Protocol.[48] However, interest in sequestering carbon in terrestrial biomass has expanded its scope from forests, and new methods focus on the potential for storage in agricultural croplands and bioenergy cropping. One method that has seen some interest is the potential for increasing the amount of carbon stored in soils, particularly

[47] Keith, D., (2000) Geoengineering the Climate: History and Prospect. *Annual Review of Energy and the Environment*. Vol. 25. pp. 245-284.
[48] UNFCCC (2018) *The Paris Agreement*. New York, Treaty Section of the Office of Legal Affairs, United Nations Headquarters. Article 6.4.

through changes in agricultural management including a switch to 'zero-till' farming.[49] There is also interest in the potential for genetically modifying plants so that they can store more carbon with longer root systems.[50]

However, by far the method which has generated the most interest is BioEnergy Carbon Capture and Storage (BECCS). BECCS envisions a wide-scale transition to growing biomass as fuel. When the energy crops are growing, they sequester carbon from the air. This would normally be released into the atmosphere again once they are burned, but BECCS combines the use of biofuel with the use of carbon 'scrubbers' in the powerplants that capture the release of carbon from the combustion facility. The result is an in-theory net-negative release of carbon, that in turn produces carbon-free energy too.[51] BECCS currently plays an essential role in projections for achieving an increased warming of less than 1.5 °C, almost all projection that led to warming remaining under 1.5 °C involve a greater or lesser BECCS regime. However, it is yet to be deployed at scale.

Similar to BECCS, BioChar is a way of capturing carbon from biological materials, potentially through specifically grown crops or from biological waste materials. Biochar is a product created through the pyrolysis (heating without oxygen) of biological materials resulting in a charred, coal like substance. Carbon is captured by the plants as they grow and is retained through the pyrolysis process. Biochar itself is a commonly used soil-fertiliser product. Produced biochar would then be stored in agricultural lands where it has the co-benefit of helping replenish soil nutrients, as well as avoiding potential land-use conflict. Some scenarios imagine biochar being created from human and animal waste, which would also minimise conflict with crop growing land.[52]

In addition to terrestrial biological means of sequestration, there has been a moderate degree of interest in the potential for biological oceanic carbon sinks. These primarily involve the potential for artificially stimulating phytoplankton blooms, which sequester carbon from the atmosphere through photosynthetic processes before dying off and sinking deep into the ocean where the carbon (in theory) remains sequestered. A useful review of this technique is provided by de Baar *et al.*[53] Research indicates that the primary limiting nutrient for the blooming of phytoplankton in the surface ocean is iron, which is why this method is sometimes referred to as Iron Fertilisation. Iron, usually in the form of filings, is added to the ocean by a ship, provoking a population boom of local phytoplankton.

This technique received a significant amount of interest in the late 1980s to mid 1990s, during which time at least 9 field trials were performed to test the hypothesised link between iron availability and plankton growth. The fact that field trials have been performed would on its own make it notable amongst geoengineering techniques, however, Iron Fertilisation also has the dubious honour of being the subject of the first 'rogue' geoengineering experiment when in 2012, Russ George, head of the company Planktos, dumped around 100 tonnes of Iron Sulphate into the ocean off Western

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[49] While discussions of the loss of Soil Organic Carbon's effects on climate had been discussed since as early as 1980, the first paper to propose that changed agricultural practices could play a role in sequestering carbon and having a deliberate effect on climate might have been: Lal, R., (2004) Soil Carbon Sequestration to Mitigate Climate Change. *Geoderma*. Vol. 123 Is. 1. pp. 1-22.

[50] Harnessing Plants Initiative. (2023) *Overview*. Salk Harnessing Plants Initiative Webpage.

[51] Ranjan M., Herzog, H.J., (2011) Feasibility of Air Capture. *Energy Procedia*. Vol. 4. pp. 2869–2876.

[52] Krounbi, L., Enders, A., Van Es, H., Woolf, D., Von Herzen, B., Lehmann, J., (2019) Biological and Thermochemical Conversion of Human Solid Waste to Soil Amendments. *Waste Management*. Vol. 89. pp. 366-378.

[53] De Baar, H.J.W., Boyd, P.W., Coale, K.H., Landry, M.R., Tsuda, A., Assmy, P., Bakker, D.C.E., Bozec, Y., Barber, R.T., et al. (2005) Synthesis of Iron Fertilisation Experiments: From the Iron Age in the Age of Enlightenment. *Journal of Geophysical Research: Oceans*. Vol. 110. Is. C9. pp. 1 – 24.

Canada, after obtaining the permission of the local council of the indigenous Haida community. George's efforts came after an early attempt to do the same off the coast of the Galapagos islands was thwarted by the Spanish and Ecuadorian governments. Iron Fertilisation, partly in response to this event, is also one of the forms of geoengineering that has attracted the most regulatory attention. Specifically, Iron Fertilisation, beyond scientific experiments is regulated by COP 9 Decision IX/16, urging a moratorium on 'large-scale' ocean fertilisation experiments, and citing the London Protocol on Dumping Wastes at Sea as precedence. Nonetheless, this decision does not have any formal legal standing. Questions remain as to how effective iron fertilisation is at storing carbon long-term, and the ecological impacts and potential side effects of altering ocean food chains in such a dramatic manner should also be seriously considered.

2.1.2 Abiotic/Chemical Carbon Capture

Not all means of carbon sequestration rely on biological processes however. Substantial effort has been devoted to the development of methods for capturing and storing carbon dioxide geologically. Unlike storage in biomass, geologic storage can maintain carbon sequestered for extremely extended periods of time.[54] In some instances, this is a process which occurs within a fossil fuel power plant, scrubbing carbon emissions as they escape the flues.[55] This is usually referred to as Point Source Carbon Capture and Storage. However, removal of carbon from flue gasses does not change the content of carbon in the atmosphere, unless the material being combusted is a form of biomass which has accumulated carbon during growth (as in BECCS). Therefore, it does not in itself constitute a form of geoengineering (it is perhaps better understood as mitigation – lowering the emissions of fossil fuel energy or industry), but it is a necessary stepping-stone technology for developing geoengineering. It should also be noted that CO_2 cannot be captured with 100% efficiency, so Point Source CSS cannot deliver on zero-carbon fossil fuels without additionally being coupled with Direct Air Capture technologies to create a net-negative effect.

Direct Air Capture and Storage (DAC) is a method for capturing carbon by reacting carbon out of the ambient air in a specially constructed industrial facility and feeding it through a compressor so that it can be stored underground (or utilised in other ways).[56] This has been proposed since as early as 1999 by Klaus Lackner.[57] There are now a few DAC facilities in commercial operation, although these are mostly capturing carbon to meet commercial demand (for low-carbon fuels), and thus are not necessarily contributing to the long-term storage of carbon. [58] The process of capturing carbon for industrial uses rather than storage is commonly referred to as CCU, or Carbon Capture for Utilisation. Note that CCU is not typically understood to be geoengineering, as the aim is to acquire useful materials rather than altering the climate. Many of these uses return the captured GHGs to the atmosphere, hence while their creation required no new emissions to be released, they do not themselves contribute to an overall reduction in atmospheric GHG concentrations and therefore only have a 'mitigation' effect on the climate.

Another method for achieving geologic carbon sequestration and storage is through a process known as Enhanced Weathering (EW). This method proposes that the natural processes of carbon

[54] Though note that not all biological carbon capture intends to store carbon indefinitely in biomass, rather it uses biomass as a means for the sequestration before moving it to geologic or other forms of storage, such as forestry products (i.e., lumber) which could be used in construction.

[55] It is somewhat contentious as to whether this is geoengineering, since it does not result in a net negative in emissions – only rending future fossil fuel combustion carbon neutral.

[56] Ranjan M., H.J. Herzog, (2011) Feasibility of Air Capture. *Energy Procedia*. Vol.4. pp. 2869–2876.

[57] Lackner, K.S., Ziock, H., Grimes, P.G. (1999) *Carbon Dioxide Extraction from Air: Is it an Option?* New Mexico, Los Alamos National Lab Reports.

[58] International Energy Agency (2022) *Reports: Direct Air Capture*. Paris, International Energy Agency Reports.

sequestration that occurs as basaltic rocks weather (i.e., are exposed to the atmosphere and eroded by precipitation) could be 'enhanced' by grinding these rocks into an easily weatherable sand that reacts with ambient carbon in the air. These basaltic sands are then weathered by rain and wind through soils and into watercourses before being washed down into the deep ocean where they are stored. This storage may also happen as the basalt seeps deep within the soils of the land it is spread over).[59] The naturally alkaline nature of basaltic rock means this method could help reduce ocean acidity – the process by which the ocean has become more acidic as a result of the carbon it has absorbed from the atmosphere as a result of fossil fuel burning. Reducing the acidity of the ocean would also improve its natural ability to act as a carbon sink too, potentially increasing the carbon sequestration effects that EW has. This would also be an 'adaptation' method.

2.1.3 Cirrus Cloud Thinning/Cloud Tuning

Cirrus cloud thinning is not a form of carbon capture, but ultimately aims to create a climate alteration in a similar manner, thus I will discuss it here. Carbon Capture works by removing a barrier (GHGs) to energy from the Earth escaping back to space. Cirrus cloud thinning works in the same way. Cirrus clouds are a naturally occurring high level cloud. Like all clouds, they reflect solar radiation away, but they also trap radiation escaping the earth by acting like a blanket. While most clouds reflect away more radiation than they trap (see section 2.2.3 on Marine Cloud Brightening), Cirrus clouds are unique in that they capture more radiation than they disperse, meaning they are a net generator of global temperature. Thus, techniques to disperse cirrus clouds, or stop them forming would in theory help lower temperatures.

Technologies for cloud dispersal have been studied since the 1940s, so the principles and techniques are now reasonably well understood. The addition of ice nuclei, injected by aircraft or cannon, cause the formation of ice crystals within clouds leading to them dispersing via precipitation. This technique is commonly referred to as 'cloud seeding' and has been periodically employed to stimulate precipitation (Notably at the Beijing Olympics). Employing these techniques to disperse cirrus clouds may be a viable technique to increase heat lost to space, although the effectiveness of this technique and its possible effects on global precipitation patterns are still poorly understood.[60] Cirrus Cloud Thinning does not neatly fit the Solar Radiation Management/Carbon Capture distinction.

2.2 Solar Radiation Management/Albedo Modification.

Carbon Capture is by far the most important form of geoengineering in terms of professional interest and its level of deployment. But the other, and by and large more controversial, way that geoengineering might be done is managing the amount of energy entering the Earth's climactic system from the sun (Insolation). Techniques that attempt to produce a cooling effect by altering the degree of insolation are collectively known as Solar Radiation Management, or SRM. SRM attempts to cool the planet by lowering the amount of solar radiation entering the system. How might this be done?

Proposals for modifying the climate in this way are remarkably old and predate modern interest in geoengineering by some twenty years or more. One of the earliest proponents was the prominent Soviet climatologist Mikael Budyko, who suggested injecting reflective aerosols into the upper atmosphere as early as 1974 in response to growing understanding of the effects of CO_2 on the

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[59] Schuiling R., Krijgsman, P., (2006) Enhanced Weathering: An Effective and Cheap Tool to Sequester Co2. *Climatic Change*. Vol. 74. pp. 349–354.

[60] Muri, H., Kristjánsson, J.E., Storelvmo, T., Pfeffer, M.A., (2014) The Climatic Effects of Modifying Cirrus Clouds in a Climate Engineering Framework. *Journal of Geophysical Research: Atmospheres*. Vol. 119. pp. 4174–4191.

atmosphere.[61] Three years later, Freeman Dyson proposed the warming effect from coal fired power plants could be partially mitigated by switching to coal of a high sulphur content, and using the smokestacks to distribute the reflective sulphur particles into the high atmosphere.[62] However, widespread interest in the possibility did not take off until the landmark 1997 National Academy of Sciences Report which reported a number of radiation modifying technologies under its list of 'climate mitigation strategies'. Practical support for the principle of producing lower temperatures via reflecting away solar radiation was also empirically evidenced in the wake of the 1991 eruption of Mt Pinatubo, which spewed 17,000,000 tonnes of sulphur dioxide into the stratosphere and resulted in temperatures in the northern hemisphere 0.5°C lower than average.[63]

2.2.1 Stratospheric Aerosol Injections

The primary means proposed for modifying the solar radiation balance is via Stratospheric Aerosol Injection (SAI). Stratospheric aerosol injection intends to create a cooling effect, as the name suggests, by increasing the Earth's reflectivity by transporting quantities of aerosolised chemicals, (usually sulphur dioxide or calcium carbonate) into the upper atmosphere, via a fleet of specially modified aircraft or other means.[64] Proposals for SAI, as above, probably date back to Budyko in 1974, however recent serious interest in the technique can be better attributed to a landmark article from 2006 by Paul Crutzen.[65] While the potential of SAI for producing a quick and cheap cooling effect with essentially 'off the shelf' technologies were lauded by Crutzen, so far SAI research has largely been confined to computer modelling.[66] These models however have suggested that this method is likely highly effective at producing a cooling effect. However, the major contention in the modelling is the other atmospheric changes regular SAI might cause. Major concerns have been raised about potential effects on hydrological regimes, particularly over potential disruptions certain SAI deployment scenarios have predicted on the South Asian Monsoon. [67] SAI would also likely have effects on plant growth that are not fully understood. This is because not only does SAI work by reducing the amount of light that reaches the earth, but it also makes the light which does arrive more diffuse. Both of these effects will impact plants' ability to photosynthesise.[68] It may also have a visual difference on the colour of the sky, potentially creating a milky white effect similar to how the sky looks over very polluted cities. A reasonably well publicised concern over SAI geoengineering (which it should be noted is also applicable to other forms of SRM) is the potential risk of 'Termination Shock'. SAI might be used as a strategy to 'buy -time' while waiting for CDR and mitigation technologies to scale up. This means that in some usage scenarios, SAI allows temperatures to remain stable while concentrations of CO_2 in the atmosphere continue to increase.

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[61] Budyko, M., (1974) *Climactic Changes*. Washington DC, American Geophysical Union. The technique is very occasionally known as a Budyko-Blanket in recognition of this.

[62] Reported in Fleming, J., (2010) *Fixing the Sky: The Chequered History of Weather and Climate Control*. New York, Columbia University Press. p. 243.

[63] Parker, D.E., Wilson, H., Jones, P.D., Christy, J.R., Folland, C.K., (1996) The Impact of Mount Pinatubo on World-Wide Temperatures. *International Journal of Climatology*. Vol. 16. Is. 5. pp. 487–497.

[64] Irvine, P. J. et al. (2016) An Overview of the Earth System Science of Solar Geoengineering: Overview of the Earth System Science of Solar Geoengineering. *Wiley Interdisciplinary Reviews: Climate Change*. Vol. 7. Is. 6. pp. 815-833.

[65] Crutzen, P. J. (2006) Albedo Enhancement by Stratospheric Sulfur Injections: a Contribution to Resolve a Policy Dilemma? *Climatic Change*. Vol. 77. pp. 211–220.

[66] Irvine, et al. (2016) An Overview of the Earth System Science of Solar Geoengineering. pp. 825-826.

[67] Tilmes, S., Fasullo, J., Lamarque, J.F., Marsh,D.R., Mills, M., Alterskjær, K., Muri, H., Kristjánsson, J.E., Boucher, O., Schulz, M., et al. (2013) The Hydrological Impact of Geoengineering in the Geoengineering Model Intercomparison Project (GeoMIP). *Journal of Geophysics Research: Atmospheres*. Vol. 118. pp. 11036–11058.

[68] Kravitz, B., MacMartin, D.G., Caldeira, K., (2012) Geoengineering: Whiter Skies? *Geophysics Research: Letters.* Vol. 39. L11801.

This in turn leads to a danger of increased warming or otherwise dangerous climactic instabilities if for any reason SRM efforts failed, were not maintained, or were improperly terminated. 'Termination Shock' refers to a scenario in which SRM abruptly ended without the corresponding level of CO_2 drawdown, leading to a rapid and dramatic increase in temperature.[69]

A few small field trials of delivery technologies have been performed, but they have been mired in public controversy and protest. In particular, the level of controversy surrounding even the research into SAI caused the SPICE program in the UK to abort a field trial of a balloon hoisted hosepipe, which was to spray harmless water particles at an altitude well below the stratosphere.[70] Since then, SAI research was largely confined to computer modelling to assess its potential impact. This was until early 2023, when US based start-up 'Making Sunsets' made the surprise announcement they had unilaterally begun making stratospheric sulphur dioxide injections, lifting the particulates into the atmosphere by modified weather balloon.[71] While these experiments were most likely completely ineffective, the fact that the company had taken payments from commercial organisations as part of a voluntary market for climate offsets marks a significant advancement in the move of SAI away from its taboo status. Nonetheless the company's actions were highly controversial, and the full effects of their announcement on the field are still emerging.

2.2.2 Solar Shades/Space Based

Another large-scale means for increasing reflectivity is space-borne infrastructure – particularly the possibility of putting reflective mirrors or sunshades in space. These would operate by intercepting solar radiation before it reaches the earth, either by using solid structures, or swarms of small satellites or dust clouds to reduce the amount of solar radiation reaching earth. These technologies essentially act as giant parasols for the earth. Proposals for this exist as early as 1989, when James Early claimed that a glass or even moon-rock construction could offset the warming effect of increasing atmospheric CO_2 concentrations. However, interest has waned as the technical constraints of erecting such a device have proved to be significant, especially in the timescales necessary. Nonetheless, Angel and Struck remain recent proponents of this method of GE.[72]

2.2.3 Marine Cloud Brightening/Micro-Bubble Shading.

While both space based and stratospheric solar radiation management propose methods for altering the climate at a planetary scale, two other methods of SRM offer the ability to alter climate at a smaller, but still large-scale degree[73]. Marine Cloud Brightening is a method gaining traction that proposes increasing the planetary albedo by increasing the reflectivity of low-lying marine clouds, by

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[69] Jones, A., Haywood, J.M., Alterskjær, K., Boucher, O., Cole, J.N.S., Curry, C.L., Irvine, P.J., Ji, D., Kravitz, B., Kristjánsson, J.G., et al. (2013) The Impact of Abrupt Suspension of Solar Radiation Management (Termination Effect) in experiment G2 of the Geoengineering Model Intercomparison Project (GeoMIP). *Journal of Geophysics Research: Atmospheres*. Vol. 118. pp. 9743–9752.

[70] The Story of the Spice Project is recounted in Stilgoe, J., (2015). *Experiment Earth: Responsible Innovation in Geoengineering*. London, Routledge.

[71] Temple, J., (2022) A Start-Up Says It's Begun Releasing Particles into the Atmosphere, in an Effort to Tweak the Climate. *MIT Technology Review*. Dec 24.

[72] Angel, R., (2006) Feasibility of Cooling the Earth with a Cloud of Small Spacecraft near the Inner Lagrange Point (L1). *Proceedings of the National Academy of Science*. Vol. 103. Is. 46. pp. 17184–17189.

Struck, C. (2007) The Feasibility of Shading the Greenhouse with Dust Clouds at the Stable Lunar Lagrange points. *Journal of the British Interplanetary Society*. Vol. 60. Is. 3. pp. 82–89.

McInnes, C.R. (2010) Space-based Geoengineering: Challenges and Requirements. *Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science*. Vol. 224. Is. 3. pp. 571-580.

[73] I.e., on a 'regional' scale.

'seeding' them with a benign material such as sea-salt.[74] Currently, pollutants emitted from industrial facilities and global shipping inadvertently affects the brightness and frequency of clouds. Pollutants form the nucleus around which water droplets condense which is the starting stage of cloud formation. The amount of cooling that this currently produces is relatively unknown.[75] However it has been attributed as a factor in explaining why ocean temperatures have risen faster the land temperatures contributing to the northern hemisphere ocean heatwave in 2023.[76] Proponents of Marine Cloud Brightening propose that by using specially modified ships, or other ocean surface devices to launch sea salt, this process can be purposefully stimulated.

Additionally, proponents of Microbubble Shading argue that albedo of the ocean surface can be increased through the stimulation of nano-scale bubbles of air. Moored platforms would force air into the ocean surface to brighten it and reflect solar radiation away. This technique has garnered a significant amount of interest for its potential to protect delicate coral reef ecosystems from 'bleaching' and dying when water temperatures exceed the narrow window corals are able to live within. The government of Australia has shown particular interest in this for the potential it has to prevent bleaching on the Great Barrier Reef.[77] There is some debate however over whether this should be properly understood as geoengineering rather than Adaptation.[78] Microbubble shading certainly has the potential to cool the seas on a 'regional' scale comprising thousands of kilometres but as it is currently envisioned, its use is limited to occasional shading of local areas, including of reefs during particularly hot summer temperature highs, but also over reservoirs, harbours, and other relatively still, shallow, and accessible areas of water.[79]

2.3 Energy Transport

In David Keith's taxonomy of geoengineering proposals, he groups together SRM and CDR as 'energy balance' techniques, which attempt to produce a change in temperature by altering the balance of energy entering and leaving the Earth's climate system. In the case of carbon capture (and cirrus cloud thinning) this is by removing the GHG constraints to energy escaping to space. SRM affects the balance by preventing the energy entering the system to begin with. Keith contrasts these with what he terms 'energy transport' modifications. Unlike energy balance modification, Energy Transport refers to methods of climate alteration that work by altering the flows and distribution of energy that are already within the Earth system. These techniques are largely a historical curiosity, receiving some serious attention in the post-war years up until the 1970s and '80s where the interest in geoengineering shifted to its potential as a method for mitigating climate change. It is worth

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[74] Originally proposed in 1990 by John Lantham: Latham, J., (1990) Control of Global Warming? *Nature*. Vol. 347. Is. 6291. pp 339–340.

[75] Myhre, G., Shindell, D., Bréon, F.M., Collins, W., Fuglestvedt, J., Huang, J., Koch, J., Lamarque, J.F., Lee, D., Mendoza, D., Nakajima, T., Robock, A., Stephens, G., Takemura, T., Zhang, H., (2013) Anthropogenic and Natural Radiative Forcing. In: Stocker, T.F., Qin, D., Plattner, G.K., Tignor, M., Allen, S., Boschung, S., Nauels, A., Xia, Y., Bex, V., Midgley, P.M., (eds) (2013) *Climate Change: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge, Cambridge University Press.

[76] Voosen, P., (2023) 'We're Changing the Clouds.' An Unforseen Test of Geoengineering is Fuelling Record Ocean Warmth. *Science*. 2nd Aug.

[77] Anthony, K.R.N., Helmstedt, K.J., Bay, L.K., Fidelman, P., Hussey, K.E., Lundgren, P., Mead, D., McLeod, I.M., Mumby, P.J., Newlands, M., Schaffelke, B., Wilson, K.A., Hardisty, P.E., (2020) Interventions to Help Coral Reefs Under Global Change - A Complex Decision Challenge. *PLoS One.* Vol. 15 Is. 8. pp. 1–14.

[78] David Harrison, comments during: Carnegie Climate Governance Initiative (C2G) (2022) *Marine Cloud Brightening – A Governance Dilemma*. UN Ocean Conference. Webinar 01/07/22

[79] Seitz, R. (2011) Bright water: Hydrosols, Water Conservation and Climate Change. *Climatic Change*. Vol. 105. Is. 3. pp. 373 - 375

considering these techniques here in order to consider the longer history of attempts at intentional climate modification, as well as to appreciate the complete variety of methods that could be used to provoke climate changes.

Most often Energy Balance proposals aim to produce a climate altering effect by altering the Earth's hydrological conditions – the flow or salinity of water, or the rates of evapotranspiration – usually on a very large scale. However, other proposals consider methods for altering the circulation of atmospheric air currents. Human activity already unintentionally alters the movement of energy around the earth, for instance the increased concentration of CO_2 in the atmosphere has narrowed the range of the Intertropical Convergence Zone (ITCZ).[80] Proposals for intentional modification are mainly limited to large-scale hydrological engineering – particularly the possibility of using dams and pumps to alter the flow of ocean currents, or to change the relative salinity or temperature of water bodies to affect their behaviour. As early as 1870, Harvard geologist Nathaniel Shaler argued that a dam to affect the flow of the warm Kuroshio current into the Bering Strait could beneficially warm the Arctic regions of the world.[81] The idea of a Bering Strait dam was also a prominent theme in Soviet geoengineering research, being proposed separately by Borisov and Shumilin, though neither could agree whether water should be pumped north or south in order to prompt a warming effect.[82] Other proposals have focussed on the potential to alter the flow of oceanic currents – in particular both Russian and American proposals for altering the course of the Gulf Stream have been proposed. As early as 1912, the American Industrialist Carol Riker, inspired by the excavation of the Panama Canal, proposed using a 200-mile-long causeway to deflect the ocean current further out into the Atlantic and away from the US East Coast, intending to warm the continent's interior.[83] More recently, proposals to alter the salinity of the Gulf Stream (to propose a cooling effect) have been considered by Hunt et al.[84]

In addition to salinity modification, the climate affecting properties of bodies of water can be altered by changing the rates at which they evaporate. Decreasing the rate at which water evaporates from a body of water can warm it considerably, and in large scale application this has the potential for climate alteration. Fleming notes a proposal for using a film of alcohol to warm the northern part of the Gulf Stream in this manner but does not list the origin of this scheme.[85] Using an alcoholic form to alter evaporation rates was also considered by Soviet scientists. This gives this method the rare accolade of being reviewed in a large-scale field trial, when experiments were conducted on the effects of various films on Lake Sevan in modern day Armenia.[86] These proposals have now widely fallen out of favour in modern discussions of geoengineering.

Energy transport modifications do not feature prominently in modern discussions of geoengineering. However, as geoengineering moves into the mainstream of climate discussions, we run the risk of side-lining the longer history of attempts to intentionally modify the climate. Moreover, while these techniques are out of favour today, this does not mean that the kinds of critique we discuss

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[80] Byrne, M.P., Pendergrass, A.G., Rapp, A.D. et al., (2018) Response of the Intertropical Convergence Zone to Climate Change: Location, Width, and Strength. *Current Climate Change Reports*. Vol. 4 pp. 355–370.

[81] Fleming, (2010) *Fixing the Sky.* p. 201

[82] Fleming, (2010) *Fixing the Sky*. p. 201.

[83] Fleming, (2010) *Fixing the Sky*. p. 201.

[84] Hunt, J.D., Nascimento, A., Diuana, F.A., et al., (2019) Cooling Down the World Oceans and the Earth by Enhancing the North Atlantic Ocean current. *SN Applied Sciences*. Vol. 2. Is. 15. pp. 1-15.

[85] Fleming, (2010) *Fixing the Sky*. p. 202.

[86] Makarova, V.S., Mkhitarian, A.M., Experiments on Using Monomolecular Films for the Reduction of Evaporation of Lake Sevan from its shore. In: Zikeev, N.T., Doumani, G.A. (1967) *Weather Modification in the Soviet Union, 1946-1966*. Washington DC, Library of Congress.

throughout the thesis would not equally apply to these methods too. For those concerned with 'tampering with nature', the energy transport modifications that were semi-seriously considered in the middle of the last century would no doubt be equally or more concerning as geoengineering methods proposed today as means for dealing with climate change. It is therefore good to keep in mind these techniques as examples of just how wide-ranging intentional climate change could be.

4.0 Conclusions

This chapter acts as a general primer on geoengineering to inform on the discussions that will be had throughout the thesis. I have discussed what geoengineering is on a theoretical level: how it compares to other ways of managing the climate crisis, and how we might accordingly define it. I argued for a modified version of the standard geoengineering definition:

> Activities that aim to alter the climate over a large-scale which are achieved through the purposeful application of technologies or techniques to alter the functioning of the Earth's biogeochemical systems.

Whenever the term geoengineering is used now throughout the thesis, it should be assumed that this is the implied meaning, unless otherwise stated.

While a high-level definition of geoengineering was necessary to proceed with our philosophical investigation, it was also necessary to consider geoengineering 'in the real world'. Substantial efforts have been devoted to detailing and cataloguing the various methods/technologies/techniques for how geoengineering might be achieved. As I argue throughout the thesis, different ways of doing geoengineering may have different moral outcomes, so it is essential that we outline them here for reference later.

Chapter 2 – Environmental Ethics and the Presumptive Case Against GE

1.0 Introduction

It is not hard to see why geoengineering prompts members of the public to accuse it of 'tampering with nature'. As I have argued in the previous chapter, geoengineering as a unified grouping of techniques and technologies, is unified by the fact it intends to create large-scale intentional change to core parts of the Earth's biogeochemical systems. Interventions in the natural world on this scale have only extremely scant precedent and where there is precedence for intentional management of natural systems, humanity's track record is extremely poor (consider the use of introduced species to manage agricultural pests, or the ecological impacts of modified hydrological regimes). Moreover, the kinds of intentional transformation envisaged by geoengineering might seem to violate a belief about the proper treatment of natural world. The mainstream tradition in modern environmentalism has typically held that humans, at least occasionally, have a duty to preserve (natural) parts of the world in an unmodified state or at the very least to keep human involvement in them to a minimum. If this is an apt characterisation of typical environmentalist sympathies then it is self-evident why geoengineering, as a program of vast ecological modification, will be a cause for concern to environmentalists, and provokes accusations of 'tampering with nature'.

However, simply recognising why there is prima facie appeal to the 'tampering with nature' accusation is not ground enough for accepting it. In order to be sure that the charge of tampering with nature is well grounded, we first need to understand the justifications for anti-interventionist or preservationist stances towards the natural world, and then explain why geoengineering specifically would violate any duty to preserve. In order to do this, we need to turn to the environmental ethics literature. Environmental ethics as a discipline has sought to understand our obligations towards the natural world and explain why, if at all, they exist. Thus, this chapter begins (Section 2) by introducing environmental ethics critiques of geoengineering.

In Section 3, I give an account of an argument presented by Christopher Preston. Preston argues that when we turn to this environmental ethics literature, we do find – as might be expected – a 'presumption' against geoengineering.[87] He writes that across the discipline, geoengineering would be 'unthinkable' to core perspectives, even those which otherwise disagree with one another. This is because of a widespread wariness within the discipline about large-scale environmental modification programs. This wariness finds expression in different ways: in Katz's concerns about preserving nature unmodified, or in Taylor's 'principle of non-interference'; but the existence of this wariness over grand environmental modification projects is why Preston finds a widespread presumption within theories of environmental ethics that geoengineering will be wrong. At best, Preston argues, geoengineering might be legitimated only as the lesser of two evils to allowing dangerous environmental change to occur unchecked. Environmentalists can support geoengineering in this way, but never as a legitimate and principled activity in and of itself.

I then (Section 3.3) set out the thesis that I will defend in this work. I agree with Preston's argument that the pressing concern of climate change will likely mean that environmental ethicists will abandon their principles in favour of the 'lesser evil'. I do not dispute that there might be an argument that shows why geoengineering is the lesser evil to climate change. However, I believe we may go a step further. While the lesser evil argument suggests that the weight of the moral

[87] Preston, C.J., (2011) Re-Thinking the Unthinkable: Environmental Ethics and the Presumptive Argument Against Geoengineering. *Environmental Values*. Vol. 20. Is. 4. pp. 457-479.

imperative to arrest climate change shows that the reasons for presuming against geoengineering are not sufficient to ground a total prohibition on geoengineering. I argue that such reasons do not necessarily need to be overridden at all for a coherent case for geoengineering to be made. I believe that when we look at some of the key positions in environmental ethics many of these perspectives can be plausibly read as open to some forms of geoengineering, in at least some situations. This means that environmental ethicists do not need to resort to showing that geoengineering is the lesser evil to be able to advocate for (some) forms of geoengineering.

In Section 4, I illustrate this by giving a review of six authors Preston cites in support of his thesis. These positions are discussed here in anticipation of reviewing in greater depth some of the stronger arguments that will be discussed in full in my subsequent chapters. I argue that in each of these cases, a plausible explanation can be given that can show the author in question will be open to some forms of geoengineering. I conclude that if there is an environmental ethics argument that can show why geoengineering will necessarily involve wrongdoing (I.e., an explanation for why it 'tampers with nature'), it cannot be found here.

2.0 Environmental Ethics Critiques

This thesis is concerned with what I will refer to as 'environmental ethics critiques' of geoengineering.[88] In this subsection I will delineate and introduce this group of critiques. I give a brief history of the development of environmental ethics within the western philosophical tradition and give an account of its major debates and concerns. This will provide necessary context for examining Christopher Preston's claims that various common perspectives within what we term 'environmental ethics' will 'presume' against geoengineering in the following section.

In the most general sense, the discipline of environmental ethics studies the moral value of, and duties (if any) owed by humans toward, the non-human natural world. Environmental ethics first developed as a distinct branch of moral philosophy in the late 1960s and early 1970s, concurrently in the USA, Norway and Australia. This was generally in response to a growing interest in and awareness of environmental problems as well as a recognition within academic philosophy that traditional ethical value systems struggled to explain the value of natural non-human entities without referring to the use value they provide for human beings.

A central concept within environmental ethics is 'intrinsic value', and identifying which kinds of entities possess it and why. Intrinsic value can mean different things in different contexts, but it always refers to a kind of value, possessed by an entity qua being that entity, as an end in itself. It is contrasted with 'instrumental value', which is the value possessed by an entity as a means to attaining some other end. A good overview of the differences between instrumental and non-instrumental valuable is provided by O'Neill.[89] 'Intrinsic value' is sometimes used to refer the subjective valuation of an entity by some (human valuer). The valuer may choose to value a particular object, such as a piece of art, for what it is rather than what it is instrumentally useful for. These valuations are subject to change, e.g., through persuasion of the valuer to value it in another way. *Subjective* intrinsic value is reliant on their being some kind of valuer to confer the value on an entity. It is in this way contrasted with *objective* intrinsic value which is thought to be possessed by an entity whether or not there is anyone else to confer it – as Rolston puts it 'these things count,

[88] While I distinguish three groups of geoengineering critique, this is not thought to be exhaustive. Nor is it meant to be a strong delineation, the boundaries of each grouping are likely porous – something may both be a technical critique and an environmental critique. The intention of this is to provide a general guide to the remit of this thesis, not a watertight categorisation.

[89] O'Neill, J., (1992) The Varieties of Intrinsic Value. *The Monist*. Vol. 75. Is. 2. pp. 119 – 137.

whether or not there is anybody to do the counting'.[90] If an entity has *objective* intrinsic value, it is because it possesses so value conferring property, which is independent from the judgement of anyone else. Central to many non-anthropocentric theories of environmental ethics is the argument that entities *other than human persons* are in possession of this kind of intrinsic value, and moreover, the possession of this intrinsic value makes the entities who possess it *morally considerable*. Put in Kant's famous terminology, moral considerability means that the entities who possess it must be considered as *ends-in-themselves* rather than simply instrument means-to-ends when making morally relevant choices. Much of early environmental ethics was concerned with arguing that traditional identifications of the distribution of moral considerability only extending to human beings (or subsets thereof) were mistaken, and proposing alternative worth-conferring properties which showed that moral considerability in fact extended to at least some non-human entities too.

Traditional ethical theories within the western philosophical canon have typically seen the set of entities which possess intrinsic value as entirely coextensive with human beings (though not, we should note, necessarily equally distributed amongst human beings). On account of this, we refer to these theories as *anthropocentric*. Different justifications have been given for this. Some of these are/were theological in character: they explain the preferential position of human beings within the moral order in a description of their preferred position within a super-natural order. For instance, within the 'Judaeo-Christian' tradition, God was thought to have granted human beings the right to 'dominate' or 'steward' all other living things.[91] A similar view appears to exist in Aristotle, in whose cosmic hierarchy human beings are the final beneficiary of the remainder of the natural world, whose purpose is to provide for them. He writes that '[if] nature makes nothing purposeless or in vain, all animals must have been made by nature for the sakes of man'.[92] Modern justifications for anthropocentrism might begin with Kant, whose emphasis on acting on correct maxims requires that ethical beings are necessarily rational beings. Thus, a property (reason) is identified which confers upon its possessor intrinsic value. We should note though that this is only a *de facto* anthropocentrism in so far as for Kant the possession of reason is thought to be exclusively limited to human beings. Kant (at least in theory) remains open to the possibility that non-human entities *could* be ends in themselves if it could be shown that they possessed the necessary properties. This basic line of thinking, that certain moral consideration conferring cognitive capacities might not be limited to humans, has occasionally been pursued as a strategy for extending direct ethical moral consideration to certain non-humans, particularly great apes.[93]

Environmental ethics is not *necessarily* a non-anthropocentric discipline. However, environmental ethics has traditionally begun with an interrogation of the purported reasons for limiting ethical considerability to humans. This is done both by giving reasons to doubt the special status attributed to human beings, and by developing arguments to show why direct ethical consideration must be extended to nonhuman things too – often by identifying a rival property to (for instance) possession of the faculty to reason that better explains our ethical intuitions and additionally can be possessed by nonhuman entities. Notably, Richard Sylvan (originally Routley) argued in 1973 that we typically intuit that nonhuman nature has non-instrumental worth. Sylvan posited a situation where the last person alive chooses to devote themselves to destroying the other living things. This is something he

[90] Rolson III., H., (1986) *Philosophy Gone Wild: Essays in Environmental Ethics.* New York, Prometheus Press.
[91] See: White, L., (1967) The Historical Roots of Our Ecologic Crisis. *Science.* Vol. 155. pp. 1203-1207.
[92] Aristotle, Barker, E., (trans) *Politics.* Oxford, Oxford World Classics. $125^{b}15$.
There is at least some contention over the depth of Aristotle's anthropocentrism, a notable detractor being Michael Woods. See: Woods, M., (1993) Aristotle's Anthropocentrism. *Philosophical Investigations*. Vol. 16. Is. 1. pp. 18-35.
[93] See for example: Cavalieri, P., Singer, P., (1995) The Great Ape Project: Premises and Implications. *Alternatives to Laboratory Animals*. Vol. 23. Is. 5. pp. 626-631.

believes we intuit to be wrong, the implication of which is that you have to accept that some nonhuman things have non-instrumental worth too.[94] Kant's anthropocentric argument against cruelty to animals (that those who are cruel to animals develop cruel habits they eventually extend to humans) also seems to broadly fail to track our moral intuitions, since we typically think those who are cruel to animals wrong those animals themselves.[95] Other thinkers, such as Paul Taylor and Tom Regan, make positive arguments to show why alternative properties might better explain the distribution of intrinsic value. We will look at their views in Chapter 3. Some environmental ethicists, as mentioned, come to the conclusion that no new non-anthropocentric ethical theory is warranted (some refer to these as *enlightened* anthropocentrists or environmental pragmatists), and yet still participate in environmental ethics because their work is still about ethical considerations that bear on the treatment of the non-human world. We should note that anthropocentric ethics might still be used to justify environmental protections. For instance, since clean water, fresh air, abundant natural beauty, etc is highly instrumentally valuable to human beings, we have strong reasons based on our ethical demands to other human people to take action to secure those instrumental goods.

We should also note here environmental ethics' split from its sister discipline of *animal ethics.* Generally speaking, there is today a disciplinary split between environmental ethics, which extends the bounds of moral consideration to collective or holistic, or non-sentient nonhuman entities (such as ecosystems or species, or plants, rivers, or mountains), and animal ethics, which holds that only individual animals can be directly morally considerable (e.g., an individual chimpanzee, human being, fox, gecko, or catfish). While both disciplines are nonanthropocentric, animal ethics has typically proceeded by locating the alternative source of intrinsic value in some cognitive capability, such as the ability to suffer.[96] The result of this is that these ethical theories are typically individualist and sentientist – they locate intrinsic value in individual beings who have requisite mental faculties.[97] Animal ethics might, like anthropocentric ethics, still have strong reasons for valuing the protection of non-sentient nature, but it only attributes instrumental value to it – the value it has to humans and non-human animals. Environmental ethics however (typically) holds that direct moral consideration is also held by non-sentient living entities (such as plants, bacteria, fungi) or collectives (species, ecosystems, landscapes). In some theories this is on account of some shared feature common to all individual living things (such as possession of an internally directed telos in Taylor, or simply because of morally relevant feature of 'life' itself as in Goodpaster). However, some theories are *holistic* rather than individualistic (such as in Callicott)[98] where a collective entity such as the biosphere, the 'land', or an entire species, is the proper subject of ethics. Throughout this thesis I am considering theories from both branches of this division.

To review, environmental ethicists have sought to re-examine the supposed special position human beings occupied within mainstream moral theories. They did this by giving reasons to doubt the explanations for the special status of humanity, but also by giving positive arguments that could explain why duties and obligations were owed to nonhuman nature. Throughout this thesis I use the term 'non-human natural world' to refer to the primary subject of environmental ethics/concerns. The specific delineation of 'non-human' reflects an acknowledgement that humans themselves are

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[94] Sylvan, R., (1973) Is There a Need for a New, an Environmental Ethic? In: Zimmerman, M., et al, (2001) *Environmental Philosophy, From Animal Rights to Radical Ecology* (3rd ed). New Jersey, Prentice-Hall.
[95] Kant, I., Health, P., (trans, ed) Schneewind, J.B., (ed)., (1992) *Lectures on Ethics*. Cambridge, Cambridge University Press. p. 212-213.
[96] See: Bentham, (1789/1948) *Introduction to the Principles of Morals and Legislation*.
Singer, (1973) *Animal Liberation.*
[97] This may well also mean that not *all* nonhuman animals are directly morally considerable – certain invertebrates for instance might plausibly lack the cognitive capacities to suffer in the requisite fashion.
[98] Callicott, J.B., (1999) *Beyond the Land Ethic: More Essays in Environmental Philosophy*. Albany, State University of New York Press.

'natural' biological entities, and yet the impacts of geoengineering on humans is not the primary investigation of this thesis. Thus, non-human natural world refers to the collective of both living and non-living natural things: e.g. (non-human) animals, plants, bacteria, rocks, rivers, mountains, soils, the ocean, the atmosphere: essentially the full complement of extant entities which are not humans nor human constructed artifacts. This does not entail any position on what kinds of entities are thought to exist: for instance, whether or not a 'forest' exists as distinct from a collection of trees, or whether or not a process such as a food chain, evolution, or the water-cycle is a relevant entity in the same way an individual biological entity such as a penguin or a clam is. As we will learn, different environmental thinkers have different ontologies, with varying degrees of both moral relevance and general plausibility. However, with the term 'nonhuman nature' I remain agnostic as to how the internal division is partitioned. I also remain generally agnostic as to whether 'nonhuman nature' accurately portions off a distinct moral community – whether all entities captured by it are morally relevant or are morally relevant in a different way to those entities outside of it. I do make evaluations on this as it comes up at relevant points within the discussion throughout the thesis. However, suffice it to say here that I am not making a moral judgement when I use 'nonhuman nature'. It simply refers to a generally identifiable subject of environmental ethics.

It is also worth emphasising here the general character that these duties or obligations were thought to take. With the necessary caveat that there can be robust anthropocentric justifications for environmental protections, the 'discovery' of the need to consider nonhuman nature as a moral subject was generally thought to increase obligations to protect or preserve nature, and otherwise constrain human action towards nature, in a way which was not seen as obligatory in non-environmental ethical theory. After all, if nature's value is only an instrumental value, then it stands to reason that if it benefits humans to deplete, damage, exploit, or dominate nature, then it is morally acceptable to do so. Recognition that there was additional non-instrumental value in nature does the opposite – it broadly establishes moral limits on human action. As Warren concisely put it, recognising that something has 'moral status' is to recognise that we 'may not treat it in just any way as we please.'[99]

In many cases this limitation on action was/is understood as negative duties (limitations on actions) – i.e., what our duties to nature are restrict actions towards it. This can often be expressed, as with human deontological ethics, in terms of rights. Animal ethics especially has a strong deontological trend (the animal rights tradition) stemming from a recognition that many sentient animals meet the criteria for being recipients of the same kinds of negative rights that protect humans from captivity, torture, or slaughter.[100] Environmental ethics has both deontological (e.g., Taylor) and consequentialist forms– i.e., where moral decisions are those actions which produce good outcomes. For instance, the Land Ethic, promoted by Leopold and Callicott, has the central maxim that actions are good so far as they produce the outcomes of 'integrity, stability, [and] beauty' [101] Animal ethics also has a strong consequentialist school, especially in traditions where it has developed from utilitarian thinking especially in Bentham and Singer where the desired consequences are mental/bodily states such as the experience of pleasure, or a general *flourishing*.[102] The split between consequentialist and deontological thinking may go some way to explaining contrasting views on the permissibility of *intervention* in nature in different

[99] Warren, M.A., (2000) *Moral Status: Obligations to Persons and Other Living Things*. Oxford, Oxford University Press. p. 3.

[100] For instance, see: Regan, (1983) *The Case for Animal Rights*.
Francione, G., (2000) *An Introduction to Animal Rights: Your Child or Your Dog*. Philadelphia, Temple University Press.

[101] Leopold, A., (1949) *A Sand County Almanac*. New York, Oxford University Press. pp. 224-5.
Callicott, (1999) Beyond the Land Ethic. Note that there are also prominent deontological readings of Leopold.

[102] Bentham, J., (1789/1948) *Introduction to the Principles of Morals and Legislation*. Oxford, Blackwells.

environmental ethics perspectives. A classic split between environmental holistic views and individualistic perspectives (particularly animal rights) concerns cases where protecting the wellbeing or lives of individual nonhuman (or human) animals may be detrimental to the welfare of an ecological whole – such as in cases where invasive or otherwise overpopulated species risk ecosystem health.[103] While a consequentialist holist may support culling members of those species, theories that that treat preferentially the rights or wellbeing of individuals may oppose sacrificing their goods for that of the whole.

While holist ethics might occasionally support interventions such as those listed above in order to preserve collective goods, it is worth emphasising that on the whole environmental ethics has focussed on the preservation of natural entities, places, collectives, and systems and typically turns away from human influence or interference in these sites. Many environmental ethics perspectives see the value nature possesses as being a factor of its 'naturalness', where 'naturalness' is in turn a factor of its independence from human influence (I discuss views of this type in Chapter 4). There is a continual tension in theories of environmental ethics between human influence being used to secure certain goods (biodiversity, ecosystem health, individual welfare) and the cost of such influence on the naturalness of the ecosystem. The balance between these will be a major theme of this thesis, in assessing how any potential benefits of geoengineering must be weighed against the significant intervention in nature which it entails.

3.0 The Presumptive Case Against Geoengineering

We can now gesture towards a somewhat ideal type of environmental ethics critique of geoengineering. Environmental ethics critiques focus on how a geoengineering program alters the relationship between humans and the natural environment. One of the possible ways it could alter that relationship is by violating a moral duty or obligation to nature. Environmental ethics seeks to identify what the correct/ethical relationship with nature is. Once this is established, we can test whether or not geoengineering really does violate the proper moral relationship. In the next section, I introduce Christopher Preston's review of various environmental ethics positions. Preston argues based on his reading of a number of core environmental ethics texts that there is a widespread presumption that geoengineering would entail wrongdoing.

3.1 Preston's Argument

In an important work on the ethics of geoengineering, Christopher Preston attempted to review a selection of notable/key positions within the environmental ethics literature and determine their probable stance on geoengineering.[104] Preston begins by recounting a discussion between notable geoengineering proponent David Keith and journalist Jeff Goodell. On the topic of using solar radiation management to save Arctic sea-ice, Keith suggests that before undergoing any such process 'we' would need to think 'very seriously' about the implications it would have on the relationship between ourselves (presumably humanity as a whole) and the natural world. Keith opines that initiating geoengineering would entail '…the end of wildness…' and we would have to accept 'living on a managed planet'.[105] Preston notes the similarity of this to the famous pronouncement of environmentalist Bill McKibben, who in 1989 argued that climate change,

[103] Singer, P., (2001) Animals. In: Jamieson, D., A *Companion to Environmental Philosophy*. Oxford, Blackwells. p. 442. Note that this may be a split not only between theoretical positions, but between animal rights theory and the *practical ethics* of conservationists themselves.

[104] Preston, (2011) Re-*Thinking the Unthinkable*. pp. 457-479.

[105] Keith, D., quoted in, Goodel, J., (2010) *How to Cool the Planet*. Boston, Houghton-Mifflin. p. 45.

affecting and altering as it does every aspect of the natural world, had effectively ended the idea of nature itself.[106] The difference however, as Preston recognises, between the two similar pronouncements, is that geoengineering implies an *intentional* change (see also this thesis Chapter 1, S.21). Intentions are of no small importance in determining the moral character of actions. The intention of an agent makes the moral difference between manslaughter and murder, telling an untruth and lying, or between overhearing and eavesdropping. In environmental ethics too, it is typically the presence of human intentions which transform a natural entity into an unnatural artifact. Preston draws attention to the centrality of intentions in artifact-making citing both Aristotle, and the more recent work on nature and artifacts by Keekok Lee.[107] If the aim of environmentalist policy is to preserve nature, then we might have an obligation to avoid making intentional changes to it. While the climate is altered both by unintentional climate change and by intentional climate change by geoengineering, only the intentional can make it artificial or 'unnatural'.[108] Geoengineering would then make the world we live in a less natural one. This might be part of the fear that tampering with or messing with nature is hitting upon.

While Preston identifies that there may be a concern that geoengineering makes the world less natural, or perhaps even wholly artificial, he also pre-empts an objection. It may be true that geoengineering will make the planet less natural, but one might reasonably ask why this is a problem. Why should we care about the world being natural at all? Perhaps those who express this worry should simply 'get over it'.[109] We might broach the same thing to those who fear tampering with nature too – in fact it might be easy to imagine as the climate situation becomes ever more perilous that this is exactly the kind of response this objection will receive! Preston recognises that in order to counter this 'get over it' objection we need to 'find an argument that [shows why] managing nature on such a grand scale is wrong in itself' or why 'an artifactual climate is inherently wrong'.[110] The search for such an argument is what prompts Preston to turn to the environmental ethics literature.

So, what does environmental ethics have to say on the subject of large-scale environmental modification? Preston claims that despite widespread disagreements within the field about the source of our obligations and duties to nature, there is a widespread *presumption* that the scale of management implied by geoengineering would be wrong. To show this, Preston offers us brief reviews from several of the central perspectives and thinkers within the discipline. Preston considers

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[106] McKibben, B., (1989) *The End of Nature*. New York, Random House.

[107] Lee, K. (1999) The Natural and the Artifactual: The Implications of Deep Science and Deep Technology for Environmental Philosophy. New York, Lexington.

[108] At least according to the mainstream view on the philosophy of artefacts which attribute central importance to the role of intentional creation in distinguishing artifacts from other material entities. See for instance: Baker, L.R., (2007*) The Metaphysics of Everyday Life: An Essay in Practical Realism.* Cambridge, Cambridge University Press. Some philosophers, including Steven Vogel, occasionally defend other views including the possibility that artifacts might be accidentally created: Vogel, S., (2003) The Nature of Artefacts. *Environmental Ethics*. Vol. 25. Is. 2. pp. 149-168. Preston attributes the mainstream view of artifacts to an origin in Aristotle, notably the importance Aristotle placed on the distinction between entities originating by nature and those existing from craft. See: Aristotle., Crisp, R., (eds) (2000) *Nichomachean Ethics*. Cambridge, Cambridge University Press. 1140a. However, Aristotle's commitment to 'artifacts' as a metaphysical entity is subject to some controversy, with opponents citing Metaphysics 1043b to illustrate his belief that that entities from nature are 'substances' i.e the primary forms of reality. Artifacts are downgraded to being compounds of natural substances and as such do not exist in direct opposition to natural entities as in the mainstream view of artifacts. Aristotle., Barnes, J., (1984) *The Complete Works of Aristotle: Metaphysics*. Princeton, Princeton University Press.

[109] Preston, (2011) *Re-Thinking the Unthinkable*. p.461.

[110] Preston, (2011) *Re-Thinking the Unthinkable*. p.462.

the works of Aldo Leopold, Lynn White, Richard Routley, Tom Regan, Paul Taylor, Eugene Hargrove, Keekok Lee, Dale Jamieson, Holmes Rolston III, Robert Elliot, and Bryan Norton. While Preston notes that his brief summations of these philosophers' arguments are not intended to provide a 'watertight case', he nonetheless expresses his belief that geoengineering would be 'unthinkable '' to each of these positions. This is because of a general trend running across these works, which emphasise minimising the amount of interference and management humans have on the planet. We see this emphasis in effect in environmentalist strategies of nature preservation. While the ethicists in question have differed on the origin of these obligations, this general conclusion that humans must limit their control over the planet and its non-human inhabitants has been reached by all of them. Thus, since geoengineering envisions expanding control - using new methods, in new areas, and on a greater scale, than previous planetary modifications - there is a general presumption from within this tradition that it will be unethical.

Preston does however claim that the presumptive argument is defeasible. He gives two arguments for why environmental ethicists might be able to begrudgingly accept geoengineering. His first argument is that geoengineering could be the 'lesser of two evils', and thus be accepted by environmentalists on this account. The latter is that he believes that intra-disciplinary debates within environmental ethics established for most philosophers that humans have moral permission to prioritise their own (i.e., their species) interests in cases of moral peril, even to the detriment of the non-human. Both arguments, he believes, offer a pathway for environmentalists to advocate for geoengineering.

For the lesser evil argument, Preston draws heavily from the work of Steven Gardiner – another philosopher to consider the ethics of geoengineering from relatively early on. In his 2010 paper, Gardiner argues that talking of 'lesser evils' in the context of geoengineering and climate change muddies the water of the discussion and opens the door to committing what are otherwise clearly immoral acts.[111] The fact that geoengineering is now being seriously considered as a solution to climate shows just how far we[112] are willing to go to avoid making serious changes to the way that we live, how we distribute the wealth of society, and how we interact with the natural world. geoengineering may be the lesser evil, but it comes with its own kind of moral cost, a kind of 'tarnishing evil' that comes with making an immoral decision in a situation where only immoral possibilities exist.[113] Preston accepts this much of Gardiner's argument, but nonetheless, he argues, geoengineering could be the 'lesser evil' in comparison with the privations of a changing climate - starvation, dislocation, ecological collapse etc. Environmentalists can accept that we 'tarnish' ourselves when we make this choice, but nonetheless, they still should be able to lay their principles aside and accede to the well accepted ethical principle of going with the less evil choice. In this sense, the presumption they have against geoengineering can be defeated.

Preston offers a second defeasibility criterion too. This is a generally agreed principle that despite the fact humans have obligations to the non-human world, in cases of peril to human life there is an obligation to act to prevent this loss of life even when this means deprioritising our duty to keep our 'hands-off' nature. The idea that, despite environmental ethics' insistence on both human and non-human being morally considerable, humans do occasionally come first, arose in response to fears of

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[111] Gardiner, S., (2009) Is 'Arming the Future' with Geoengineering Really the Lesser Evil? Some Doubts About the Ethics of Intentionally Manipulating the Climate System. In: Gardiner, S., Caney, S., Jamieson, D., and Shue, H., (eds) *Climate Ethics: Essential Readings*. Oxford University Press, Oxford.

[112] 'We' of course means a small subset of powerful actors: most individuals of course have no say in this at all.

[113] I return to this idea in Chapter 5.

legitimating 'eco-fascism'.[114] The collectivist tradition within environmental ethicists' tendency to identification of the locus of moral concern in collective entities rather than individual I.e. ecosystems, 'nature', 'the land' etc, meant that they were open to individuals' interests being sacrificed for the good of that collective. Contrary to the more individualistic discipline of animal rights scholarship, collectivist environmental ethicists typically had no qualms advocating for culling overpopulated animal populations, if that overpopulation was the result of human caused ecosystem disturbance, and crucially if doing so would help promote overall ecosystem stability. Moreover, since certain traditions within conservation environmental ethics attributed no special place to human beings over other entities[115], the logical conclusion appears to be that environmental ethics could countenance the culls of individual persons too if it was discovered that the human population was a net detriment to the collective. The response to this concern of 'ecofascism' was for several proponents of holistic theories of environmental value to adopt second-order principles which attempted to explain why individuals (especially human individuals) couldn't always be sacrificed for the benefit of the whole.[116] For instance, Callicott's later responses to those critics who charged his ethics with ecofascism, was that the demands of environmental ethics were an 'accretion' on top of our regular moral duties. Environmental ethics burdens us with additional moral duties but does not replace or supersede our traditional ethical obligations owed to one another.[117]

For Preston, the adoption of second-order principles to defend the prioritising of human wellbeing lays out a route for showing why geoengineering might be acceptable. The worry that we shouldn't tamper with nature is a worry about the collective (e.g., whole ecosystems, species, or the entire global biosphere according to different theories) – a collective which benefits or has its inherent value left better intact by having minimal human interference. But in the case of geoengineering vs a warming climate, living by this principle seems to entail allowing the significant harms and destruction of climate change to go unchecked, and thus the lives of (human) individuals being sacrificed for the abstract good of the collective. The general presumption that this should not be allowed, lest we become 'eco-fascists by omission', means that intervention via geoengineering can be justified by environmental ethicists. While we do have duties which are directed to the ecological collective, in the case of climate change, the rights of individuals are sufficiently imperilled for it to become necessary to intervene. While both this argument and the 'lesser-evil' argument are similar, and ultimately both come to the conclusion that geoengineering might be permissible, they are subtly different. The lesser-evil argument allows geoengineering to be permitted based on a general principle that of two evils, the lesser one ought to be chosen. The 'second order principles' argument is about the priority of duties: where duties we owe to humans are thought to supersede duties owed to nonhumans (in Callicott's terms, they are an accretion), even if the result of doing so would not be the 'lesser evil' if both human and the non-human natural world's interests had been weighted evenly.

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[114] The origin of the term ecofascism to describe the effects of holistic ethical theories seems to originate with Ferré. Ferré, F., (1996) Persons in Nature: Towards and Applicable and Unified Environmental Ethics. *Ethics and the Environment*. Vol. 1. Is. 1. pp. 15-25. Note that the debate precedes this though.

[115] This is particularly true of the early Callicott, c.f. Soulé, while a collectivist does defend a special ethical position from human persons. See: Soulé, M.E., (1985) What is Conservation Biology? *BioScience.* Vol. 35. Is. 11. pp. 727-734.

[116] This occurred most notably in debates between J.B Callicott and Tom Regan in the late 1980's through until the 1990s. See for example: Regan, (1983) *The Case for Animal Rights*. Callicott, J.B., (1999) Holistic Environmental Ethics and the Problem of Ecofascism. In: Callicott, J.B., (1999) *Beyond the Land Ethic: More Essays in Environmental Philosophy*. Albany, State University of New York Press.

[117] Callicott, (1999) *Holistic Environmental Ethics and the Problem of Ecofascism*.

We may briefly schematise Preston's argument somewhat like this:

1) Geoengineering involves substantial environmental modification of 'the Earth's basic biogeochemical parameters'[118] or of some other, typically 'natural' and valuable part of the nonhuman world.
2) There is a presumption amongst environmental ethicists that geoengineering, due to the modification that it entails, is morally wrong ('it is hard to imagine any of the central positions in the [environmental ethics] literature endorsing the alteration of Earth's fundamental biogeochemical processes')[119]
    a. This presumption holds because the presumption central to environmental ethics is that human actions need to be circumscribed in such a way that the human-independent processes are left largely intact. If environmentalists tend to value the fundamental, human-independent processes, then geoengineering will obviously be a cause for concern.[120]
    b. This presumption is strengthened by the 'Prudential Argument' that we are in general not very competent modifiers of the environment. ('The presumptive argument is bolstered by recognition of the extraordinary complexity of earth's ecological system and often a deep scepticism about scientists' ability to manage it')[121]
3) This presumption is however 'defeasible'.[122] Two pathways to this are detailed:
    a. The 'lesser evil' route: geoengineering involves immoral modification of the Earth but it is a lesser evil than allowing climate change to continue unabated (i.e. without geoengineering).
    b. Environmental ethicists generally accept that human needs may be prioritised in cases of urgent need – we may prioritise our need to cool the planet over any non-anthropocentric interest that nature may have in remaining unmodified by geoengineering.

Thus, Preston purports to have identified a broad trend amongst a number of core positions in environmental ethics, that while defeasible, *presumes* against geoengineering.

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[118] Preston, (2011) *Re-Thinking the Unthinkable*. p. 459.

[119] Preston, (2011) *Re-Thinking the Unthinkable*. p. 462.

[120]Preston, (2011) *Re-Thinking the Unthinkable*. p. 464.

[121] Preston, (2011) *Re-Thinking the Unthinkable*. p. 464. Note that this is a somewhat different argument – the main thrust of the argument would show that even the most competent ecosystem engineers would be wrong to modify the environment in the way that geoengineering entails.

[122] Preston, (2011*) Re-Thinking the Unthinkable*. p. 465.

3.2 A Brief Aside on Scott (2012)

Before going on to situate this thesis in relation to the argument presented by Preston, we must acknowledge that a very similar argument was published nearly concurrently by Dane Scott (2012).[123] Scott evaluates two environmental ethics perspectives on the role of technology in mediating human/nature relations and argues that neither would 'welcome' geoengineering.

The first perspective reviewed is the argument that technological 'solutions' to environmental problems are a response typical of societies or social reasoning systems which systemically devalue or dominate nature. Scott cites the work of Alan Drengson, Lynn White, and Eric Katz as the foundations of this view; the latter two of whom are also used by Preston to support his argument. I evaluate the strengths of an argument against geoengineering from White in this chapter, Katz in Chapter 4, and a similar view from Adorno and Horkheimer in Chapter 5. The second perspective Scott considers is a pragmatic critique about the role geoengineering might play as a 'technological-fix'. A technological fix is usually understood as being the use of technology to provide an ameliorative 'solution' to a problem which leaves the social system that causes the problem unchanged or unexamined. Geoengineering, Scott argues, can be seen through this lens: by delinking emissions from climate/temperature outcomes they allow a social/economic system of fossil fuel enabled consumption to be continued unchallenged. To this extent, Scott argues, geoengineering fails to adequately solve the underlying problem.

Scott's argument effectively mirrors that of Preston, albeit in less detail. Both review positions in environmental ethics, including two in common, and find that they presume against geoengineering. Like Preston, Scott thinks that this presumption might be defeated by the necessity of using geoengineering to prevent greater harm. Though my focus on this thesis is on Preston's more developed position, to the extent that Preston and Scott's arguments are similar, the responses I make throughout this thesis can be seen as a response to Scott too.

3.3 This Thesis in Relation to Preston

I think that Preston quite clearly demonstrates that for environmental ethicists there are important countervailing reasons (preference for the lesser evil, and protection of the individual) which can defeat any presumption against geoengineering. I agree with Preston's analysis in this case: I too think that environmental ethicists can use these reasons to reconcile themselves with geoengineering. However, this thesis takes the environmental ethics case for geoengineering a step further. I argue that we may not even need to invoke Preston's defeasibility criteria to win begrudging environmentalist support for geoengineering. Preston himself writes that he does not believe that the case he presents for a presumption against geoengineering is necessarily 'watertight' - i.e., he remains open to the possibility that an argument in favour of geoengineering from within environmental ethics is at least a possibility. I believe that his assessment here is correct. This thesis aims to pick up these threads.

I argue that many of the core positions in environmental ethics may always have been more open to geoengineering than Preston originally accounted for. In other words, I argue that it is difficult to locate within environmental ethics something that can ground a presumption against geoengineering to begin with. Preston writes that geoengineering is 'unthinkable' to environmental ethics – possible under duress, but under normal circumstances not something which could ever be ethically defensible. I, on the other hand, take it that there are at least some instances where geoengineering can meet environmental ethics criteria for moral actions. Throughout this thesis I aim to show that the core positions in environmentalism can countenance at least some forms of

[123] Scott, (2012) *Geoengineering and Environmental Ethics*. p. 10.

intentional climate modification within the bounds of their moral theories. In other words, there may be some forms of geoengineering which do not violate our obligations to the natural world and are thus not (lesser) evils at all. I argue that of the positions reviewed there are good reasons for reading them as being open to *at least some* forms of intentional climate modification. This thesis then can be read as investigating Premise 2a of the schema presented above. While I argue that environmental ethicists in general may be more open to geoengineering than Preston suggests, I do concede that this is not true for *all* the positions I review. In some cases, particularly in the case of Erik Katz (whom Preston does not review), I argue that Katz's moral philosophy does rule out geoengineering. However, I argue that Katz does not provide sufficient reasons for us to accept his theory. Thus, his argument cannot support a presumption against geoengineering.

Likewise, this thesis intends to set aside concerns related to claim 2b – Preston's 'Pragmatic Argument'. The pragmatic argument is certainly a powerful challenge to geoengineering: the extreme complexity of the atmosphere and humanity's poor track record of environmental modification can attest to this. However, the strength of an environmental ethics challenge to geoengineering is that, if successful, it would show why even a flawless implementation of geoengineering would be wrong. The challenge for the anti-geoengineering environmental ethics positions is not to show why a failed geoengineering is wrong, but rather why even a successful one would be wrong. By evaluating how environmental ethics cases fare against a successful geoengineering, we can learn more about those positions than we otherwise could. We of course cannot set feasibility completely aside - it is still a major consideration in our overall evaluation of geoengineering. Moreover, in a field prone to making speculation and exaggeration it would be foolish to take statements about the efficacy or plausibility of any geoengineering technique at face value. However, throughout this thesis when presenting a geoengineering technique, I am not evaluating whether a feasible version of it exists, but how environmental ethicists may respond to it if such a version could be found and implemented.

To be clear about the limitations of my argument, this thesis is focussed entirely on the strength of these environmental ethics arguments against geoengineering: whether geoengineering would 'tamper with nature' and whether that is something morally wrong and important to avoid. But this is not at all the limit of critiques of geoengineering. There are, I take it, many reasons to oppose geoengineering that do not fall into the realm of environmental ethics questions. There are still major concerns with the global and distributive justice implications to the large-scale deployment of geoengineering, that this thesis leaves aside. There are additionally credible worries with the role geoengineering plays in deterring action to mitigate emissions. There are, of course, also questions about the practicality and feasibility of many of the proposed programs, such as whether they could be ready to be deployed within a useful timeframe. Even if environmental ethics arguments related to tampering with nature cannot show why geoengineering is wrong, it does not mean that we do not have other strong reasons to not geoengineer!

The difference between my work and Preston's is to show that at least some forms of climate modification can be accepted by environmental ethicists without compromising their principles. Hypothetically they might accept that under particular or specific conditions the climate may permissibly be intentionally modified. But what does this tell us about their practical support for geoengineering, as we find it today? In the final chapter of this thesis, I review past attempts to create principles for ethical geoengineering. I find that there has been a lack of engagement amongst these with theories of environmental ethics, and therefore most papers do not include principles for ensuring geoengineering is environmentally ethical. However, based on my argument in the thesis, we know many central environmental ethics positions do not necessarily exclude some forms of geoengineering, and thus it is possible that criteria for a specifically environmentalist geoengineering could be developed. Drawing on the discussions in the previous chapters, in Chapter 6 I offer some guidance for the development of geoengineering governance principles that can attend to our environmental ethics worries.

This, I argue, can give environmentalists a practical role to play within discussions of geoengineering. Rather than just accepting geoengineering as the 'lesser evil' option, environmentalists may now be able to discuss which options closer fit their principles and should be favoured. They may now be able to advocate upon the basis of environmental ethical principles for certain kinds of geoengineering to be preferred over others.

4.0 Permissibility of Geoengineering in some Environmental Ethics Perspectives

This thesis is intended as a constructive response to Preston, that reassesses whether the authors he cites in favour of a presumption against geoengineering really do support his conclusion. However, note that the authors I choose to cover in this thesis are not one and the same with those that Preston reads. This is in order to show the wide applicability of my argument, extending even to major positions in the environmental ethics literature which are not covered in Preston's original review. Nonetheless, it is important to give assessments of the texts Preston relies on to support his argument for there being a presumption against geoengineering. While the constraints of space do not permit me to devote full chapters to each of the authors Preston reads, by showing that a plausible route for justifying some forms of geoengineering exists in a broad swathe of the purported supporters of the presumptive case, this begins to unsettle Preston's conclusions. In the following section, I give brief reviews of some of the authors cited by Preston, as well as some other key figures in the discipline who do not receive full chapters in this thesis. I attempt to show that they can each be read as being open to geoengineering under certain conditions.

4.1 Anthropocentric Theories: Eugene Hargrove, Rolston III and Elliot

One author Preston cites in support of his argument is Eugene Hargrove. Preston finds support for a presumption against geoengineering from Hargrove's statement that: 'when we interfere with nature, regardless of whether our intentions are good or not, we create a break in [that] natural history'. [124] Similarly, Rolston III argues that the value of unmodified nature is as 'the profoundest historical museum of all'.[125] The link that unmodified nature has with the past, as an authentic example of natural history, is the value it (ought) to have to humans and explains why we ought to preserve it. Elliot makes a similar argument: unmodified nature has a value that is a factor of its authenticity, something which rewilded or restored nature will never have.[126] Just as we prefer the first edition to the reprint, the genuine article to the forgery, or the mediaeval castle to the one in Disneyland, the authenticity of wild nature is something to value, which can never be reproduced. Once we geoengineer the planet, we will never be able to recover that authentic wildness even if we stop. We will look at Elliot in closer detail in Chapter 4. However, much the same thing seems to be going on in Hargrove's statement– the harm is identified with creating a break with natural history; the unbroken link to the authentic past.

These three arguments fit into a tradition of (enlightened) anthropocentric justifications for nature preservation – i.e., arguments that purport to show why nature should be preserved based on the

[124] Preston, (2011) *Re-Thinking the Unthinkable*. p. 146. Originally Hargrove, E., (1996) *The Foundations of Environmental Ethics.* Texas, Environmental Ethics Books. P.196

[125] Preston, (2011) *Re-Thinking the Unthinkable*. p. 464. Originally Rolston III, (1988) Environmental Ethics. p. 14.

[126] Elliot, R., (1997) *Faking Nature: The Ethics of Nature Restoration*. London, Routledge.

interests of human beings, rather than of 'nature' itself. This branch of anthropocentric argumentation goes something like this:

1) Unmodified nature has some special quality which is not present in modified landscapes or 'natures'.
2) This quality is valuable to persons, or at least *ought to be* seen as valuable.
3) Thus, if we want to preserve this value for ourselves, we must not modify (or limit as far as possible the modification of) nature.
4) The (purported) presumption against geoengineering follows naturally, given that geoengineering involves a significant modification of nature.

An initial reason to doubt this argument is that they could be reliant on changeable human preferences. They might be read as suggesting that if we[127] really value authentic natural continuity that only unmodified natures possess, then we ought to preserve them wherever we can. But then, if we don't value it, or find other aesthetic values to be preferable, then we have no reason to try and preserve them either. Environmentalism is relegated to a consensus building activity. The major challenge for the anthropocentric version of this argument is to explain why the authenticity of nature is preferable to the values which can be found in altered environments. Martin Krieger sets out this challenge in his 1973 paper, 'What's Wrong with Plastic Trees?'.[128] He argues that as our skill in reproducing nature increases, as well as our ability to socially condition ourselves, we may one day prefer the artificial to the natural – perhaps valuing greater than authenticity the skilled hand of the reproducer, or totally novel ecosystems that nature never produced. If our rationale for not geoengineering relies on public interest in preserving the authentically natural, our ability to shape public interest to favour other things means that this is shaky ground to build on. If we are basing our argument for not geoengineering on a preference for non-geoengineered environments, we have to prepare ourselves to meet Krieger's challenge: will we never prefer the skill of the talented geoengineer, or the comforts of a regulated climate, to that which was handed us by nature?[129] How will we argue against geoengineering if this is the prevailing opinion?

A second reason to doubt these accounts is that their arguments are reliant on an assumption that whatever value that unmodified nature is thought to possess can never be regained when it is lost. I look into this argument in great detail in Chapter 4 on Eric Katz. However, suffice it to say here, these arguments have proved to be highly contentious within environmental ethics. Eric Higgs, Ned Hettinger, and Donna Ladkin have all argued that the value possessed by nature can be restored once lost.[130] If these arguments are successful, then these theories fail to show why geoengineering is necessarily wrongful, *provided that*, any changes that it makes to nature are able to meet whatever criteria it is that allows nature's value to be restored. This might, for instance, involve

[127] It is important to question the implied 'we' in these arguments too, it seems to me that these views privilege a kind of expert observer who can distinguish the authentic from the fake; and potentially also a viewer of a particular social and cultural background who has been taught to appreciate wilderness/unmodified nature too.

[128] Krieger, M.H., (1973) What's Wrong with Plastic Trees? *Science*. Vol.179. pp. 446-455.

[129] These arguments are illustrative only, and could be substituted for any other reasons you feel most convinced by as to why geoengineering could appeal to public sentiments.

[130] This list is far from exhaustive. See: Hettinger, N., Nature Restoration as a Paradigm for the Human Relationship with Nature. In: Thompson, A., and Bendik-Keymer, J., (eds) (2012) *Ethical Adaptation to Climate Change: Human Virtues in the Future.* Cambridge, MIT Press. Higgs, E., (2003) *Nature by Design: People, Natural Process, and Ecological Restoration*. Cambridge, MIT Press.
Ladkin, D., (2005) *Does 'Restoration' Necessarily Imply the Domination of Nature*? Environmental Values. Vol. 14. Is. 2. pp. 203-219.

being able to reverse whatever changes geoengineering makes. I discuss the reversibility of geoengineering throughout this thesis, including in Chapter 3, and again extensively in Chapter 6.

A third and final reason we might have to preliminarily doubt these arguments is that they rely on the assumption that geoengineering really does work on unmodified nature. However, it is grimly evident that the atmosphere, the carbon cycle, or whatever else you think might be the relevant entity demanding preservation in the case of geoengineering, has already been modified. This is true both for unintentional modifications, in the case of anthropogenic climate change, but also potentially intentional modifications too, such as artificial nitrogen cycling. I make this argument in much greater detail in Chapter 4 Section 2. It is enough to note here that if these arguments are reliant on identifying a value present in unaltered nature, but the 'nature' geoengineering modifies has already been altered and lost its value, then these arguments do not seem to be able to critique geoengineering. While it is unfortunate that 'nature' was lost to begin with, geoengineering only seems to alter already unnatural parts of the world. Provided it does so beneficially, then it seems geoengineering can be allowed.

This short review cannot give us reasons to discount these three theories entirely. It has however, I hope given us reasons to doubt whether they truly presume against geoengineering. This thesis largely leaves the 'enlightened anthropocentric' or 'pragmatic environmentalist' arguments to one side. The exception to this is the argument of Adorno and Horkheimer against the 'domination of nature' examined in Chapter 5. This argument differs in some important ways to the three arguments presented above, in that it doesn't rely on aesthetic preference for nature over modified environments, which - as I have argued – seem to provide a weak basis for defending a presumption against geoengineering. Equally their theory provides a potential means for defending an account of wrongdoing to nature based on a charge of 'domination', which did not rely on the untenable foundations which Katz (Chapter 4) built his ethics upon. This language of 'dominating nature' is regularly found in lay critiques of geoengineering and it is for this reason, it is worth considering Adorno and Horkheimer's theory.

4.2 Aldo Leopold and the Land Ethic

Aldo Leopold was an American forester, ecologist and writer. He lived at the turn of the 20th century and worked most of his life in the newly formed US Forestry Service, eventually working his way up the ranks before transferring to the University of Wisconsin to become the first US professor of wildlife management. Leopold's best-known work, 'A Sand County Almanac' (1949) predates the modern interest in environmental ethics by some 20-30 years, but has subsequently been reread as one of the foundational texts in the field. Leopold does not give us a well worked out schema for understanding our obligations to the natural world, but throughout 'A Sand County Almanac' he gives us maxims of his so-called 'Land-Ethic'.

Leopold's land ethic is best explained through two of his maxims:

> That land is a community is the basic concept of ecology, but that land is to be loved and respected is an extension of ethics.[131]

And:

> A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise. [132]

[131] Leopold, (1949) *A Sand County Almanac*. pp. vii-ix.

[132] Leopold, (1949) *A Sand County Almanac*. pp. 224-5.

The Land-Ethic is therefore most often interpreted as a form of what would later be called 'ecological-holism' that treats the whole community of living/natural things (The Land) as a singular entity demanding of moral concern. Leopold sees The Land as possessing as a collective a kind of intrinsic value that demands right-treatment. But what form exactly does this right-treatment take?

Partly this is explained in the second maxim above – that actions should preserve the integrity, stability and beauty of the land. However, he gave some more specific criteria too. As Preston notes, 'In the earliest work in modern environmental ethics, heavy-handed management was roundly criticised by Aldo Leopold. His request for 'gentler criteria' when 'remodelling the Alhambra with a steam shovel' exhibited this sentiment'.[133] The implication is that the ecological community to which we owe our duties is beautiful yet fragile and delicate. Like an ancient monument, even the smallest imprecision can tarnish that beauty, or upset the equilibria of the entire system. Leopold's arguments against large-scale intentional environmental alterations are therefore pragmatic: not trusting in our skills to make alterations safely we run the risks of failing in our duty to not upset ecological balance. Making large-scale alterations would be like as an amateur painter, accepting a contract to touch-up the Mona Lisa: we run the risk of moral failing (spoiling the art) from an aggrandised estimation of our talents. Leopold makes this argument elsewhere in his corpus too, as a pragmatic case for wilderness preservation to be central to ecological management, arguing that it is easier to preserve untouched wilderness than it is to recreate it.

It is plain how Leopold's maxims might form the basis of an argument against geoengineering. Leopold clearly has a strong preference to avoid large-scale modification of the natural world.[134] Geoengineering might very well be the proverbial act of taking a steam-shovel to remodel the Alhambra. Geoengineering proposes taking some rather crude, and largely untested implements, to carve away and reshape delicate atmospheric processes of which we in turn know surprisingly little. Surely the pragmatic side of Leopold captures the very reasonable worry that when we act in these uncertain conditions, we risk destabilising the ecological whole in such a way that compromises the beauty of it and violates our obligations to preserve its stability and integrity. However, I would argue this pragmatic argument is defeasible. I think two routes are potentially open if we want to show that geoengineering, in some form or another, might be compatible with a belief in the Land-Ethic.

Firstly, we can interpret Leopold's pragmatic argument as making a call for care and precision in our ecological works. We must not be heavy-handed! Returning to my analogy with the painter touching up a master work: we might think the risk of damage, and its associated moral cost, must be abated by hiring a skilled artisan. We might read Leopold as urging caution in our geoengineering rather than an outright prohibition on the activity. For instance, Leopold's demands might mean not acting where effects are uncertain, focussing on using well-established techniques, and always acting with an eye to preserving the beauty and integrity of nature. Leopold might be read as having a kind of pragmatic objection, and whether or not it is successful is reliant on empirical assessment of geoengineering development. This argument might show why we should not geoengineer, or indeed perform any kind of environmental alteration, under conditions of sufficient uncertainty over the likely effects. It does not on its own show why geoengineering simpliciter – i.e., intentionally modifying the climate - is an inherently wrong thing to be doing. To put it in other terms, it does not show why should we think our obligations to the natural world *necessarily* preclude geoengineering.

[133] Preston, (2011) *Re-Thinking the Unthinkable*. p. 462. Quoting: Leopold, (1949) *A Sand County Almanac*. p. 226.

[134] Note that there is some discussion over the appropriate scale that Leopold's ethics can be applied to. See for instance, Callicott, J. B., (2013) *Thinking Like a Planet: The Land Ethic and the Earth Ethic*. Oxford, Oxford University Press.

On this reading, geoengineering might be acceptable provided we have a necessary level of certainty in the effects of our actions, and engineer with the steady hand of a skilled craftsman.

I think my argument above shows what it needs to show – that Leopold's 'Land-Ethic' does not give us a reason why geoengineering should necessarily be forbidden. However, we might not be giving the pragmatic argument a fair hearing here. After all, it might not be particularly likely that geoengineering, as a suite of technological techniques, might ever be able to attain the level of certainty in action needed to assuage the worry of accidental damage. I have argued that Leopold could assent to geoengineering if it was skilfully done, well planned, and its effects easily predictable in advance. But the complexity of trying to intentionally alter the Earth's climate might all but rule this out in practice. Geoengineering has a particular epistemic problem: given the scale that it works over, it is not always possible to experimentally test its effects before implementation. An art restorer can practice their technique on replicas, and hone their craft on less valuable canvases. Even Leopold's steam-shovel operator, we might think, could at least hypothetically find ways to practice and test their methods before working up to the Alhambra. But there are no spare climates for the geoengineer to cut their teeth on – the only option they have for trialing their methods is on the entity we are supposed to protect. Currently geoengineering, especially SRM, is largely confined to computer simulations and moratoria on field trials are in place. Despite the best efforts of computer modelling, any implementation of geoengineering will likely occur under conditions of uncertainty. So, while Leopold cannot absolutely guard against geoengineering, the difficulty for geoengineering techniques to meet his threshold set out by the pragmatic argument might still be an effective prohibition on geoengineering.

However, we can level a broader defence of a Leopoldian geoengineering than just the pragmatic argument. A second route to showing that the Land-Ethic can tolerate some amount of geoengineering is to focus on Leopold's second maxim: that 'A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise'. This might offer a stronger objection than the pragmatic argument, as it could show why geoengineering, even under cases of perfect certainty as to its effects, would be wrong. If geoengineering 'tends [otherwise than] to preserve integrity, stability, and beauty' then it is wrong to geoengineer. It is also clear how an argument against geoengineering might originate from this maxim. After all, the watchword of geoengineering is 'change'! Geoengineering refers to techniques that change the natural constraints of the world, it alters how the carbon-cycle or the heat balance works. That might seem to fail on this maxim's demand to 'preserve integrity and stability'.

However, while it is certain that geoengineering implies alteration and change, it is not necessarily true that alteration and change imply instability or loss of integrity. We should note that geoengineering is being proposed, at least in some instances, with an aim to preserve: for instance, the preservation of a particular global average temperature or of a climate which in certain important ways resembles one that exists now or existed prior to the noticeable effects of climate change. Moreover, the purpose of preserving this is to prevent (or at least minimise), we might think, the disruption to the integrity and stability of ecological systems caused by anthropogenic climate change. We live in quite a different world to Aldo Leopold – a world where our climate system is already disturbed. We are no longer in a situation (if indeed we ever were) where we can talk meaningfully about preserving untouched wildernesses. The Land-Ethic might be able to morally condemn the actions that led us to this point, i.e., the unchecked burning of fossil fuels disrupting the stability of the ecologic whole. But geoengineering aims to act upon the already damaged to try and minimise the disruption and retain a modicum of stability. In this context, can we not say that geoengineering aims to preserve integrity and stability?

4.3 Richard Sylvan

Preston argues that Richard Sylvan's (previously Routley) ethical theory also presumes against geoengineering. This is supported, Preston argues, by Sylvan's claim that policies of 'complete interference' are wrong, because 'some worthwhile parts of the Earth surface should be preserved from substantial human interference, whether of the 'improving' sort or not'.[135] Sylvan argues that an environmental ethic cannot be based upon a view that humans have a duty to 'steward' the Earth or 'co-operate' in its development, cultivation, or improvement.[136] Sylvan claims the latter view would entail 'See[ing] the Earth's land surfaces reshaped along the lines of the tame and comfortable north-European small farm and village landscape' and that adopting this view of the appropriate relation to nature would lead to 'a principle of total use, implying that every natural area should be cultivated or otherwise used for human ends, 'humanised'.' [137] Once again, the focus that Sylvan places on avoiding the 'total use' and 'humanised' landscapes lends itself to a prima facie presumption against geoengineering.

There are two important points which must be raised in objection here. Primarily, the quote that Preston is drawing upon looks like a case against geoengineering because it rules out not only destructive interference but 'improving interference' too. It's trivial to understand why environmentalists will reject geoengineering if all it could offer was destruction, but the difficulty for opponents of geoengineering is that there might be cases where geoengineering offers the possibility to save or repair nature too. We might think of microbubble shading to protect coral reefs, SRM to keep ice-sheets intact, or afforestation that captures carbon but also provides habitat. More generally we might think anything that can arrest the destructive spiral of climate change might be 'improving interference'. However, Sylvan's argument purports to show why these would be unacceptable too, thus if successful would pose a real challenge to geoengineering.

However, it appears that the quote Preston takes from Sylvan has unfortunately been taken quite out of context. Returning to the source, it is evident that the 'improvement' that Sylvan is keen to avoid is 'improvement' of nature, *for the benefit of human persons*. However, we might think that an important factor to consider in whether an intervention in nature is legitimate is whether or not it benefits nature itself, in addition to, rather than just human beings. Indeed, Sylvan acknowledges this himself, writing that his argument is rendered 'innocuous' if the 'total use' he sought to prohibit include 'use' for preservation or other acts designed to benefit nature.[138] So while Preston claims that Sylvan rejects even 'improving' intervention in nature, a closer reading of Sylvan shows that he really only rejects alterations of nature which only benefit humans. Thus, it's not clear that Sylvan rejects out of hand making modifications to nature that are intended to improve nature itself. If geoengineering can be legitimately understood as doing that, Sylvan might be able to accept it.

4.4 Lynn White Jr

Preston sees White as supporting a presumption against geoengineering based on his rejection of 'the dogma of man's transcendence and rightful mastery of nature'.[139] This 'dogma' is White's

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[135] Sylvan, (1973) *Is There a Need for a New, an Environmental Ethic*? p. 19.

[136] Sylvan, (1973) *Is There a Need for a New, an Environmental Ethic*? p. 18-19.

[137] Sylvan, (1973) *Is There a Need for a New, an Environmental Ethic*? p. 19.

[138] Sylvan does note this to be a 'Somewhat illicit' reading of 'use' but does not appear to justify why we should think this. Sylvan, (1973) *Is There a Need for a New, an Environmental Ethic*? p. 25.

[139] Preston, (2011) *Re-Thinking the Unthinkable*. p. 463.

description of modern, 'western' societies' typical attitudes toward the natural world, and inheritance, he thought, of ideas handed down from Christian thought. White's paper is notable as a historical account on the intellectual origins of the environmental crisis.[140] We do not necessarily need to go into the accuracy of White's history in order to make our response to him. We might though have some reasons to doubt whether White's characterisation of Christian beliefs towards the environment are accurate, especially in relation to geoengineering. Many authors have noted objections to geoengineering based on a belief that altering the natural world in this way would 'play god'.[141] This seems to evidence a powerful tradition to the contrary – that religious ethics in fact is cautious of geoengineering and large-scale ecological change rather than permissive. Though as Hartmann notes these arguments are easily rebuffed.

Our response to Preston's reading of White can be similar to our response to Preston's reading of Sylvan. We may put aside our doubts about the accuracy of White's history and accept for the sake of argument that there is indeed a particular historic tradition of viewing human beings as 'masters' of nature that has been handed down to us, and moreover that this has legitimated actions which have led to environmental destruction. Even assuming this for the sake of argument, it does not tell us what a non-destructive ethic towards the environment looks like. The conclusion that Preston infers from this is that an ecologically non-destructive ethic must necessarily reject any role for 'mastery' of nature, and this seems like an intuitive response to White's argument. Preston does not note this, but we could add here White's clear pessimism over ecological uses of technology (he writes: 'More science and more technology are not going to get us out of the present ecologic crisis until we find a new religion, or rethink our old one').[142]However, where we might query Preston's reading is his interpretation that rejecting the 'dogma of… rightful mastery of nature' means completely abandoning any licence to make intentional alterations to nature. As we have discussed in our response to Sylvan, it is not clear why rejecting 'mastery over nature' necessarily entails rejecting even 'improving' interventions, particularly when they are done specifically for the benefit of the more-than-human world.

We should pay attention to White's quote on science and technology above. White rejects the idea that science and technology can solve ecological problems 'until we find a new religion or rethink our old one', that is to say, until we have rejected the 'dogma of rightful mastery of nature'. Read literally, the implication is that White has no absolute critique of the use of science and technology (including one might think, geoengineering technologies) provided that they are coupled with a social system that thinks ecologically and sees itself as part of, rather than master of, nature. The question then is whether there is something inherent about geoengineering technologies that make them necessarily irreconcilable with a new, ecological, relationship with nature. I discuss these ideas in greater detail in Chapter 5, where I ask whether or not a society that does not 'dominate nature' as Adorno and Horkheimer put it, would ever choose to intentionally alter the climate. Similarly in Chapter 6 I evaluate what it might take for a geoengineering program to 'live-with-nature', something which again seems to track with White's understanding in a broad shift in how nature is valued. The parallels between White's use of 'mastery' and accounts of 'dominating' nature should be evident. Nevertheless, it is enough to say here that I think that at least occasionally, social systems that have rejected domineering or masterful views of themselves over nature might still have cause to geoengineer – perhaps as an act of 'solidarity' with the suffering natural things that

[140] White, L., (1967) *The Historical Roots of Our Ecologic Crisis*. Science. Vol. 155. pp. 1203-1207.
[141] See for instance: Carr, W., (2014) 'It's God's Stuff We're Messing With' Geoengineering as a Religious Issue. *Geoengineering Our Climate Working Paper and Opinion Article Series*. pp. 1-6.
Clingerman, F., O'Brien, K. J., (2014) Playing God: Why Religion Belongs in the Climate Engineering Debate. *Bulletin of Atomic Scientists*. Vol. 70. Is. 3. pp. 27-37.
Hartmann, L., (2017) Climate Engineering and the Playing God Critique. *Ethics and International Affairs*. Vol. 31. Is. 3. pp. 313-333.
[142] White, (1967) *The Historical Roots of Our Ecologic Crisis*. p. 1207.

have been or will be harmed by allowing climate change to progress unchecked. If this seems plausible, then there is again to reason to think that White will not always presume against intentional climate modification, but is rather restricted to critiquing a system of values that has generated geoengineering as a solution to climate change today. What it does not show is a general case that would apply to all geoengineerings in all cases.

5.0 Conclusions

This chapter has introduced environmental ethics arguments as a specific subset of critiques of geoengineering. These critiques are concerned with the proper relationship between human beings and their (typically) natural surroundings. Environmental ethics critiques operate by making a claim about what the proper relationship, including what standards of treatment are owed, between humans and nature is, and then attempting to show that geoengineering would violate this proper relation.

A useful review of many core positions in environmental ethics is provided by Preston, who argues that despite their differences there is a defeasible 'presumption' against geoengineering shared by all. Similar conclusions are reached by Dane Scott. I aim to show that this case regarding a 'presumption' has been overstated, and closer readings of the environmental ethics positions cited in favour of it generally show a greater deal of openness to geoengineering than claimed by Preston. The major goal of this thesis is to provide these closer readings and establish whether or not a general case exists against geoengineering in the works of central environmental ethics thinkers.

Section 4 of this chapter has begun to unsettle Preston's case. I argued that many of the authors Preston cites in favour of the presumption might be able to accept geoengineering. For each of these authors I have highlighted areas in their work where a pro-geoengineering case might be developed from. I will now proceed to a more in-depth discussion of several core environmental ethics positions not discussed here. In Chapter 3 I consider 'Respect for Nature' ethics – characterised by the work of (the early) Tom Regan, and especially Paul Taylor. Preston cites both of these authors as having allied positions and for that reason they are considered together. Unlike many of the positions reviewed above, Taylor has a highly developed ethical theory which goes to length to explain the origins of our obligations to nature stemming from the *telos* of biological organisms, something which demands ethical respect. Both Taylor and Regan conclude that respecting nature entails negative duties towards it, expressed as a 'Preservation Principle' by Regan, and a 'Duty of Non-Interference' by Taylor. If successful, this argument might provide a general objection to geoengineering. Chapter 4 considers an argument from Eric Katz, who claims that transforming nature into an artifact involves 'domination'. If geoengineering makes nature artificial, by imposing human intentions onto unmodified parts of nature, then a strong case could be made for its wrongdoing. Assessing this argument also demands a full chapter. In Chapter 5, I consider a similar position by Adorno and Horkheimer. These authors argue that certain societies 'dominate nature' when they treat nature entirely instrumentally, rather than as an end-in-itself. Their argument may be a way to explain via analogy with human domination why geoengineering is wrong, even if Katz's argument from domination fails.

Chapter 3 - Does Respect for Nature Support a Presumptive Argument Against Geoengineering?

In the previous chapter I looked at a number of positions in environmental ethics and assessed whether or not they would support a general case against geoengineering. I argued that while each of the theories offers some face-value reasons for objecting to geoengineering, none appeared to have a watertight case against it. This chapter continues this process of evaluating core environmental ethics positions for their potential support of geoengineering. In particular, this chapter evaluates support for a presumption against geoengineering from two related theories of environmental ethics: those of Tom Regan and Paul Taylor. Both Taylor and Regan made important early contributions to the field of environmental ethics, which remain influential in recent discussions of the ethics of geoengineering. Both philosophers attempt to show that humans have moral duties towards nature on account of nature's non-instrumental value, claiming that we ought to adopt an attitude of 'respect' toward nature. Similarly, both authors conclude that acknowledging this demand for respect involves accepting a 'hands-off'[143] prohibition on human interference with nature, which Taylor terms the 'Preservation Principle.'[144] I refer to both positions as Respect for Nature ethics, or RfN.

It is on account of these principles that RfN has been viewed as an ethical theory which will oppose geoengineering. Numerous authors who have considered the ethics of intentional climate modification have come to the conclusion that it would be rejected by RfN. For instance, a call to 'Respect Nature' appears as a challenge geoengineering must meet in order to be ethical in the works of Dale Jamieson and the so-called 'Tollgate Principles'.[145] I discuss these further in Chapter 6. Daniel Callies writes that: 'The claim that intentionally manipulating the climate would show a lack of *respect for nature* enjoys prima facie plausibility.'[146] And crucially for us, Christopher Preston writes: 'these authors [Taylor and Regan] suggested that the management of nature on a grand scale is wrong. Climate engineering would appear to run counter to this basic environmental intuition against meddling with earth's fundamental processes.'[147] On this ground, Preston argues that RfN contributes to a 'presumptive argument' for a prohibition on geoengineering.

In this chapter I evaluate Taylor and Regan's arguments for RfN and assess whether they do support a prohibition on geoengineering. I argue that while Preston is correct in identifying *prima-facie* reasons for thinking that RfN supports an argument against geoengineering, I argue that a close reading of their work will show that, when properly understood, neither theory can outright prohibit geoengineering. However, I also give reasons to doubt that the RfN theory is defensible at all, by arguing that neither author can convincingly show where nature's non-instrumental moral worth originates. I first outline the arguments made in favour of nature's non-instrumental moral worth by Taylor and Regan (1.1). Then I offer two challenges and conclude that RfN fails to show that we have obligations not to intervene in nature (1.2). I then briefly consider Dale Jamieson's case for an

[143] Regan, T., (1981) The Nature and Possibility of an Environmental Ethic. *Environmental Ethics*. Vol. 3. Is. 1. p. 22.
[144] Taylor, P., (1986) *Respect for Nature: A Theory of Environmental Ethics*. Princeton, Princeton University Press. p.32.
[145] Gardiner, S.M., Fragnière, A., (2018) The Tollgate Principles for the Governance of Geoengineering: Moving Beyond the Oxford Principles to an Ethically More Robust Approach. *Ethics, Policy & Environment*. Vol. 21. Is. 2. pp. 143-174.
[146] Callies, D.E., (2015) Climate Engineering: For and Against. *Global Justice: Theory, Practice, Rhetoric*. Vol. 8. Is. 2. pp. 104-110. Emphasis own.
[147] Preston, C.J., (2011) Re-Thinking the Unthinkable: Environmental Ethics and the Presumptive Argument Against Geoengineering. *Environmental Values*. Vol. 20. Is. 4. p. 463.

instrumental adoption of RfN's normative principles, decoupled from an argument for nature's moral worth, and acknowledge that this offers a means for accepting my objections but adopting the normative principles proposed by Taylor and Regan on different, entirely anthropocentric instrumental grounds (1.3). I then present the second prong of my argument. I argue that the normative principles of RfN still allow some forms of geoengineering to be permitted (2.0). I outline how both Taylor and Regan allow for exceptions to the duty of non-interference, which have been overlooked in Preston's reading (2.1). I then show that some forms of geoengineering meet Taylor's own criteria for legitimate forms of interference (2.2). I conclude that RfN does not support a general prohibition on geoengineering (3).

I conclude that RfN cannot rule out all forms of geoengineering, that at least some geoengineering could be legitimate in Taylor and Regan's ethics – in other words: geoengineering might be able to 'respect nature'. Since some forms of geoengineering could be permissible in RfN, we can infer that its criticisms of geoengineering are not focused on general features shared by all forms of geoengineering and we must also conclude that RfN cannot be used to support a general case against geoengineering. If a general case is to be formulated, a stronger argument will need to be made which can show why even 'respectful' methods for geoengineering must be prohibited.

Why Should We Adopt an Ethics of Respect for Nature?

In this section I give an introduction to the ethics of RfN. In section 1.1 I introduce Taylor and Regan's ethical theories. I begin (1.1.1) by giving some history on the context they developed their theories in, and what texts I have used in this chapter to construct their positions. In 1.1.2 I then give an account of their arguments, highlighting the major elements of the theories and their similarities and differences. In section 1.2 I give an initial critique of these theories. Both Taylor and Regan's ethics rely on identifying a property that can ground an expansion of moral considerability beyond sentient living things. However, in 1.2 I challenge each of their attempts to do so. In particular, I focus on the implausibility of Taylor's candidate property – the possession of *telos* in living beings – as a source of moral considerability. The success of this challenge to the grounding of their ethical projects does not on its own shown that their theories do not presume against geoengineering. However, the broad points that are raised in this critique about the viability of extending ethical consideration to nonconscious nature will prove relevant throughout the thesis. With this in mind, in 1.3 I look at a suggestion by Dale Jamieson that environmentalists might want to simply ignore the difficulties RfN has in grounding its ethics, but simply adopt its normative principles anyway, as doing so would have beneficial environmental outcomes. RfN remains relevant in discussions of geoengineering, and Jamieson allows proponents of its normative principles a way to advocate for acting according to its demands without the baggage of its complicated ethical underpinnings. This allows us to go on to discuss the implications of its normative demands in the following Section (2) and consider whether or not they actually presume against geoengineering.

1.1 Taylor and Regan's Ethics

1.1.1 A Note on the Texts

Tom Regan is best known for his later work on animal rights theory which proved to be highly influential within that field. However, the arguments which this chapter considers are drawn from his lesser-known foray into environmental ethics. These works were published from the mid-1970s into the early 1980s and predate the publication of his best known work 'The Case for Animal

Rights'.[148] In particular, this chapter looks especially at the ethical arguments made in Regan's 1981 paper: 'The Nature and Possibility of an Environmental Ethic' (henceforth 'Nature and Possibility'.)[149] Additionally, supplementary material for interpreting Regan's views within this work are drawn from his earlier work on non-human interests developed in his conversations with Feinberg.[150] These two papers deviate substantially from Regan's better-known animal rights work and Regan subsequently believed them to be either mistaken or in the case of 'Nature and Possibility', a mere *illustration* of how an environmental ethics position could be formulated.[157] However, since Preston includes 'Nature and Possibility' among the positions which supposedly support his 'presumptive argument against geoengineering', I put aside the fact that Regan later distanced himself from this work and evaluate the argument put forward here on its own merits.

Paul Taylor develops his environmental ethics roughly contemporaneously with that of Regan. Material for what would become his major work was first published as an article in The Journal of Environmental Ethics in 1981, titled: 'The Ethics of Respect for Nature'.[151] The argument made here was then expanded upon in his most well-known, and highly influential work, the book 'Respect for Nature' in 1986.[152] I have used both to construct Taylor's position here. Additional clarificatory points have been drawn from Taylor's 1983 essay 'In Defence of Biocentrism', a short response to an essay by Gene Spitler.[153] Due to the many key similarities between Regan and Taylor's work the following section should be understood as a summary of a general ethical argument of this type (which I term RfN), presented in the strongest possible form from a reading of both authors. In fact, in Respect for Nature, Taylor attributes his inclusion of a 'Duty of Non-Interference' as part of his ethics, to Regan's work in 'Nature and Possibility'.[154] Since this is one of the crucial aspects of their ethics that I am evaluating in this chapter (it is from this duty that Preston thinks a presumption against geoengineering follows), it makes sense to consider these positions together. However, where there is significant difference between Regan and Taylor, or where critiques are applicable only to one rather than the other, I refer to the author by name.

1.1.2 Foundations of Regan and Taylor's Ethics

Taylor and Regan both present a non-anthropocentric theory of environmental ethics which attempts to show that non-instrumental moral worth is not unique to human persons or sentient animals, but rather exists in all living entities (humans, animals, plants, bacteria etc), and in Regan possibly some non-living things too. Non-instrumental moral worth refers to the particular way in which an entity is valued. Consider again the difference between harming a painting and harming a human person. It may be morally wrong to destroy a painting, but we tend to believe that the harm is done to those whose enjoyment of the painting has now been hindered. The painting had worth, but only instrumentally to the worth of others. Conversely, when we harm another person, we wrong them directly. Their worth is usually thought of as 'non-instrumental'.[155] Having non-instrumental moral worth means being able to be directly wronged, and to be the subject of direct moral concern. Those entities which possess this kind of value are ends-in-themselves, they are what instrumentally valuable things are instrumentally valuable for.[156] Proponents of non-anthropocentric

[148] Regan, (1983) *The Case for Animal Rights*.
[149] Regan, (1981) *The Nature and Possibility of an Environmental Ethic*. pp. 19-34.
[150] Regan, T., (1976) Feinberg on What Sorts of Beings Can Have Rights. *The Southern Journal of Philosophy*. Vol. 14. Is. 3. pp. 485-498.
[151] Taylor, (1981) *The Ethics of Respect for Nature*. pp. 197-218.
[152] Taylor, (1986) *Respect for Nature*.
[153] Taylor, P., (1983) In Defence of Biocentrism. *Environmental Ethics*. Vol. 5. Is. 3. pp. 237-243.
[154] Taylor, (1986) *Respect for Nature*. p. 175.
[155] There are likely instrumental harms too, I for instance, prefer it when my friends are not being harmed by others; thus, their wellbeing is non-instrumentally valuable to themselves and instrumentally valuable to me.
[156] O'Neill, (1992) The Varieties of Intrinsic Value. pp. 119 – 137.

theories of moral worth generally make the claim that some non-human entities also possess this type of value, and morally speaking are closer to humans than they are to paintings.

Both Taylor and Regan argue that the existence of this non-instrumental value throughout 'nature' obliges humans to treat it with certain standards of respect, including negative duties to preserve or otherwise not interfere with nature. RfN holds that respecting nature means acknowledging the non-instrumental moral worth possessed by individuals and respecting those individuals' interests. The challenge that proponents of RfN faces are therefore twofold: they must show that natural entities a) possess interests, and b) possess some property (Φ) that makes those interests demanding of respect. Since RfN wants to include non-sentient entities (e.g., all non- and potentially some animal life, as well as non-living entities in Regan) in its moral circle it is evident that Φ will need to be something which does not rely upon the possessor to have cognitive states (e.g., reason, or the capacity for suffering), and in turn this feature Φ must be shown to ground moral obligations.[157] If it fails to show either of these, then it fails to establish that non-instrumental moral worth exists in nature.

RfN argues for a new account of interests that can accommodate the 'interests' of non-sentient beings. Regan argues that 'interests' have (falsely) been conflated with 'possessing desires', which presupposes the necessity of consciousness, and thus excludes much of nature.[158] Both authors therefore adopt a novel account of interests as *'*possessing a good of one's own*'*, which can be either promoted or frustrated. For example: while a plant does not *desire* (in the sense of having a belief about what it wants and how to achieve it) to be moved into the sunlight we might say it is *the plant's interest* to be moved into the sun, since doing so is instrumentally valuable to the plant achieving its own personal good (survival, or flourishing perhaps). Both Regan and Taylor's account of interests is built upon a teleological account of biology, where individual organisms strive to achieve particular goals related to their specific biological purpose or *telos*. Taylor explains that living things are teleological since they are 'goal oriented… a unified system of organised activity, the constant tendency of which is to preserve its existence by protecting and promoting its wellbeing'.[159] For example, a plant is interested in being moved to the sun because it needs the sunlight to survive, grow, and reproduce itself, and thereby achieve its telos.[160] This idea of biological teleology is controversial and discussed in greater detail later (2.2). However, for our purposes here, it is sufficient to recognise that biological teleology is what Taylor uses to extend the notion of interest-holders beyond the boundaries of entities who are sentient, because it allows for a notion of interests which are not linked to mental states.

However, showing that non-sentient entities can possess interests (in the new, expanded sense) is not on its own sufficient to show that we are obliged to give them moral consideration – we also need to be convinced that those interests are morally relevant.[161] In his reply to Feinberg, Regan acknowledges that many non-sentient and non-living entities have purposes, the achievement of which can be advanced or frustrated depending upon how we treat them.[162] According to the definition of interests above, a bicycle might be thought to have an interest in being oiled regularly and generally well maintained, in order to achieve its purpose of being a useful form of transportation. Accepting that these interests are morally relevant would evidently open RfN to claims of overextension and absurdity. After all, the purpose of RfN is to show why we have a duty to

[157] After all, it is trivial to consider that there are some features shared by all of these entities that have no moral relevance at all, e.g., their being composed of matter or their existing on earth.
[158] Regan, (1981) The Nature and Possibility of an Environmental Ethic. p. 22.
[159] Taylor, (1986) *Respect for Nature*. p. 45.
[160] Taylor, (1986) *Respect for Nature*. pp. 60-71.
[161] This would be true whether we accept Taylor and Regan's novel account of interests or a traditional account.
[162] Regan, (1976) Feinberg on What Sorts of Beings Can Have Rights. pp. 485-498.

protect and care for *natural* entities, and not, presumably artifacts like bicycles, computers, houses, golf-courses etc. Therefore, in order to avoid the charge of absurdity, proponents of RfN must either explain why only natural objects and no artificial objects can have interests (i.e., why the bicycle lacks interests), or could bite the bullet and accept that bicycles and other artificial things do have interests, but offer a reason why only the interests of 'nature' deserve to be respected and the interests of bicycles and other artificial things do not. Put another way, proponents of RfN must be able to identify some property or feature (call it Φ) that natural entities possess which unnatural ones do not which can explain why only natural interests should enter into moral considerations. If either of these could be shown, then RfN would successfully exclude artificial entities and avoid the charge of overextension.

As for the identity and distribution of said property Φ, Regan and Taylor's thinking diverges. Regan acknowledges the necessity of Φ existing for an environmental ethics to be successful, but does not name a candidate property. We can glean a few additional details about what Regan thinks however. Regan agrees that all living beings possess Φ, but we can also infer from his comments in 'Nature and Possibility' that *some* non-living natural entities also possess Φ. On the latter point, this is evident in his discussion of the moral deservedness of 'Wild stretches of the Colorado River', but not 'a small, muddy creek'.[163] We might be tempted to infer from this that Φ is some kind of aesthetic value – after all, an appeal to aesthetic beauty would seem to explain why Regan thought the river but not the creek was directly morally valuable. But this cannot be the case, since Regan is concerned with developing a non-anthropocentric ethics, and thus an appeal to human notions of beauty will not suffice. So, while we know something about how Regan saw direct moral consideration being distributed (all living things, some but not all non-living non-artificial things), he does not present an argument for what it is that unites all those entities.

Taylor argues that: 'Wild living things are deserving of the concern and consideration of all moral agents *simply in virtue* of their being members of the Earth's community of life', indicating that he believes Φ is 'membership in the community of life'.[164] To explain this, Taylor adopts a stance he refers to as 'Teleological Biocentrism'. Teleological Biocentrism is a stance which purports that living entities are teleological entities – i.e., entities with a purpose. Moreover, possession of this purpose gives an entity a good of one's own (the degree to which they are fulfilling their purpose). Finally, purposeful entities, Taylor thinks, are directly morally considerable.[165] For Taylor, Φ is therefore limited to biological entities, but found in all of them in virtue of their teleology. This also entails that Taylor's ethics are, in his words, 'species impartial'. Since it is possession of teleology which makes something morally considerable, and all living things have teleology, all living things are equally morally relevant (though note that I dispute just how committed Taylor is to this view in Section 1.2.2). So, Taylor, by adopting Teleological Biocentrism claims to have found a reason for thinking all living entities, and no non-living or artificial entities are morally relevant. However, in 1.2 I argue that Teleological Biocentrism does not succeed in doing what Taylor expects it to.

1.1.3 The Normative Principles of RfN

Having identified reasons for thinking that 'nature' is worthy of direct moral consideration, Taylor and Regan go on to outline what this entails for our ethical responsibilities. I will outline more about the specifics of their ethics as it becomes necessary to discuss them, but it is worth clarifying the basics here. For Taylor, accepting that nature has non-instrumental moral worth means adopting what he terms an 'attitude of respect'. This in turn means adopting 'standards of good character' and crucially 'rules of right conduct'.[166] Taylor outlines four rules, understood as broad duties, which

[163] Regan, (1981) The Nature and Possibility of an Environmental Ethic. p. 22.
[164] Taylor, (1981) The Ethics of Respect for Nature. p. 201.
[165] Taylor, (1986) *Respect for Nature*. pp. 119 – 129.
[166] Taylor, (1986) *Respect for Nature*. p. 172

are in turn governed by a number of priority principles (which I discuss in greater detail in Section 2). These are: duties of: a) Non-maleficence, b) Non-interference, c) Fidelity, and d) Restitutive Justice.[167]

Crucially it is this duty of non-interference that Preston believes supports a presumption against geoengineering. Taylor splits the rule of non-interference into two parts. The first part includes a duty to refrain from 'placing restrictions on the freedom of individual organisms.'[168] This includes actions that either directly or indirectly constrain the 'normal activity and healthy development of an animal or plant.' These constraints range from very direct restrictions on freedom such as physical constraints like cages or traps, to the indirect loss of ability to live a fulfilling life such as reduced mobility stemming from a traffic injury. All of these violations of the duty of non-interference stem from actively harming an organism and preventing it from being able to pursue its telos in the way that would have occurred had the duty to not intervene been adhered to. However, the second element of the duty of non-interference also explicitly rules out interference in nature which might be otherwise *beneficial* to nature. This is the duty to let 'wild creatures... carry on their existence in a wild state... *no matter how well we treat them'.*[169] Respecting this duty means that 'we must not try to manipulate, control, modify, or 'manage' natural ecosystems or otherwise intervene in their normal functioning'.[170] It is perhaps evident from these principles why Preston should conclude that Taylor presumes against geoengineering. After all, geoengineering certainly seems to imply 'control' or 'modification' in natural ecosystems, in a way which alters their normal functioning. Moreover, Taylor seems to be able to guard against a potential counter-argument that geoengineering could be legitimate since it only modifies these natural entities in a beneficial manner, as the duty of non-interference explicitly forbids even such beneficial interventions. However, as I will argue throughout this chapter, Preston's conclusion is based on a surface level reading of Taylor.

Similar conclusions are reached by Regan. While Regan is generally lacking in the detail of Taylor, the important take-away is that he advocates for what he terms 'the preservation principle'.[171] This is a principle of 'nondestruction, noninterference, and generally nonmeddling'. This follows from the recognition of inherent value in natural entities, and that the best way to preserve that value comes from generally acting in a way to preserve those natural entities intact. Thus, there is a duty not to involve ourselves in or modify them; it is a duty to preserve nature's value wherever it is found. Again, it is for this reason that Preston counts Regan as a supporter of a presumption against geoengineering. Crucially however, Regan understands the duty of noninterference to be only a 'prima facie' duty rather than an 'absolute' duty. For Regan this means that the preservation principle is a general guideline but one which does not hold in every case. In particular, Regan believes that in cases where what was valuable in nature may be lost due to inaction, it is permissible to intervene in order to preserve that value. The implications of this on his ability to presume against geoengineering will be discussed in Section 2.

1.2. Two Challenges

In the previous section we established that proponents of RfN need to identify a property Φ which can show why the interests of nature matter morally. Without such a property showing why we have an obligation to treat nature with respect (and crucially showing why we have a duty of non-intervention specifically) RfN cannot be the basis of a general argument against geoengineering.

[167] Taylor, (1986) *Respect for Nature*. p. 172.
[168] Taylor, (1986) *Respect for Nature*. p. 173.
[169] Taylor, (1986) *Respect for Nature*. p.174. emphasis own.
[170] Taylor, (1986) *Respect for Nature*. p.174.
[171] Regan, (1981) The Nature and Possibility of an Environmental Ethic. p. 31.

I offer two challenges to RfN's argument for the non-instrumental moral worth of nature. The first objection argues that neither author successfully identifies a plausible property (Φ) for grounding non-instrumental moral worth (1.2.1). Regan does not give a candidate for Φ and so this section is largely focussed on evaluating Taylor's argument for Teleological Biocentrism. I argue that Taylor fails to establish the plausibility of 'Teleological Biocentrism' as a basis for Φ. This is because Teleological Biocentrism fails to do the job Taylor intends for it, namely extending the boundaries of moral considerability beyond animals (human and nonhuman) to all living things, while excluding non-living things which also have internally directed teleologies. This leaves Taylor with two choices: either drop the 'teleological' aspect of teleological biocentrism and resort to making a new argument that can explain why only living things have non-instrumental value, or drop the 'biocentrism' part and risk charges of absurdity having been forced to accept certain non-living non-natural entities might be the subject of direct moral consideration. Suppose the latter option is chosen. In 1.2.2 I develop a second objection: that is that Taylor does not establish why telos is morally relevant.

The success of these objections shows (1.2.3) that Taylor and Regan do not give us good grounds for accepting an RfN ethics. While they may succeed in showing us why we should have an expanded notion of interests which can include non-conscious nature (a claim I have not evaluated), they fail to show why this new sense of interests has the moral demandingness of the account which only applied to humans and some nonhuman animals. Despite, I believe, the success of this argument, in 1.3 I consider a case put forward by Jamieson for adopting the normative principles of RfN despite these problems in the base of the theory. Given the possibility of accepting something like RfN based on Jamieson's instrumental argument for it, coupled with the popularity of RfN in discussions of the ethics of geoengineering, it remains worthwhile to discuss whether or not accepting RfN actually 'presumes' against geoengineering in S.2.

1.2.1 The Identity of a Property that Grounds Non-Instrumental Moral Worth (Φ)

Central to Taylor's argument in 'Respect for Nature' is his theory of Teleological Biocentrism. Teleological Biocentrism claims that the inherent value of living things is explained by the fact that they are goal-driven, i.e., teleological things. Taylor argues that living things are organised in such a way that each part of them contributes to pursuing the interest of the whole, which in turn maintains the existence of the system. For Taylor, living things are distinct from non-living things, and morally relevant, because they are organised to pursue their interests. Taylor argues that teleological biocentrism provides a candidate for Φ. I assess his case for this here and consider objections to Teleological Biocentrism put forward by Basl and Sandler, and Holm.

Teleological Biocentrism does two important jobs for Taylor: it (a) limits the distribution of interest holders to only biological entities, which guards against a charge of overextension and absurdity, and (b) identifies a candidate property, 'possession of telos', for Φ. I argue against the use of 'possession of telos' as Φ in the following section (2.2). However, in this section I argue that teleological biocentrism fails to achieve (a). I argue that Taylor's teleological biocentrism fails to exclude some non-biological things (what I will refer to as the 'overextension claim'). If the overextension claim is true then Taylor's argument becomes vulnerable to a reductio ad absurdum, since it commits Taylor to accepting that certain non-living non-natural things are worthy of moral consideration. I should note that I am not assuming that non-living things having non-instrumental moral worth is prima facie absurd (although many would claim that it is). Rather, I claim that the particular examples that teleological biocentrism fails to exclude – in particular non-natural non-living things such as bicycles and candle flames – are absurd.[172] Accepting that these particular non-biological entities could be

[172] Or at the very least, are a consequence unintended and likely unwanted by Taylor.

included in Taylor's ethics delegitimises RfN as means for showing the extent of our moral obligations.

Earlier in this chapter (1.1.2) we established the importance to RfN of establishing how the telos of a non-conscious natural entity, such as a plant, differs from that of an artificial entity, such as a bicycle. The importance of this distinction was noted because it appeared that adopting RfN's theory of interests allowed us to say that a bicycle has interests too as its ability to fulfil its purpose could be advanced or hindered. Admitting this though would seem to conflict with Taylor's central claim of Teleological Biocentrism that it is limited to, as the name suggests, only biological things. Now, to be clear Taylor does not argue that non-living things cannot have purposes. Indeed, it is quite obvious that they do, after all what is a bicycle if not an object purpose built as a mode of transportation? Rather, Taylor argues that the kinds of purpose/telos that non-living artificial things have is significantly/qualitatively different from that of biological things, since it is 'built into them by their human creators'.[173] Taylor's actual claim then is that only individual living-things have *internally directed teleologies* which can be understood only by reference to itself. Taylor claims that when we move the plant into the sun, the benefit from the plant satisfying its interest is directed internally towards itself. Conversely when we oil our bicycles, while we can say that the bicycle's interests were met, the benefit is directed externally to the person who needs the functioning bicycle.[174] Here we also see the origins of Taylor's ethical individualism, as the internal directedness of each living thing's telos establishes it as a 'teleological centre of life' with its own unique 'point of view'.[175] Establishing the overextension claim requires that we show that there are non-living entities which have this particular internally directed form of teleology.

If we momentarily concede to Taylor that internal and external teleology really is split between biological and nonbiological things in this way, let us try to understand why the distinction between internally and externally directed telos matters to Taylor and understand what exactly he thinks the common telos of all living things is. In 'Respect for Nature' Taylor appears to give several related, but distinct, answers to this question. In one instance Taylor advocates a commonly held evolutionary account of biological telos, that: (x) an organism's purpose is to reproduce and pass on its genes.[176] Elsewhere he argues that (y) an organism's aim is simply to survive.[177] Finally he suggests that survival alone is not enough but instead (z) living a 'flourishing life', described as 'maintaining the normal biological functions of its species throughout its entire span of life', is considered the purpose for organisms.[178] Clearly these concepts are interrelated. (y) for instance, is instrumental for (x), and both may be instrumental for (z). Since it is not clear which of these principles Taylor favours, each of them is evaluated; however, I find Taylor has problems with overextension no matter which account is adopted.

First of all, there appears to be a conflict between adopting (x) and remaining committed to the internal directness of biological telos. Basl & Sandler describe Taylor as 'conflating the explanation of teleological organisation with the subject of teleological organisation'.[179] Certainly, most organisms seem to be designed to reproduce,[180] but if this is the telos they are directed towards it is no longer

[173] Taylor, (1986) *Respect for Nature*. p. 124-125.
[174] Taylor, (1986) *Respect for Nature*. p. 61.
[175] Taylor, (1986) *Respect for Nature*. p. 121-122.
[176] Taylor, (1986) *Respect for Nature*. p. 122.
[177] Taylor, (1986) *Respect for Nature*. p. 121.
[178] Taylor, (1986) *Respect for Nature*. p. 66-67.
[179] Basl, J., Sandler, R., (2013a) Three Puzzles Regarding the Moral Status of Synthetic Organisms. In: Kaebnick, G. E., Murray, T. H., (eds) *Synthetic Biology and Morality: Artificial Life and the Bounds of Nature*. Cambridge, MIT Press. pp. 89–106.
[180] Although it should be noted that not all individual organisms do this. Consider the droves of sterile worker bees, biologically incapable of reproducing themselves, who pass on their genes only through the coordinated effort of a colony.

true that their telos can be understood only in reference to themselves. When discussing biological teleology, 'reproduction' is more accurately understood as 'passing on genes'. However, we know that parents pass on their genes when their offspring have offspring too. So, can it really be said that an organism's purpose is internally directed when it has been imparted by, and is instrumentally valuable for fulfilling the purposes of, an organism's parents? Crucially, adopting reproduction as the telos seems to mean giving up on what was purported to be special about the telos of biological things - that is its internal directedness. If it is not only internally directed teleologies which matter, then Taylor does not seem able to distinguish between non-conscious natural things, and from non-conscious non-natural things which uncontroversially do not possess non-instrumental worth.

Sune Holm argues that in the face of this objection Taylor can best strengthen his argument by abandoning (x) in favour of (y): an organism's purpose is simply to survive. Some further clarification on what (y) entails may be necessary here. It may initially seem that (y) is an undesirable route for Taylor, as survival seems to be an impossible task. After all, no organism can survive indefinitely, and it is unlikely that Taylor is claiming that no organisms achieve their telos.[181] Adopting (y) instead would mean adopting what Holm describes as the 'organisational account' of biological teleology.[182] Holm argues that organisms are teleological in so far as each of their constituent parts is directed towards maintaining the conditions required for its own existence and the continual maintenance of those parts. An animal's eyes, legs, teeth, and stomach all work together to acquire the nutrients required to continually maintain each component part, and thus the maintenance of the entire internally directed system. This initially seems to help guard against the claim of overextension that (x) was vulnerable to. While some comparison with non-living entities is possible, these rely on the intention of an external agent to make sense. For instance: a bicycle might be said to maintain its own conditions for survival by continuing to have working parts and remaining worthy of its owner's maintenance, but this is no longer a self-organising system like an organism might be. However, Holm argues that even adopting (y) does not totally safeguard Taylor from the claim of over extension. Holm proposes a candle flame and the water cycle as internally directed non-biological teleological entities. Consider the burning candle flame: it requires fuel and oxygen to continue maintaining its existence, and as it burns it draws oxygen down towards it and spreads towards new fuel sources. [183]Therefore, adopting (y) does not seem to protect Taylor from the claim of overextension, as he would now be forced to include candle flames and any other non-biological yet teleological entities as subjects of moral calculations.[184]

Finally, Taylor might adopt (z), that the purpose of an organism is to live a flourishing life. Taylor explains his notion of flourishing through the example of a butterfly, living out each phase of its life cycle in a 'normal manner… under favourable environmental conditions… and maintaining the normal biological functions of its species throughout the entire span of [its] life'.[185] Here Taylor's argument appears to presume its own conclusion as 'flourishing' is defined in terms exclusive to biology; in particular, biological functions and life. Just as Regan and Taylor argue that the concept of interests has been formulated in terms which exclude non-conscious entities, Taylor's concept of 'flourishing' is unable to accommodate non-living entities. Taylor has assumed what was trying to be proved. But I would suggest that an alternative account of flourishing along Taylor's lines could be formulated to account for the 'flourishing life' of non-biological entities too: for example, a bicycle

[181] Though note it may be possible to have a purpose which it is impossible to fulfil.

[182] Holm, S., (2017) Teleology and Biocentrism. *Synthese.* Vol. 194. Is. 4. pp. 1075-1087.

[183] Holm, (2017) Teleology and Biocentrism. p. 1086.

[184] Taylor (Taylor, (1986) *Respect for Nature*. pp. 124-125) actually appears to be open to there being some internally directed non-biological teleological entities: in a brief passage discussing the potentiality of artificial intelligence, which he suggests could have a good of its own independent of its creator. For our sakes here though it is sufficient to note that an intelligent robot or non-biological person is substantially different morally to a candle-flame.

[185] Taylor, (1986) *Respect for Nature*. p. 66.

might be said to have had a flourishing existence if it has no unexpected maintenance issues (a cracked frame), under favourable environmental conditions (such as not being left in the rain to rust), throughout its expected product life-time. Of course, this is not strictly true since bicycles and other non-living things do not have a 'biological life' or a 'species', and so could not meet the exact wording of Taylor's account. However, the exercise here is not to assume there is something special about biology – if we exclude non biological entities definitionally then Taylor would be presuming his own conclusions. Therefore, I find that adopting (z) still leaves Taylor vulnerable to (1).

From this discussion we must conclude that Taylor is unable to exclude non-living entities from being included in his ethics and therefore does not have sufficient grounds for adopting Teleological Biocentrism. Holm proposes that Taylor should simply bite the bullet and adopt (y) while abandoning his claim that biological entities are the only morally relevant entities.[186] However, since adopting this 'teleocentric ethics' would require Taylor to say that candle flames are directly morally considerable, Taylor cannot reasonably accept this option. Another option for Taylor might be to abandon the teleological element of his theory, and simply claim that there is something special about living things that makes them worthy of respect.[187] This also seems to be an unattractive prospect for Taylor, since it errs too close to the morally arbitrary preference of humans for living rather than non-living things, to be a convincing explanation for Φ. At the very least, an entirely new argument would need to be provided which could show why all and only living things are worthy of a distinct moral status. I therefore conclude that Taylor has failed to provide sufficient grounds for adopting teleological biocentrism and cannot show why we have obligations to treat nature as if it had non-instrumental moral worth.

1.2.2 The Moral Importance of Telos

In the previous subsection, I show that by adopting telos as the key property in determining whether an entity has non-instrumental moral worth, Taylor is unable to limit the extension of moral considerability only to living things, since he is also required to include some non-living but nevertheless, teleological things. I believe that this shows that RfN produces absurd conclusions, and therefore should not be used as the source for our ethical system. However, while an unappealing option, it is possible that Taylor or his proponents may simply 'bite the bullet' and accept that including non-living teleological things in the realm of moral considerability is an acceptable price to pay. Therefore, in this subsection, I argue that there is an additional problem with adopting the possession of a telos as Φ. This is that in Respect for Nature, Taylor substantially degrades the importance of telos compared to traditional markers of moral importance, such as ability to suffer. Even if we accept that we have some obligation to respect all internally directed teleological entities, the standard of treatment that this entitles them is so miniscule that it substantially restricts Taylor's ability to ground his normative principles.

Taylor's biocentrism is made up of three key points: (1) Living things are morally relevant because of their telos (I call this the moral relevance of telos), (2) all living things possess a *telos,* and therefore: (3) All living things are equally morally relevant.[188] However, it is tempting to counter-argue that: since not all living things are equally morally relevant (not-3) then *telos* does not make living things morally relevant (not-1). This argument certainly seems to have intuitive appeal, after all it is certainly controversial to claim that humans and dandelions are equally morally relevant. An argument of this form can be found in Gene Spitler.[189] However Taylor is more than capable of

[186] Holm, (2017) Teleology and Biocentrism. p. 1086.
[187] Kenneth Goodpaster makes an argument that 'life' qua being alive is sufficient for being a morally considerable entity. See: (Goodpaster, (1978) On Being Morally Considerable. pp. 308-325.) Taylor also appears to have a view similar to this in his earlier 1981 work. See: Taylor, (1981) The Ethics of Respect for Nature. p. 201. Note that it is not entirely clear how compatible this view is with teleological biocentrism.
[188] Taylor, (1986) *Respect for Nature*. pp. 119-126.
[189] Spitler, G., (1982) Justifying a Respect for Nature. *Environmental Ethics*. Vol. 4. Is. 3. pp. 255-260.

avoiding this reductio with a qualification: (3a) All living things are equally morally relevant; *all other things being equal.*[190] I will argue that adopting (3a) still undermines Taylor's commitment to the moral relevance of telos(1), since adopting (3a) entails accepting that there are principles which are more important in determining the moral status of an individual than that individual's possession of telos.

Throughout 'Respect for Nature', Taylor gives several reasons why the interests of some organisms should be prioritised over those of others. For instance, in his discussion of the compatibility of vegetarianism with the ethics of RfN, he argues that:

> ...susceptibility to pain does not give animals a higher inherent worth… nevertheless any form of conscious suffering is an *intrinsically bad occurrence*… concern for [sentient beings'] well-being will accordingly include attempts to minimise *intrinsic evils*, in their lives… when there is a choice between killing plants or killing sentient animals, it will be less wrong to kill plants if animals are made to suffer.[191]

From this we can infer that, amongst the qualifications in (3a), the capability of an organism to experience unpleasant mental states is a legitimate reason for prioritising its wellbeing over that of an organism that does not possess this capability. This does not on its own entail that (3a) conflicts with the moral relevance of telos (1), but it does significantly reduce the weight that possession of telos affords in everyday moral decision making. Additionally, Taylor distinguishes between the obligations grounded by RfN and the obligations which humans owe to each other according to human ethics. Taylor accepts that a rational person's own duties to other humans outweigh the duties they have to nature (all things otherwise being equal).[192]

Taylor himself acknowledges that (3a) implies a weakening of the moral relevance of telos (1) in his response to Spitler: possessing moral worth does not mean never harming its possessor, only that we give adequate reasons for doing so.[193] This admission appears to significantly alter the ability of RfN to satisfy its own requirement to be species egalitarian. While all organisms are guaranteed a modicum of respect, Taylor's own second-order principles more or less guarantee that in practice the system will still be ranked in accordance with the capacities of individuals for traditionally morally relevant qualities such as ability to suffer or the ability to rationally contemplate the categorical imperative. This is not a claim that telos doesn't mark out those entities which need to be considered in moral calculations, even if the consideration they are owed is very small, but rather since the consideration that they are owed might be so small compared to the weight given to traditional recipients of moral consideration, it should make us doubt whether the normative outcomes (such as a principle of non-interference) would really follow from accepting their moral relevance. The likelihood that 'all things' ever will be equal once we begin to accept these other morally relevant criteria is essentially nil, so it is unclear why we should think we are really bound to any of the distinct normative implications of RfN including a principle of non-interference.

Teleological Biocentrism appears to leave Taylor's argument between a rock and a hard place. He could either accept (3) unqualified and be left vulnerable to Spitler's reductio or qualify this claim in line with (3a), but undermine the moral relevance of telos (1). Accepting the revision of (3a) and including a major role for cognitive capacities would entail accepting that RfN is failing to achieve its own goals of creating a species-egalitarian ethics, which Taylor believes is necessary for an ethics that can adequately protect nature. Since adopting (3a) means systemically prioritising the interests of sentient animals, and above all humans, over all other kinds of living things, in practical terms RfN

[190] Taylor makes this response himself in his response to Spitler: Taylor, (1983) In Defence of Biocentrism. *Environmental Ethics*. pp. 237-243.
[191] Taylor, P., (1986) *Respect for Nature*. p. 295. [emphasis my own].
[192] Taylor, (1986) *Respect for Nature*. p. 284.
[193] Taylor, (1983) In Defence of Biocentrism. pp. 237-243.

is not going to differ significantly from moral philosophies which only assign instrumental worth to nature. By showing that RfN still systematically prioritises human interests over nature, we may infer that it will be inadequate to ground a prohibition on geoengineering. RfN's supposed support for a presumption against geoengineering was based on its ability to prohibit human interference in the more-than-human world, by forming the basis for a 'duty of non-interference'. This, Taylor argues, follows from having a property Φ which can show why all living things are worth of 'respect' However, Taylor's own downgrading of the importance of telos, and making it secondarily important to traditional measures of moral considerability, entails that the justifications which need to be given to allow harms to most non-human living things is extremely low. Thus, teleological biocentrism does not seem to be adequate grounds for a 'duty of non-interference'.

1.2.3 Conclusions

In order to show we have obligations to nature, RfN must be able to show the source of these obligations. It attempts to do this by showing that natural entities have interests, and also possess a property Φ which distinguishes those interests from the (morally irrelevant) interests of non-conscious non-natural entities. I have however argued that Taylor's candidate for Φ is implausible. In section 1.2.1 I argued that Taylor's account of teleological biocentrism could not exclude non-living, but nonetheless teleological, things from having non-instrumental moral worth. This on its own might be grounds for a charge of absurdity and reason to reject RfN. A possible route remains open for Taylor to simply 'bite the bullet' and accept that RfN also includes obligations to some non-living things. If this were the case, RfN would no longer be based on teleological *biocentrism*, but instead just a telocentric ethics, and one that is open for charges of absurdity. In Section 1.2.2 I have argued that even if we accepted this move to teleological ethics, Taylor does not necessarily show why this entails adopting his normative principles. I have shown that Taylor continually returns to more traditional candidate properties for conferring non-instrumental moral value throughout Respect for Nature, showing that it is not teleological biocentrism doing the explanatory moral work. By failing to show the moral significance of teleology, Taylor fails to establish why the interests of nature matter morally, and why we have obligations towards it. Because non-sentient entities factor so little into our moral calculations, any duty of non-interference which might be owed is likely to in practice be a very small impediment to actually acting as if nature lacked moral considerability at all. If this is the case, the RfN might not present a serious challenge to geoengineering, even if that geoengineering is only beneficial to human beings, since the interests of humans count for so much more than the interests of non-conscious nature which a duty of non-interference was meant to safeguard.

1.3. Jamieson's Instrumental Account of Respect for Nature

I take it that the objections raised above present serious challenges to RfN's ability to identify why nature has non-instrumental moral worth. Jamieson, however, argues that adopting RfN's normative principles, including the principle of non-interference, will have good outcomes for nature's protection; and this gives us a pragmatic reason to accept Taylor's normative conclusions even if we dismiss his method of grounding his ethics in teleological biocentrism. [194]If we accept this 'pragmatic-RfN', Preston could salvage RfN as a support for a presumption against geoengineering since we would still have reasons for adopting the principle of non-interference. This pragmatic version of the argument has been influential in discussion of the ethics of geoengineering, including in the 'Tollgate Principles' (discussed further in Chapter 6), thus it is important to recognise its claims here.[195]

[194] Jamieson, D., (2010) Climate Change, Responsibility and Justice. *Science and Engineering Ethics*. Vol. 1. pp. 431-445.

[195] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. pp. 143-174.

Jamieson gives three arguments for a pragmatic-RfN, which I summarise here. (1) Humans require nature to flourish in order to achieve a number of benefits to themselves and acting in accordance according to the norms RfN is the best way to ensure nature flourishes. (2) The non-instrumental moral worth of human persons can only be understood against a background of nature's merely instrumental value. Jamieson asks us to compare the relationship between humans and nature with figures in representational painting; where the importance of the figure in the foreground gains its meaning the backdrop they are set within. Thus, Jamieson thinks that preserving nature is essential for preserving an important source of meaning in human lives. (3) The mistreatment of nature creates dispositions in persons to mistreat other persons. Adopting RfN will therefore lead to more virtuous interactions between moral agents.

It is not necessary to give Jamieson's argument a full hearing here, though I note that (1) and (3) are both unevidenced empirical claims and are vulnerable on that account. Nonetheless, some may be convinced by Jamieson's three arguments to adopt a pragmatic-RfN, including a principle of non-interference, and use this to support the presumptive case against geoengineering. In the following section (2) I argue that even if we adopt a pragmatic-RfN, rather than one based on teleological biocentrism we still do not find grounds for prohibiting geoengineering. This is because, I argue that the ethical principles of RfN namely do not lead to a categorical prohibition on geoengineering. That is to say, some forms of geoengineering could 'Respect Nature' and be permitted. This is true whether or not it is justified by teleological biocentrism, or pragmatic reasons. In the following section, I begin an evaluation of what RfN's ethical principles actually entail vis-à-vis intentional climate change.

2.0 Why Geoengineering Could be Compatible with Respect for Nature

In this section I argue that Taylor and Regan's own formulations of RfN do not show that all forms of geoengineering would be deemed impermissible by the principles of RfN. If this can be shown, it will substantially damage Preston's identification of a support for the presumption against geoengineering in Taylor's and Regan's ethics. I argue that firstly (2.1) both Taylor and Regan allow for situations where the 'Preservation Principle' (Regan) and the 'Duty of Non-Interference' (Taylor) may be overridden; namely, when doing so is motivated by a sense of duty to nature. I show from Taylor's discussions that a criterion for legitimate interventions exists: 'Causing no permanent harm', and 'creating a great benefit'. I argue that Preston overlooks the importance and implications of these exceptions when claiming that RfN supports a prohibition on geoengineering. Secondly (2.2), I argue that these exceptions allow for some forms of geoengineering to be permissible. Using the criteria for legitimate interventions described in the previous subsection, I compare some candidate forms of geoengineering with Taylor's own examples of legitimate interventions, and I argue that they are morally comparable. In order to be consistent, I therefore conclude that Taylor cannot object to all forms of geoengineering. I conclude (2.3) that, contra Preston, some forms of geoengineering are compatible with RfN.

2.1 Exceptions to the Duty of Non-Interference

Preston notes that RfN ethics have a strong focus on the negative right of nature to exist free from human interference. Preston writes that:

> these authors [Taylor & Regan] suggested that the management of nature on a grand scale is wrong. Climate engineering would appear to run counter to this basic environmental intuition against meddling with earth's fundamental processes.[196]

[196] Preston, (2011) Re-Thinking the Unthinkable. p. 463. emphasis added.

Preston has a strong prima-facie case for RfN's support for a prohibition on geoengineering. However, in this section I show that both Regan and Taylor allow for situations where their non-interference principles can be superseded by other duties. I argue that this has been overlooked in Preston's reading, and this oversight should give us further reasons to doubt his identification of support for the presumptive argument in RfN.

2.1.1 Regan's exceptions to the 'Preservation Principle'

In 'Nature and Possibility' Regan argues that acknowledging the non-instrumental moral worth of nature includes an obligation to abide by what he terms the 'Preservation Principle'.[197] He describes this as a 'moral Imperative for preservation (letting be).'[198] Due to Regan's defence of this principle, Preston identifies him as a supporter of the presumptive argument against geoengineering.[199] I argue that Preston's identification is mistaken.

While Regan does believe in a duty to avoid human interference in nature, he makes it quite clear that this is only a prima facie duty: a duty that often or generally holds true but where exceptions may be made. He argues that the principles which show that nature has non-instrumental moral worth, the possession of a worth-conferring property Φ, also show that in certain circumstances, a duty to intervene exists. He considers a situation where a river which possesses Φ will, through natural changes, lose possession of Φ. In this circumstance respecting nature's inherent moral worth means overriding the preservation principle in order to: 'preserve or increase what is inherently valuable in nature.'[200]

Contrary to Preston's interpretation of Regan, I believe that from the previous quoted statement, we should infer that Regan may be surprisingly amenable to geoengineering. The fact that Regan believes that respecting nature involves a duty, not only to preserve existing value, but also *increase* it, implies that he actually has an uncommonly interventionist stance. Proponents of geoengineering might find an unlikely source of support from Regan, as, if they are properly motivated by a duty to nature rather than 'human interests', then the duty to preserve the inherent value of nature might require us to geoengineer if doing so is the best method for safeguarding whatever it is in nature that makes it morally considerable from the effects of climate change. Moreover, the duty to increase what is inherently valuable in nature would appear to suggest that humans are duty-bound to employ their rational faculties to optimise the quantity and quality of natural value. We should therefore conclude that contra Preston, Regan clearly sees that there are occasions where an obligation to geoengineer supersedes the general obligation to non-intervention.

2.1.2 Taylor's exceptions to the 'Duty of Non-Interference'

Taylor also believes that respecting the non-instrumental moral worth of nature requires us to adopt a 'Principle of Non-Interference'.[201] He describes this as a prohibition on trying to 'manipulate, control, modify or 'manage' natural ecosystems, or otherwise intervene in their normal functioning'.[202] Based on his support for this principle, Preston claims that Taylor's theory supports the presumptive argument against geoengineering.[203] It is clear why, on this quoted statement

[197] Regan, (1981) The Nature and Possibility of an Environmental Ethic. p. 31.
[198] Regan, (1981) The Nature and Possibility of an Environmental Ethic. p. 31.
[199] Preston, (2011) Re-Thinking the Unthinkable. p. 463.
[200] Regan, (1981) The Nature and Possibility of an Environmental Ethic. p. 32.
[201] Taylor, (1986) Respect for Nature. p. 173.
[202] Taylor, (1986) Respect for Nature. p. 175.
[203] Preston, (2011) Re-Thinking the Unthinkable. p. 463.

alone, Taylor would indeed appear to give strong reasons to believe geoengineering was incompatible with RfN. Nonetheless, I argue that Preston attributes too much weight to Taylor's support for the non-interference principle, and overlooks the numerous exceptions that Taylor allows to non-interference for in 'Respect for Nature'.

While Taylor clearly places a lot of weight upon non-interference in his ethics, the principle of non-interference is in fact just one amongst a 'non-exhaustive' list of principles that make up the attitude of RfN.[204] Taylor lists four core principles in 'Respect for Nature': these are the principles of a) Non-Maleficence, b) Non-interference, c) Fidelity, and d) Restitutive Justice.[205] While Taylor believes that conflicts between the duties will be rare, he does offer priority-principles for mediating conflicts between them.[206] I argue that despite the strong prima facie case for a prohibition of geoengineering found in b) the principle of non-interference, (d) the principle of restitutive justice could potentially oblige us to geoengineer.

The Principle of Restitutive Justice obliges moral agents to make amends for previous instances of wrongdoing.[207] For instance, Taylor considers that a woodland which had been polluted must be cleaned and restored to its original state. Taylor also acknowledges that in some circumstances, environmental harms are so total that restoration is no longer possible. In these instances, the obligation of restitutive justice is deferred to an individual or ecosystem of the same type.[208] Based on his discussions here, we may construct a tentative case for legitimate geoengineering:

(1) The duty of restitutive justice obligates us to compensate nature for prior moral transgression.

(2) The restitution should try to restore the circumstances which were present prior to the transgression.

(3) Climate change is an example of prior moral transgression.

(4) Geoengineering may be used restore the climate to its state prior to climate change.

(5) The duty of restitutive justice supports the use of geoengineering.

However, this is likely too quick. We may accept points 1 - 4 but reject 5. Taylor is not committed to saying that all forms of compensation are equally desirable or acceptable. Since geoengineering seems to conflict so prominently with the principle of non-interference, Taylor will likely want to say that in this case the cure is worse than the disease.

When, as in this case, two duties conflict, Taylor includes a number of priority principles to mediate the disputes and help us understand where our obligations lie. Specifically discussing potential conflicts between the principles of non-interference and restitutive justice, Taylor offers as a maxim: 'If no permanent harm is caused… and a great benefit can be produced we might consider the duty of restitutive justice to outweigh that of non-interference'.[209] This gives us two criteria (no permanent harm caused, and great benefit produced) that geoengineering must meet if it is to be considered a legitimate interference. Taylor also gives a few examples of legitimate interventions. As we have seen above, clearing pollution from a forest is considered to not conflict with non-interference. He also considers 'organising a captive breeding scheme to reintroduce endangered animals' and 'constructing a barrier so that animals do not enter radioactive areas'.[210] Geoengineering proponents now only have to show that some forms of geoengineering are morally

[204] Taylor, (1986) Respect for Nature. p. 171.
[205] Taylor, (1986) Respect for Nature. p. 171.
[206] Taylor, (1986) Respect for Nature. pp. 192-198.
[207] Taylor, (1986) Respect for Nature. p. 186.
[208] Taylor, (1986) Respect for Nature. p. 187.
[209] Taylor, (1986) Respect for Nature. p. 196.
[210] Taylor, (1986) Respect for Nature. p. 196.

similar - in the sense of causing no harm and producing a great benefit - to these forms of intervention to show that geoengineering is compatible with Taylor's principles of RfN. In the following subsection (2.2) I argue that some forms of geoengineering do meet these criteria.

I have now shown that both Regan and Taylor allow exceptions to their non-interference principles which are not accounted for in Preston. I have argued that these exemption clauses allow, hypothetically, for geoengineering. If geoengineering is the best way to preserve the inherent value of nature, I have argued that Regan's ethics show we would be duty-bound to do it. I have also shown that Taylor's principle of restitutive justice can sometimes supersede the principle of non-intervention, which could hypothetically allow for geoengineering provided it abides by the maxim of compensating for prior moral transgression in a way that causes no permanent harm and creates a great benefit.

2.2 Can Geoengineering Respect Nature?

In the previous subsection I showed that geoengineering may hypothetically be permissible, within Taylor's account of RfN, as a form of restitutive justice. Restitutive justice can supersede the principle of non-interference when it: (a) produces a great benefit, and (b) produces no permanent harm. If there are forms of geoengineering that conform to (a) and (b), then those forms of geoengineering can respect nature. If this can be shown, then Taylor's argument cannot be used to support a general prohibition on geoengineering, although certain types of geoengineering may still be prohibited. I compare some potential geoengineering techniques with examples of interventions in nature given by Taylor which meet (a) and (b) and argue that some forms of geoengineering are morally equivalent to those examples. Therefore, I conclude that Taylor will support some forms of geoengineering.

2.2.1 Does Geoengineering Cause a Great Benefit?

I first briefly consider (a) whether geoengineering can cause a great benefit. Answering this question presents some challenges as the answer hinges not only on the technical feasibility of geoengineering, but also the fact that the outcomes of geoengineering are uncertain until after deployment. It is certainly possible that geoengineering has the potential to cause great environmental harm through disruptions to global temperature and weather. On the other hand, geoengineering's potential harms need to be compared with the imminent and pervasive threat of unchecked climate change. The typical argument of geoengineering proponents is that geoengineering is a tool to be used if or when it is too late to prevent the harms of climate change through traditional mitigation methods. In such a scenario there may be great benefits to humans and nature associated even with an imperfect geoengineering solution.

I take it that (a) is at least plausible. We might argue something like this: (1) mitigating the worst effects of climate change will cause a great benefit to nature, and (2) mitigating the worst effects of climate change may require at least some geoengineering, then (3) geoengineering may have some great benefits. Of course, establishing (2) is reliant on a number of empirical claims. Is a climate change strategy without geoengineering able to produce similarly beneficial outcomes as one with it? Will the geoengineering methods required to produce these beneficial outcomes be technically and socially feasible? It could only be known with any certainty whether a benefit would be produced through a close analysis of the likely harms of inaction with the possibility of the particular technology creating more harm than it prevents. RfN requires that when we assess the moral harms of climate change, we must consider more than just the interests of humans and their property. Proponents of a particular method of geoengineering would need to give compelling evidence that their technique would be broadly beneficial, not only to humans, but on an assessment of the

interests of nature too. For instance, geoengineering might be beneficial if it prevented the deaths of vulnerable coral reefs and all of their non-human inhabitants who rely on the oceans remaining at a constant cool temperature so they can live their lives with the best chance of fulfilling their telos.[215] If proponents of geoengineering could show this, then their preferred method of geoengineering would be able to satisfy the first condition of Taylor's criteria. We do not need to have the final say on (2) now. It suffices to say that if there are hypothetical forms of geoengineering which could satisfy (2), then (a) is hypothetically fulfillable. This is all we need to know if we want to show that RfN cannot *rule out* geoengineering.

2.2.2 Taylor's Concept of Permanent Harm

I will now argue that at least some forms of geoengineering will cause no permanent harm (b). In order to make this argument, we need to establish Taylor's own interpretations of both permanence and harm. Our discussion of harm should be prefaced with an important clarification. Taylor does not believe that RfN entails a duty to prevent all instances of harm, as might be the case if living things had a right not to be harmed. [211]Since RfN believes that all living beings can be harmed, it is prima facie impossible that humans could avoid causing any harm at all: plants and fungi will still need to have their lives cut short for food. Even simply washing our hands is likely to cause the deaths of numerous microbes. Geoengineering, like almost any human activity, is therefore guaranteed to cause harm, but this on its own is not evidence in favour of it being morally wrong. RfN then does not prohibit the causing of harm, rather it requires that we give sufficient justifications for the harm we cause. Below is a discussion of the kinds of harm that exist once we have adopted Taylor's biocentric outlook, and the circumstances under which he believes it is permissible to cause harm.

According to Taylor's teleological biocentric outlook, we can see that wrongdoing occurs when an entity's interests are frustrated by the actions of a moral agent. Taylor outlines two ways in which living things can be harmed. First of all, harm can refer to actions which prevent an organism from fulfilling its telos, which Taylor describes as actions which 'destroy or take away a condition favourable to [an organism]'.[212] When we understand living things as goal-oriented towards survival, we can understand that actions which frustrate an organism's ability to survive harm it. In the simplest form, we can see that failing to water our houseplants plants 'harms' them because being watered was instrumental to achieving their telos. It does not imply any kind of mental state in the victim, feelings of pain, etc. I call this teleological harm. While according to Taylor's theory all living things are able to be teleologically harmed by actions that frustrate their achievement of their telos, as we saw in section 2.2, Taylor also includes a separate role in his ethics for consciously unpleasant experiences too, such as pain, boredom, hunger etc.[213] For the beings with the capacities for conscious experience, these also represent separate kinds of harm. I call this conscious harm.

Additionally, Taylor's account of 'flourishing' gives us important insights into how teleological harm can be caused. For Taylor, teleological harm occurs when an organism is prevented from 'maintaining the normal biological functions of its species throughout its entire span of life'. [214]Understanding exactly what constitutes 'normal biological function' is therefore going to factor into exactly what actions are teleologically harmful. It is tempting to read 'normal biological function' as a stand-in for either 'natural function' or 'as it would function in the wild', and Taylor's support for the principle of non-interference would appear to lend credence to this interpretation. For instance, while a tiger in a zoo may have all the necessary conditions for survival, it may still be

[211] Taylor, (1986) *Respect for Nature*. p. 295.
[212] Taylor, (1986) *Respect for Nature*. p. 62.
[213] Taylor, (1986) *Respect for Nature*. p. 295.
[214] Taylor, (1986) *Respect for Nature*. p. 66.

teleologically harmed if we consider its normal biological functions to include prowling the jungle and catching its dinner.[215]

RfN proponents may draw from this discussion on teleological harm, and Taylor's support for the principle of non-intervention, to argue that geoengineering might cause some harm by making the world 'less wild'. For example, since geoengineering involves putting core natural processes under human control, living things are no longer able to live as they would have naturally, and are therefore unable to fulfil their normal biological functions, and are therefore harmed by geoengineering. I call this the unnatural lives argument. We should first of all note that Taylor's example of a legitimate intervention, the endangered condor captive breeding scheme, also appears to prevent living things from living as they would normally. This seems to be evidence that for Taylor 'protecting biodiversity' must be a legitimate reason to cause harm to some living things (perhaps because the normal biological functions of the animals and plants outside of captivity are dependent on them co-inhabiting their environment with condors).[216] Proponents of geoengineering can therefore argue that if geoengineering prevents (for instance) biodiversity loss (through the ill-effects of climate change), then a certain degree of harm caused by geoengineering will be justifiable in pursuit of that aim.

Moreover, I argue that the unnatural lives argument is based on a mistaken account of 'normal biological function'. Understanding 'normal biological function' as a 'life in the wild free from human interference' tends towards an imagined or idealised past, when in reality many normal lives for nonhumans have been interwoven with the lives of humans for hundreds or thousands of years. For example, in the UK much of our 'natural' areas, such as moorland, have been created through hundreds of years of human activity, but we probably wouldn't want to say that skylarks on those moors are unable to fulfil their 'normal biological functions'. Many species have used their natural tendency for adaptation to create lives around humans, and our understanding of normal biological function must be able to acknowledge this. Once we allow our understanding of 'normal biological function' to account for lives with human influence it loses its usefulness in justifying the unnaturalness argument, since even the influences of geoengineering in something's life does not automatically evidence that it has been harmed. When discussing the harms of geoengineering for instance, it simply will not be sufficient to say that any particular living thing has been teleologically harmed simply because its life has been made less 'natural' through living in a geoengineered world. Evidencing teleological harm will require that we show that its life is in some way different from the life that members of its species would have been able to live had geoengineering not been undertaken. I therefore conclude that the un-natural lives argument is unsuccessful at showing that geoengineering necessarily causes harm.

Returning to the captive breeding of endangered birds example can also help us shed light on the criteria of permanence. Taylor considers this to be a legitimate form of interference with nature despite it not only being harmful, but also a permanent condition for those individual birds who are deprived of their freedom and live out their entire natural lifespan in captivity.[213] This would appear to directly contradict Taylor's own condition that interventions cause no permanent harm, unless we infer that Taylor does not think that the captive breeding scheme is permanent. If this inference is correct it would appear to contradict Taylor's commitment to individualism, since as we have pointed out, for the individual birds involved this would be a permanent condition. Despite this, it

[215] Though note the controversy over considering 'survival' to be an entities telos.

[216] Alternatively, we might think that condors can be subject to confinement because such confinement is essential for species survival – which might be consistent with Taylor's understanding of telos as 'reproduction'. In this case, human confinement would actually assist the fulfilment of telos, if careful captive breeding management was a necessary condition of condor genes persisting into the future. If this is the case, it's plain to see how an argument for geoengineering might be crafted too (e.g., geoengineering will prevent species loss by mitigating climate change, thus geoengineering contributes to telos fulfilment).

seems likely that Taylor is interpreting it as not permanent because the captive breeding scheme aims at being temporary. It is to use a technical term 'self-obviating': it aims at its own elimination.

It is worth considering just what temporary might mean in this context. From the perspective of the individual birds involved the captive breeding scheme does not appear temporary either, since it may well contain them for their entire lives. Similarly, for the humans involved in instigating the program it may be a long term multi-generational effort. Due to this, I argue that duration is a less important indicator that a harm is temporary than whether the scheme that causes the harm has planned discontinuance. This is whether the program contains within its design the aim that it will no longer need to exist. The captive breeding scheme is temporary because planned discontinuance is contained within its design. Once the populations of endangered condors have been restored to a stable amount, perhaps to the numbers they were at prior to human persecution, then the scheme can be concluded and the whole ecosystem divested of human influence. Conversely a zoo, which causes much the same harm as the captive breeding, would not be legitimate since its design aims for it to persist and continue making returns for its shareholders for as long as possible, rather than planned discontinuance.

We should conclude that, according to Taylor's theory, permanent harm to individuals (life-long captivity) is justifiable when it causes a great benefit (protecting biodiversity), and the cause of the harm-causing intervention is designed to be temporary (by designing for self-obviation). The remaining step to show that geoengineering could cause no permanent harm is to show that geoengineering can be self-obviating.

2.2.3 Does Geoengineering Cause Permanent Harm?

It would initially seem trivial to show that geoengineering can be planned to be discontinued. Proponents of geoengineering regularly talk about it as a 'stop gap' or 'buying time' solution to climate change, which can be implemented quickly to prevent the harms of climate change before a more complete or thorough solutions can be found.[217] However a large amount of discussion has been devoted to analysing the long-term implications of geoengineering, including whether or not geoengineering can be easily reversed once implemented. Discussions on geoengineering's reversibility have focussed on both the technical feasibility, as well as the decision-making governance involved, and I review both aspects of this discussion here. Whether or not it is possible to reverse geoengineering will be essential to evaluating whether or not it can be temporary, and thus whether it can cause no permanent harm.

How geoengineering projects are governed once they have been implemented presents a major challenge for proponents of geoengineering. Lin (2012) describes the so-called 'thermostat dilemma'.[218] He argues that different states will benefit from different global temperatures, which makes governing a transition away from geoengineering once it has been implemented a hard geopolitical problem. Similar problems are described by Rickle *et al (*2010) [219] and Wong (2014).[220] While these scholars show that a transition back to the status quo after geoengineering has political difficulties, there is nothing to suggest that it is not possible.

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[217] Buck, H.J., Martin, L.J., Geden, O., et al., (2020) Evaluating the Efficacy and Equity of Environmental Stopgap Measures. *Nature Sustainability*. Vol. 3. pp. 499–504.
Keith, D., MacMartin, D., (2015) A Temporary, Moderate and Responsive Scenario for Solar Geoengineering. *Nature Climate Change*. Vol. 5. pp. 201–206.

[218] Lin, A., (2012) Geoengineering's Thermostat Dilemma. *Law and the Future and the Future of Law*. Vol. 2 Is. 1. pp. 173-183.

[219] Ricke, K., Morgan, L., McGranger, A., Myles, R., (2010) Regional Climate Response to Solar Radiation Management. *Nature Geoscience*. Vol. 3. pp. 537-541.

[220] Wong, P. H., (2014) Maintenance Required: The Ethics of Geoengineering and Post Implementation Scenarios. *Ethics, Policy & Environment*. Vol. 17. Is. 2. pp. 186-191.

The technical feasibility of reversing geoengineering (b) also presents challenges. I discuss this point in greater detail in Chapter 6, however we can briefly consider some of the major issues here. Different geoengineering proposals have relative levels of difficulty associated with 'reversing' them. However, the importance of reversibility as a factor for evaluating geoengineering has become increasingly influential, making its way into the Tollgate Principles, as well Olson's 'Soft Geoengineering' principles.[221] Amongst the least reversible form of geoengineering is Solar Radiation Management. Scholars have pointed out that unless SRM is accompanied by a means of sequestering carbon, SRM comes with the potentially disastrous consequence of causing rapid and extreme global warming if maintenance lapses and solar radiation could no longer be redirected in the appropriate quantities to keep up with increasing concentrations of atmospheric greenhouse gases.[222] While acknowledging the difficulties of the termination problem, in their analysis Rabitz finds that it is not a uniquely difficult problem and believes that there are cooperative governance solutions for eventually phasing out SRM. Lawford-Smith and Currie argue that phase-out problems are not exclusive to SRM geoengineering either, and consider the biological and geological impacts of spreading large quantities of minerals in previously mineral poor areas to sequester carbon through enhanced rock weathering.[223] Olson considers a number of geoengineering propositions and appraises them on their potential to for 'rapid reversibility if problems arise', and comments favourably on Bright Water and ICE911's proposals for surface albedo raising, as well as Direct Air Capture & Storage generally.[224] Whether these solutions could be scaled up to become an effective solution to climate change remains to be seen, but nonetheless it remains true that at least some geoengineering proposals could be reversible.

While it may be possible for some geoengineering proposals to be reversed once they have begun, this does not exclude the possibility that they would cause some non-temporary harms in the meantime. If they did, they would not meet the criteria for a legitimate intervention. As we have seen in the previous chapter, certain large-scale geoengineering proposals certainly have the potential to cause high levels of disruption to major natural systems such as the South Asian monsoon. Even if disruption caused to major weather patterns like this could be reversed, the effects of the disruption on the ecosystems that rely on them during the disruption could certainly be long term. In these cases, the ability to monitor the effects of the ongoing geoengineering on the climate and if necessary, rapidly halt the process are going to be necessary for harm reduction.

However, for other forms of geoengineering the scope for causing harm seems to be much lower. McDonald et al (2019) discuss the potential for locally applied geoengineering technologies in protecting coral reefs from rising ocean temperatures.[225] Coral reefs are extremely vulnerable to even moderate amounts of ocean warming and due to this only a short window of time remains to secure their survival. McDonald et al propose using 'floating sunshields' as a form of solar radiation management to shade the Great Barrier Reef until long term solutions to ocean warming can be operationalised. Since the sunshields could be easily removed this technology could be rapidly reversed if needs be. While more research needs to be done on the wider-reaching effects of shading an area of ocean the size of the Great Barrier Reef, to be sure that it will not cause long term

[221] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. pp. 143-174. Olson, (2012) Soft Geoengineering. pp. 29–39.
[222] Rabitz, F., (2018) Governing the Termination Problem in Solar Radiation Management. *Environmental Politics*. Vol. 28. Is. 3. pp. 502-522.
[223] Lawford Smith, H., Currie, A., (2017) Accelerating the Carbon Cycle: The Ethics of Enhanced Rock Weathering. *Biology Letters*. Vol 13. Is 4. April
[224] Olson, (2012) Soft Geoengineering. pp. 29–39.
[225] McDonald, J., et al. (2019) Governing Geoengineering Research for the Great Barrier Reef. *Climate Policy.* Vol. 19. Is. 7. pp. 801-811.

disruption, the local scale of McDonald's proposals makes this seem to be a plausible candidate for a form of geoengineering that might be able to meet Taylor's criteria.

2.3 Conclusions

In this section I have argued that the normative principles of RfN, as outlined by Regan and Taylor, do not ground an absolute prohibition on geoengineering. In section 4.1 I argued that Preston was mistaken in his readings of Regan and Taylor. I showed that both authors have exempting conditions to their non-interference principles, which hypothetically allowed for geoengineering. Regan especially appeared to be surprisingly open to the possibility for geoengineering if it was motivated by a sense of duty to preserve the natural world from the harms of climate change. We must therefore conclude that Regan's argument cannot be used to support a prohibition on geoengineering. From our reading of Taylor, we also showed that his argument could allow for geoengineering as a method of restitutive justice to nature for the harms of human caused climate change. We concluded that Taylor could accept geoengineering if it caused a great benefit, and no permanent harm. In section 2.2 I argued that it seems possible for some forms of geoengineering to satisfy this requirement. Drawing from Taylor's own examples of legitimate interventions in nature, I argued Taylor understood permanent harm as being irreversible changes to nature which negatively impact the ability of members of the community of life on earth to pursue their telos. What made Taylor's examples of legitimate interventions legitimate, I argued, was the fact they could be reversed – and specifically, they were 'self-obviating,' i.e., the interventions were designed to be temporary and succeeded when they made themselves obsolete. I argued that the feasibility of geoengineering to be reversed, and the potential benefits that mitigating the worst effects of climate change would bring, showed that geoengineering might be able to meet Taylor's criteria for legitimate interventions in nature. If a geoengineering program were able to create a benefit by stabilising and preventing the harms of climate change, and was designed for 'self-obviation,' it could 'respect nature' too. We must therefore conclude that Taylor's RfN will also not support an absolute prohibition on geoengineering.

3.0 Chapter Conclusions

I have argued throughout this chapter that respect for nature ethical theories, as conceptualised by both Tom Regan and Paul Taylor, do not necessarily support a general case against geoengineering. This conflicts with the conclusions of Christopher Preston, who interprets these authors as providing support for a presumptive case against geoengineering. I have initially shown that both authors are unable to show that nature has non-instrumental moral worth. This shows that RfN is unable to ground obligations towards nature, including the duty of non-interference, upon which Preston bases his argument for the existence of a presumption against geoengineering. I then briefly outlined Dale Jamieson's argument for an instrumentally grounded Respect for Nature. Jamieson's arguments offer an alternative justification for adopting the principles of RfN, and thus a potential way for opponents of geoengineering to deploy them in support of a prohibition on geoengineering. In section two I have argued that even if we adopt the normative principles of RfN, they do not support an absolute prohibition on geoengineering either. Preston's argument was reliant on both authors' stated support for principles of non-interference in nature, in order to ground support for a prohibition on geoengineering. I have argued that while both authors support non-interference principles, in both cases these can be outweighed by exempting conditions, which have been overlooked in Preston's analysis. These exempting conditions allow some, at least hypothetical, forms of geoengineering to be compatible with the ethics of RfN. Therefore, if there is a general case to be found against geoengineering, we must conclude that it is not found here. In the next chapter, we investigate whether such a general case might be found in the work of Eric Katz.

Chapter 4 - Eric Katz and the Non-Domination case against Geoengineering

1.0 Introduction

Whether it be solar radiation management or carbon dioxide removal, geoengineering involves making substantial transformations to the Earth's key biogeochemical processes. This may very plausibly make us feel uncomfortable. It might seem to run counter to the common environmentalist intuition that we ought to preserve and maintain natural areas and systems free from human influence. We might even worry that expanding human influence into these untouched areas goes beyond the legitimate extent of human dominion; that these areas *ought* to remain nature, and we have no right to be there at all. One way that we might plausibly express these worries is through the language of *domination*. A simple explanation of domination might be as the constraint of autonomy, of one agent over another, resulting from an illegitimate disparity of power. Perhaps this can explain what is going on when human control extends its reach into natural systems. But while the importance of domination is clear in discussions of just relations between human persons, it is less clear how applicable the charge of domination is to explain our relationship with, and obligations to, non-human nature. Indeed, it is highly contentious as to whether any non-humans even have the capacities, such as autonomy, that make domination possible.

Nonetheless, there appears to be no shortage of commentators willing to suggest that domination would be the consequence of geoengineering. For instance, in one of the first articles to assess the ethical consequences of geoengineering, Dale Jamieson writes: 'if [geoengineering] were successful, it would still have the bad effect of reinforcing human arrogance and the view that the proper human relationship to nature is one of domination'.[226] Similarly Charles Eisenstein claims that: 'geoengineering seeks to take our centuries-long domination of nature to a new extreme, making the entire planet an object of manipulation.'[227] Clive Hamilton claims that: 'Climate engineering represents a conscious attempt to overcome resistance of the natural world to human domination, the last great stride towards total ascendancy'.[228] Buck et al write that for ecofeminists: 'The flavor [sic] of old hopes [of dominating nature] lingers within the geoengineer's dream.'[229] A similar concern appears to be present when Shiva worries that geoengineering extends the 'engineering paradigm': the desire by certain humans to make nature as manipulable and controllable as a piece of machinery, so that it can serve human ends with the least resistance.[230] The importance of the machinery metaphor, and the vision of seamless control-without-resistance it presents, is also noted by Nerlich and Jaspal in their discourse analysis of geoengineering technical papers. They show that the desired effects of geoengineering are regularly explained by analogy to machinery: by tweaking the Earth's thermostats, installing a dimmer switch, or 'hacking', 'fixing' or 'repairing' the planet or climate.[231] We might see this as evidence that geoengineering aims to exert a particular kind of

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[226] Jamieson, D., (1996) Ethics and Intentional Climate Change. *Climatic Change*. Vol. 33. Is. 3. pp. 323–336.
[227] Eisenstein, C., (2015) We Need Regenerative Farming, Not Geoengineering. *The Guardian*. March 9th.
[228] Hamilton, C., (2013) The Ethical Foundations of Climate Engineering. In: Burns, W., Strauss, A., (eds) *Climate Change Geoengineering: Philosophical Perspectives, Legal Issues, and Governance Frameworks*. London, Cambridge University Press. pp. 39-58.
[229] Buck, H.J., Gammon, A., Preston, C.J., (2014) Gender and Geoengineering. *Hypatia.* Vol. 29. Is. 3. pp. 652-669.
[230] Heibel, M., Shiva, V., (2013) Terra Futura 2013 Interview with Vandana Shiva about Geoengineering. *NoGeoingegneria*. July 9th.
[231] Nerlich, B., Jaspal, R., (2012) Metaphors We Die By? Geoengineering Metaphors and the Argument From Catastrophy. *Metaphor and Symbol*. Vol. 27. Is. 2. pp. 131-147.

power over nature, transforming it from unruly and unpredictable nature into inherently controllable machine, able to respond to whatever commands we give it – something akin to domination.

An influential version of a 'domination of nature argument' is given by Erik Katz. Katz is not mentioned as one of the authors whose work supports a presumptive case by Preston.[232] Nonetheless, Katz is perhaps the pre-eminent thinker concerned with the environmental ethics of dominating nature and throughout his career (from the beginnings of environmental ethics as a discipline) he has developed a philosophical system which aims to ground a case for nature preservation based on a concern for nature's autonomy. For Katz, nature develops autonomously up until the point when it becomes transformed into a human-made artifact. Artifacts are the products of human intentions, and have no autonomy of their own, only the purposes for which they were designed and created. Since the process of transforming nature to artifact involves the constraint of autonomy, it is for Katz properly understood as domination. Moreover, once lost, nature's autonomy can never be regained; thus, preserving nature's autonomy requires a strict commitment to leaving alone those remaining unaltered landscapes and systems. For much of his career, Katz has deployed versions of this argument to oppose policies of 'nature restoration': attempts to recreate natural environments from denuded and formerly human used ones. Since even 'restored' landscapes are created intentionally, they too are artifacts and thus can never properly recapture the value possessed by truly autonomous nature. Hence nature restoration is at best futile, and at worst gives a licence for further domination of nature on the promise that it can be restored at some future point.[233] However, Katz does not limit the application of his argument to traditional cases of nature restoration. Katz has recently claimed that his argument can be equally applied to provide a case against geoengineering, writing: 'The possibility of geoengineering the planet to solve the problem of climate change and global warming is a stark and powerful example of the continuing project of human domination'.[234] Perhaps then Katz's argument can show why we ought not to geoengineer, based on a respect for nature's autonomy, and an imperative to avoid domination.

This chapter aims to evaluate Katz's argument and its application to geoengineering. In Section 2, I give a full account of Katz's argument as it developed through his work and in conversation with his critics, before drawing up a schematic of his argument. In Section 3 I argue that a strong challenge can be made to Katz before even doubting the veracity of his premises; that his definition of 'natural' is prohibitively narrow, so narrow that it may plausibly contain zero examples. This would of course show that his argument cannot be used to guide actions and would contribute a negligible amount to discussions about the legitimacy of geoengineering or its design. Katz must therefore alter his definition of 'nature' or else resign his argument to describing wrongdoing which occurred in the past. In addition to the problems caused for Katz by his overly restrictive use of 'nature', in Section 4 I argue that Katz also misapplies the term 'domination' to explain the harm purportedly caused when nature becomes artificial. I argue that domination, at least in the way we use the term to describe relationships between human persons, cannot apply to many non-human natural entities (which Katz would like to apply it to), since these entities lack interests. We can concede to Katz the notion that non-human nature has autonomy, but without a set of interests it cannot be harmed/wronged when that autonomy is constrained – through geoengineering or otherwise. Following this through, Katz is unable to establish that becoming artificial *harms* nature: eroding his case for a non-anthropocentric argument against geoengineering. I conclude in Section 5 that while Katz's theories do seem to effectively rule out geoengineering (unlike Regan and Taylor who I

[232] Though he is found in Scott's very similar argument. Scott, (2012) Geoengineering and Environmental Ethics. p. 10.

[233] Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community*. Lanham, Rowman and Littlefield Publishers.

[234] Katz, E., (2015) Geoengineering, Restoration, and the Construction of Nature: Oobleck and the Meaning of Solar Radiation Management. *Environmental Ethics*. Vol. 37. Is. 4. pp. 485-498.

analysed in the previous chapter), we have good reasons to reject them as sources for ethical guidance anyway. The restrictive bounds of his definition of nature mean that his theory has extremely limited potential to guide actions, and he fails to explain the purported cost of constraining nature's autonomy. This shows that Katz is unable to explain why geoengineering entails wrongdoing, and thus cannot provide us a general environmental ethics case against geoengineering.

2.0 Katz and the Argument Against Nature Restoration

In this section I give an account of Katz's ethical theory. In Section 2.1 I give a brief history of the development of Katz's ethics across his work, outlining which works I am drawing from in my account of Katz, and explaining the context he was writing in and the environmental problems he was responding to. In 2.2 I then detail the central contention of Katz's argument – that the act of intentionally modifying unaltered nature is an act of 'domination'. Then in 2.3 I look at how his argument could be deployed against geoengineering (or to use Preston's terms, why it might be thought to presume against geoengineering). I look briefly at Katz's own writings on geoengineering here too. Finally in 2.4 I give a formalised summary of Katz's argument.

2.1 Katz's Philosophical Project

In this section I aim to give a thorough overview of Katz's philosophical system, and to detail Katz's objections to both nature restoration and geoengineering in their strongest form. Katz's position has developed and been refined over the course of decades and across multiple different publications. The result of this is that there are occasions where Katz appears to contradict himself, uses technical terms inconsistently, or offers different responses to the same challenges. Acknowledging this is not meant as a critique of Katz's work and should not necessarily be interpreted as a failing on his behalf to formulate a seamless philosophical project. Instead, it is simply a necessary acknowledgement for interpreting the account of his work given here, where I have made certain decisions about which material ought to be prioritised in creating a coherent and strong account.

My account of Katz's work is drawn in particular from: 'The Big Lie: Human Restoration of Nature', 'The Call of the Wild: The Struggle Against Domination and the Technological Fix of Nature', 'Artifacts and Functions: A Note on the Value of Nature' and 'Imperialism and Environmentalism'; each of these republished and revised in 'Nature as Subject' (1997).[235] These are supplemented where appropriate by additional comments on his work found in 'Preserving the Distinction Between Nature and Artifact' (2011) and 'Further Adventures in the Case against Restoration (2012).[236] Finally, Katz's specific beliefs about geoengineering, particularly his view that his earlier work on nature restoration applies to contemporary debates about geoengineering, are found in 'Geoengineering, Restoration and the Construction of Nature: Oobleck and the Meaning of Solar Radiation Management' (2018).[237]

Katz dates his own philosophical interest in environmental restoration to his reading of Martin H. Krieger's provocative 1973 essay 'What's Wrong With Plastic Trees?'.[238] Krieger argued that how humans value the natural world changes over time, as does our ability to reproduce those aspects

[235] Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community*. Lanham, Rowman and Littlefield Publishers.
[236] Katz, E., (2012) Further Adventures in the Case Against Restoration. *Environmental Ethics*. Vol. 34. Is. 1. pp. 67-97.
[237] Katz, (2015) Geoengineering, Restoration, and the Construction of Nature. pp. 485-498.
[238] Katz, (1997) Nature as Subject, p. xix.
Kreiger, M.H., (1973) What's Wrong With Plastic Trees? *Science*. Vol. 179. Is. 4072. pp. 446-455.

which we value in nature. The implication of this for Krieger is that there is nothing wrong with 'plastic trees' – unnatural or artificial imitations of natural environments – since with the appropriate skill of reproduction, and indeed the ability to socially condition humans to become disinterested in those elements of nature which cannot be reproduced, both plastic and natural trees can equally satisfy human desires. Katz writes that Krieger's arguments:

> …destroyed any anthropocentric foundation for environmental preservation – thus challenging all who follow to develop a justification for environmentalism that is non-anthropocentric, that is not based on the satisfaction of human interests.[239]

Katz's major philosophical motivation then was the development of an environmental ethic which could show, for reasons other than fickle human preferences, why nature ought to be preserved. Perhaps because of the provocation provided by Krieger's hypothetical plastic trees, Katz's philosophical attentions have been focussed on what he sees as the 'problem of environmental restoration'. Environmental restoration might be broadly thought of as environmental policy and management which seeks to return denuded human-used environments such as forestry plantations or grazing-lands to a 'natural' state, frequently the state they were in before humans first began to influence them, or at least before they were 'over-used' or 'exploited' in some relevant sense. Today we might call this 'Rewilding'. Katz often illustrates environmental restoration through the work of Steve Packard of 'The Nature Conservancy' in 'restoring' the tallgrass savannas and oak woodlands of the American Midwest. Packard worked with several areas of degraded prairies; enlarging the areas, clearing brush and planting once typical prairie species in the place, and creating an ecological community which closely resembles the original, or 'natural', state of the area when it was first found by Europeans.[240]

Katz, while admitting that Packard's efforts were laudable, saw a confounding philosophical problem here. While the prairie created by Packard certainly resembled the natural prairies which had once dominated that area, Packard had instead only created: '… an artificial substitute for the real savanna, one based on human technologies and designed for human purposes: a grand vision of the old Midwest.'[241] In other words, another plastic tree. The 'Problem of Environmental Restoration' is found in this paradox. Humans' desire to recreate 'natural' environments, like those that existed before they transformed them for their own purposes. However restored environments, *because they are willed into existence out of human desires*, are just as artificial as the unnatural environments that they are supposed to replace. Nature restoration is therefore a contradiction in terms: nature can never truly be recreated once it is lost, all we can do is create convincing 'plastic' fakes.

Katz was not the first to make this argument. Eight years before Katz first published a version of this argument in 'The Big Lie', Robert Elliot wrote that restoring damaged natural systems and landscapes was equivalent to art forgery.[242] Forged paintings may be pleasant to look at, especially to the untrained eye. But for Elliot, and Katz, a forgery can never have the same value as the original. The value of the original is found in the knowledge that it was created by a particular individual artist, at a particular time; and the context of an artwork's creation is often invaluable to the study of the art appreciator. Likewise, natural environments are a product of a particular natural history; the history of evolution charting its course freely and purposelessly without human intervention, in unbroken historical succession from the distant past, up until the moment we come into contact with them. Restored environments, like forgeries, lack this continuity and context in the past which

[239] Katz, (1997). p. xix.

[240] Katz, E., The Big Lie, in Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community*. Lanham, Rowman and Littlefield Publishers. p. 101.

[241] Katz, The Big Lie. p. 101.

[242] Elliott, R., (1982) Faking Nature. *Inquiry.* Vol. 25. p.91-93.

we so value in the originals. Thus, the value of restored environments can never be an adequate substitute for the value of the original.

Elliot's work was highly influential on Katz's own thinking. However, Katz did not find it fully satisfying. Elliot's work still attributed wrongdoing to the supposed deception or impoverishment of the experience of a human viewer. Elliott did not argue that nature itself was harmed by being forged. Thus, the argument remained vulnerable to the challenge laid down by Krieger. Given enough time and social conditioning we might simply be taught to prefer the hard work and craftsmanship of the skilled forger than the original provided by nature, or indeed to prefer entirely new environments with no natural equivalents. An adapted version of Elliott's argument would have to be constructed that showed that restoration harmed or wronged nature itself, if Katz were to show why restoration was necessarily wrongful.

2.2 Katz's 'Argument from Domination'

'The argument from domination' is the name I use to refer to Katz's major argument against environmental restoration, which is present throughout most of his works on the topic. The argument from domination claims that the harm done to nature when it becomes transformed into an artifact is a kind of domination: an imposed constraint on freedom, or a removal of autonomy. Katz's position is perhaps best summed up in a quote from 'Artifacts and Functions':

> Can the metaphor of domination be translated into the realm of nonhuman natural processes? Yes: Within environmental policy domination is the anthropocentric alteration of natural processes. The entities and systems which comprise nature are not permitted to be free, to pursue their independent and unplanned courses of development, growth, and change. Thus, the existence of domination results in the denial of free and unhindered growth and development… it attacks the preeminent value of self-realisation.[243]

Unlike Elliott's argument from forgery, Katz's argument from domination represents a genuine attempt at providing non-anthropocentric grounds for explaining the moral harm of nature restoration based on nature's interest in developing autonomously from human intentions.[244] Whether we should actually think that nature has an interest in autonomy is a question I will return to in section 4. However, before sketching a full formulation of Katz's argument, it is worth considering exactly what Katz means by nature's autonomy here.

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[243] Katz, E., Artifacts and Functions, in Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community. Lanham, Rowman and Littlefield Publisher*s p. 130.

[244] At several points in his career, Katz also gives anthropocentric arguments against restoration. In 'Preserving the Distinction Between Nature and Artifact' he argues that nature restoration involves the vice of hubris; the arrogant belief that humans can and should control everything in the natural world (Katz, E., Preserving the Distinction Between Nature and Artifact. in Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community*. Lanham, Rowman and Littlefield Publishers p. 77).
In 'Further Adventures…' he argues that accepting nature restoration really can substitute unaltered nature would be a pragmatically bad move for environmentalists, since it would give a licence to those who would overexploit or damage nature to go ahead with the promise that they would restore it at a later date. Katz, Further Adventures in the Case Against Restoration. p. 72.
Interesting parallels may well be drawn in the second case to the worry amongst environmentalists today that advocating for geoengineering gives licence to fossil fuel extractors to continue further into the future. However, it is beyond the scope of this chapter to discuss these arguments here. Instead, the focus is limited to Katz's better known, non-anthropocentric argument from domination.

One thing which becomes clear at this point is the importance Katz places on the division between 'nature' on the one hand and 'artifacts' on the other.[245] This bifurcation is of great importance to Katz's thinking, with Katz himself writing that:

> ...the central idea within any practical environmental ethics would be a workable differentiation of the 'natural' from the 'artificial' … How is the value of the wild natural world different from the value of human technological artifacts? [246]

The notion of nature's autonomy is essential in understanding this difference. If we return again briefly to Robert Elliot's argument, a key difference which was established between 'Originals' and 'Forgeries' was the history and provenance of the artwork in question. This line of thinking is reflected in Katz's understanding of the distinction between natural and artificial environments. While artifacts are designed and created intentionally to serve a purpose set in advance by their human creators, natural processes 'pursue their own independent and unplanned course of development'.[247] Katz regularly cites Andrew Brennan's depiction of nature as being 'Intrinsically Functionless': not created for any particular purpose or evolved for any special reason.[248] The difference between the natural and the artificial is therefore an issue of teleology: the purposeless and the purposeful. Nature is autonomous to the extent that its development continues in an unbroken chain with no intention or design from human beings. When humans intentionally alter a landscape or an ecosystem, the unbroken history of autonomous development is broken, and the landscape or ecosystem becomes an artifact. Likewise, according to Katz, this autonomy cannot be regained through restoration since restoration projects are also products of human intentional design rather than autonomously and purposelessly existing natural developments. When nature becomes artificial it is therefore a permanent change: even an artifact which is abandoned and receives no more human interference after its creation, such as an overgrown garden, can never regain the continuity with natural development which was lost when humans first interfered. Katz writes that 'Although nature can develop autonomously after a human intervention into the system, the resulting system will always be different from a natural progression without human interference.'[249] Since restoration can never properly regain whatever value unaltered nature is

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[245] Humans also appear to form a third category in Katz's ontology, the maker of artifacts and the dominator of nature. Katz provides frustratingly little explanation as to why humans (unlike other animals) occupy this special ontological position.

[246] Katz, E., Call of the Wild. In: Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community*. Lanham, Rowman and Littlefield Publishers p. 109.
Katz is of course not alone amongst environmental ethicists in this regard – for many theorists the boundaries of the natural and unnatural is central to the discipline, and the regulation of the boundary the central normative question. See for example: Hettinger, N., Throop, W., (1999) Refocusing Ecocentrism. *Environmental Ethics*. Vol. 21. Is. 1. pp. 3-21.

[247] Katz, Call of the Wild. p. 115.

[248] See: Katz, Artifacts and Functions. p.123 for instance. Originally Brennan, A., (1984) The Moral Standing of Natural Objects. *Environmental Ethics*. Vol. 6. pp. 41-44. While Katz chooses Brennan to cite, he might just as well have cited a number of other environmental ethicists, including: Keekok Lee, who argues that nature is 'fully autonomous' because it can exist independently of humans (Lee, K., Awe and Humility: Intrinsic Value in Nature. Beyond an Earthbound Environmental Ethics. In: Attfield, R., and Belsey, A., (eds) (1994) *Philosophy and the Natural Environment*. Cambridge, Cambridge University Press. p.93); Birch on nature's 'continuous participation in the emergence of novelty' (Birch, T., (1990) The Incarceration of Wildness: Wilderness Areas as Prisons. *Environmental Ethics*. Vol. 12. Is. 1. p.11); Evernden on wild nature existing free of human designs (Evernden, N., (1992) *The Social Creation of Nature*. Baltimore, John Hopkins University Press.); or Cuomo on the 'dynamic charm' of nature and its 'unique causal and motivational patterns and character' (Cuomo, C.J., (1998) *Feminism and Ecological Communities: An Ethic of Flourishing*. London, Routledge.). I note these here to illustrate that definitions of nature based on the notion of nature's autonomy from human imposed purposes are relatively common amongst Katz's contemporaries.

[249] Katz, (2012) Further Adventures in the Case Against Restoration. p.75-76

thought to possess, then the normative conclusion which must be drawn is that we must avoid as much as possible the alteration of unaltered nature.

From this discussion we can also begin to see why Katz believes that the transformation of nature into an artifact entails the specific harm of domination. After all, clearly domination involves controlling other agents and their actions (usually through the exercise of an unjust and unbalanced distribution of power).[250] For Katz, the domination of human by human is the same phenomenon as the process of making nature artificial, since both involve an agent in a position of power imposing their intentions onto a previously autonomous other. Katz identifies the process of constraining nature's autonomy with 'domination'. His intention in doing so is to explain why he thinks this constraint is morally problematic – by drawing the comparison with the self-evident wrongdoing of domination. But it is worth considering here exactly why he thinks this is, and to whom the harm is directed. Katz defines 'domination' as 'denial of free and unhindered growth and development… attack[ing] the preeminent value of self-realisation'. But this requires further unpacking. For instance, to whom is the preeminent value of self-realisation valuable? Who is wronged when domination occurs?

On its surface, the most straight forward answer to this is that nature itself is wronged. After all, when we talk about domination amongst human persons, the recipient of the harm is predominantly the person who is having their autonomy constrained. Ergo, making nature into an artifact, including by geoengineering, would inflict a harm upon nature which has its autonomy constrained. Moreover, this explanation seems to be consistent with Katz's own interest in developing a non-anthropocentric ethical theory: that is to say, one which does not rely upon harms done to humans to explain how we should treat nature. Katz's ethical position is a form of 'ecological holism', which suggests that 'environments… whole systems of entities co-existing in a complex interaction' are the proper subjects of moral consideration.[251] This again implies that the 'domination wrongs nature' [that is natural entities, communities and systems] view is the correct interpretation of Katz's position. I am however sceptical that Katz actually succeeds in showing that nature *is* harmed by domination, and I dispute this point in Section 4.

2.3 Restoration or Geoengineering?

To summarise the preceding discussion: Katz argues that the value of nature is a function of its autonomy – its unbroken history of purposeless development free from human intentional alteration. Whenever humans intentionally alter nature, they make it into an artifact. This changes its teleology from something that exists purposelessly as nature to something which exists to serve human purposes. By altering the teleology of the world in this way, humans impose anthropocentric ends upon nature. Doing so, Katz believes, is domination. Nature is no longer free to pursue its own independent development, it now only exists for the reasons humans have designed for it. Therefore, in order to preserve nature's value. As a corollary of this, attempts at ecological 'restoration' are at best futile, since restored ecosystems, like other artifacts are a product of human intention, rather than the independent development of nature. Nature 'restorations' can never restore the value that is present in an otherwise identical, but truly natural ecosystem.

It is worth here considering how this argument can be deployed within a discussion of geoengineering. At least two reasons for the argument's relevance might be considered. Firstly, we might plausibly think that the parts of nature that certain forms of geoengineering seek to alter (the

[250] For instance, Pettit, P., (2005) The Domination Complaint. In: Williams, M.S., Macedo, S., (eds) *Political Exclusion and Domination*. New York, New York University Press. pp. 87–117. Though note that it is sufficient to recognise that any kind of folk understanding of domination is likely to hit on these basic features.
[251] Katz, E., Buffalo-Killing and the Valuation of Species. in Katz, E., (1997) *Nature as Subject: Human Obligation and Natural Community*. Lanham, Rowman and Littlefield Publishers. p. 55.

carbon cycle or the chemical composition of the upper atmosphere, for instance) are genuine examples of nature, never intentionally altered by humans (although I dispute this claim in section 3). If so, then the natural value that Katz purports to be present only in unaltered nature is present here, and would be lost in the event that geoengineering went ahead. Or to put it in Katz's terms: geoengineering would constrain the autonomous development of these processes by making them into an artifact.

Secondly, geoengineering shares some relevant similarities with the aims of ecological restoration projects. Christopher Preston for instance notes that 'Climate engineering could be viewed as simply the largest [nature] restoration project of all'.[252] He notes that for at least some scenarios, the purpose of a geoengineering intervention is to restore a historic global average temperature or atmospheric concentration of CO_2, usually to pre-industrial levels.[253] On the face of it, this is similar to the objectives of ecological restoration. In this case, Katz's account would suggest that geoengineering would be futile for the purposes of preserving natural value. Even if solar radiation management successfully preserved polar environments from melting or enabled delicate reef ecosystems to recover from the damage caused by climate change, these ecosystems will no longer be natural, as their link with the unbroken autonomous development of natural entities has been severed. They are now more akin to exhibits in a zoo than truly natural entities. If Katz's theory is correct, he will have given us an explanation for why geoengineering would still entail a form of wrongdoing.

It is worth emphasising that final point. Katz is committed to saying any and all intentional alteration is 'domination', from injecting thousands of tonnes of sulphur dioxide into the stratosphere to alter the albedo of the entire planet, all the way down to knapping flint; scale does not appear to be a factor in determining what is or isn't 'domination'. Does this mean Katz is committed to saying that all forms of domination are as bad as each other, for instance, that SRM and flint-knapping carry the same moral cost? Katz is perhaps not committed to going this far. While he is committed to saying all intentional modifications are domination, it is clear that large amounts of domination (say, transforming an entire forest into a housing estate) are less preferable than small ones (doing the same to a small woodland). Indeed, it is evident from Katz's expansive understanding of what acts involve domination that human life would simply not be possible without *some* amount of domination. Katz is still able to appreciate that there are trade-offs to be made, but he is committed to saying that wrongdoing always occurs.

[252] Preston, C.J., (2012) Beyond the End of Nature. *Ethics, Policy and Environment*. Vol. 15. Is. 2. p. 195.

[253] We should note though that not all GE aims at a restoration. There is no reason, in theory or practice, that climate engineering must try and replicate former ecological states. It may instead aim at creating something preferable, or even novel! I discuss this further in Chapter 6.

2.4 Summary of Katz's Argument

We can now summarise Katz's argument:

1. Nature is autonomous [by virtue of being independent from human intentions and pursuing its own development]

2. Human influence on nature, including restoration and/or geoengineering (GE), turns nature into an artifact [something that owes its existence to human intentions]

3. Artifacts are not autonomous

4. So when restoration / GE turns nature into an artifact, nature's autonomy is lost

5. This loss of autonomy constitutes a form of domination (as domination entails a denial of autonomy)

6. Domination wrongs nature

7. Conclusion: Restoration / GE of nature is therefore wrongful

We are now prepared to discuss the implications of Katz's argument for our ability to accept geoengineering. In the following two sections, I present two challenges to Katz. In section 3, I do not critique any of these premises directly, but argue that the implications of accepting Katz's argument is that there is no nature remaining. If there is no nature, then GE does not transform it into an artifact (since it is an artifact already), and therefore Katz does not provide an argument against GE. In Section 4 I argue contra point 6. I argue we can accept for the sake of argument Katz's novel understanding of natural autonomy, but deny his conclusion that restricting this autonomy entails wrongdoing. I argue that Katz's argument relies upon a false analogy with restricting the autonomy of human persons. If this is the case, then Katz fails to show why 'dominating nature' is wrong.

3.0 Challenges to Katz 1: Cannot Guide Actions

3.1 Is There any Nature Left?

As we have seen in the previous section (2.2), Katz understands nature as entities and systems which have developed independently of human intentions. They exist at the end of a causal chain of uninterrupted 'purposeless' evolution, never having been made into an artifact through intentional human modification. Moreover, the key point that Katz makes in his arguments against environmental restoration, is that once nature becomes an artifact, it can never become natural again. Even if an artifact (say a garden) is abandoned by its human creators and allowed to change and grow *as it might without influence* (native trees and plants reclaim it), it remains an artifact. Effectively, Katz sees nature as a non-replenishable, finite resource. Before humans, or for 'the last ten thousand years' of human existence at least,[254] this resource was fully stocked, but as more and more of the world is transformed by people, we can imagine this stockpile has slowly been depleting. The normative conclusion Katz would have us draw is that without sound preservationist policy this stockpile will one day expire and there will be no nature remaining.

[254] Katz thinks that humans occupy a unique ontological position outside of nature, in a technological and cultural world. Katz recognises this was not always the case though: prehistoric humans were presumably just as natural as the other flora and fauna of Earth. Only after our ability to transform nature expanded does Katz think we assume the responsibility of nature preservation. He writes: 'Of course, humans are biological beings, and in some sense natural, but we humans have lived for the last ten thousand years as cultural beings, modifying natural processes to suit our needs and interests. We live our lives in a cultural world, what Jacques Ellul called a technological milieu; we do not live in nature'. Katz, (2015) Geoengineering, Restoration, and the Construction of Nature. p. 489.

It is worth acknowledging first off that the idea that nature can never be restored following human interference is, I think, highly counter-intuitive. A garden reclaimed by the natural advance of a forest seems to me to unambiguously be 'nature' true and proper. Moreover, many challenges to this point in Katz's thought have already been made by Andrew Light, Eric Higgs, Richard Sylvan, Ned Hettinger, and Donna Ladkin, albeit with mixed success.[255] However, enough time and effort has been devoted to this line of argument by the authors above and I do not wish to go over these arguments again here. Instead, I believe that a new critique of Katz can be developed by accepting his argument here and attempting to follow it through to its conclusions. My contention is that Katz's definition of 'nature' is so prohibitively narrow that it plausibly admits no examples. If this is the case, then Katz's theory becomes effectively useless for helping us deliberate over environmentalist policy, including whether geoengineering should be accepted or rejected. Katz would be able to tell us why we ought not to alter unaltered nature, but if there is no unaltered nature then his theory becomes impotent. At best, he would be able to explain the character of past-wrongdoing, i.e., when we first made the natural world artificially. But he would be unable to explain the wrongdoing of current alterations of the 'natural' world. Crucially, this means he could not be used as a supporter of an argument against geoengineering.

Since for Katz the only true nature is untransformed nature, candidate examples must show that they do not currently and have not had any human influence for the past tens of thousands of years. These examples must now be vanishingly rare if they even exist at all. After all, as Bill McKibben provocatively claimed over thirty years ago now, through climate change there is no environment on Earth that does not in some way bear the evidence of human interference: resulting in what McKibben refers to as 'the end of nature'.[256] Another popular way of describing this time where human influence extends throughout the entirety of the world is as the 'Anthropocene'.

We do need to be slightly careful here, because Katz does not press the point quite so firmly as McKibben does. Katz does not believe that any and all human influence destroys nature, rather it is human *intentions* that matter. Once humans adapt nature to suit their needs, that natural entity becomes an artifact because its teleology is changed. A crisp packet blowing into the woods, or the footprints left from a hike probably do not make nature an artifact. Nonetheless, with tens of thousands of years of human history to be reckoned with, this is still a formidable hurdle to surmount. Surely there are no longer any terrestrial environments in Europe that no one ever over-optimistically tried to plant crops, enclosed for their herds, set a weir, or coppiced? Does this mean that Katz's argument cannot be applied to constructively guide policy anywhere in Europe?

Moreover, if this problem did not seem difficult enough as it were, the trouble is compounded by the difficulties of determining the extent of 'natural entities and systems'. An important question to ask might be: how far do the effects of intentional alteration travel? Rabbits, for example, now inhabit near enough the entirety of the United Kingdom and are an integrated part of the ecosystem here. Yet these rabbits were brought to this island by (as the story goes) the Romans, to act as a source of food and sport to hunt. They are, for Katz, unnatural. What we need to know then is whether the unnaturalness is confined to the individual rabbits themselves, or if the ecosystem as a

[255] Hettinger, (2012) Nature Restoration as a Paradigm for the Human Relationship with Nature.
Higgs, (2003) Nature by Design: People, Natural Process, and Ecological Restoration.
Ladkin, (2005) Does 'Restoration' Necessarily Imply the Domination of Nature? pp. 203-219.
Light, A., Ecological Restoration and the Culture of Nature: A Pragmatic Perspective. In: Gobster, P.H., Hull, R.B., (2000) *Restoring Nature: Perspectives from the Social Sciences and Humanities*. Washington D.C, Island Press.
Sylvan, R., Mucking with Nature. In: Morscher et al (eds) (1998) *Applied Ethics in a Troubled World*. New York, Kluwer Academic Publishers. pp. 57-84.

[256] We should also note the similarities between McKibben and Katz's understanding of nature as totally free of human influence. McKibben, (1989) *The End of Nature.*

whole – to which the Romans intentionally introduced the rabbits – is now unnatural. If the latter is the case, then small changes (such as planting a single tree), might render huge areas of land or entire ecosystems artificial, again diminishing the chances that any examples of nature remain.

If the ecosystem as a whole is able to remain natural despite having integrated unnatural elements, then Katz is going to face some difficult ontological questions as to how 'entities and systems' are defined in his work. After all, Katz is committed to a form of environmental holism, where whole ecosystems, environments, landscapes etc are just as much the subject of moral considerability as human individuals. But admitting that an ecosystem can include some artificial parts and some natural parts seems to significantly complicate this story. Katz would need to explain why it makes sense to consider that parts of a whole can be dominated while the whole itself remains autonomous. If this cannot be done, Katz might have to give up on his ethical holism. This is likely an unattractive move for him to make, significantly reducing the scope and distinctiveness of his ethics. After all, Katz's ethical theory attempts to explain harms that are done to collective entities – particularly ecosystems which are 'restored'. For our sakes as well, it might reduce his ability to comment on geoengineering, which as an activity works on natural 'systems' such as the atmosphere or the carbon cycle rather than (generally speaking) individual entities. So, Katz is in a position where he must either accept that small changes to natural systems render the whole system artificial, thus severely limiting the remaining stock of natural entities, or he will likely have to make significant changes to the holism of his ethics, limiting its ability to explain purported 'wrongs' directed at collective entities such as ecosystems.

We might also question what kinds of intentional activity nature can survive. Katz's examples are limited to examples of intentional physical transformations. However, it is not clear why it should only be physical changes that can change nature to artifact. Given that Katz is concerned with teleological changes – changes in purpose -it would seem like mere changes in the perception of nature would also be enough to make it artificial since they can change purpose just as much as physical alteration. For instance, if I start seeing a certain tree as a memorial or a particular river as sacred, this appears to change teleology too. No longer would that tree be mere purposeless nature, it is now imbued with human intention just as if I had made it into a physical artifact. The tree or river now has a use, as a memorial or object of worship, given to it by an intentional agent. If we admit that non-physical changes can also make artifacts this further reduces the potential pool of candidates for true nature. Can we really believe that there are any places or landscapes that no one in human history ever thought of as sacred?[257]

Even more provocatively we might also wonder if the act of merely dedicating a natural area a 'wilderness preserve' or otherwise acting to ensure its preservation doesn't transform it into an artifact. Of course, there are physical, material changes which occur when a landscape is given legal protection: fences may be constructed to surround it, people may be kept out (or forcibly removed in the sad cases of many so-called wilderness preservations), and its ecology may be monitored and studied. But we might also think beyond these physical changes, whether they happen or not, an intentional change has been made when we intentionally decide not to become involved. Once we

[257] In his work Katz talks about the process of making something an artifact as being centrally a teleological change: from purposeful nature to an artifact with an externally directed teleology. However, the thrust of the argument that this alteration of an entities purpose involves domination is that such changes in purpose 'constrain free development'. What we should anticipate here is that while the memorial/sacred landscape has an external teleology, its actual course of material development might be completely unchanged, thus Katz might be able to argue that this was not in fact domination. However, I believe Katz should be reluctant to take this route, as it seems to break the essential connection in his argument between artifacts (things with external teleology) and 'free unconstrained development'. After all, in an ecological restoration, once the actual acts of replanting, removing invasive species, cleaning up pollution etc are completed, these landscapes also have 'free unconstrained development', so this would utterly undermine his argument.

declare our intentions to keep this place as an untouched wilderness, it is no longer nature developing freely and without human intention, it would be an *intentional preserve*. Accepting this conclusion would strike a truly devastating blow for Katz, since we must conclude that even attempting to preserve nature also inadvertently destroys it. Once we become wise to this gambit, the only way to preserve a particular natural area is never to become aware of its existence.

As we have seen, a central element of Katz's ethics is that once nature becomes an artifact, it can never become natural again. The implication of this, I have argued, is that there is quite possibly no truly natural 'entities and systems' left. This was because small alterations to nature (for instance introducing a new species to an ecosystem it was not naturally a part of) will render large parts of the world artificial. Moreover, since the kind of changes that Katz is concerned with are changes to the purpose of nature (where artifacts are a kind of entity with a purpose, and nature is an entity with no purpose), even *non-physical* changes might be able to make nature artificial too. Provocatively, I suggested that even choosing to preserve a certain natural entity or system might render it artificial. If nature can irrevocably be made artificial by surprisingly innocuous changes, then over Katz's own proposed timeframe of 10,000 years of human existence, it seems highly unlikely that there is any significant amount of true nature remaining. If this is the case, then Katz's ethics become unable to guide our actions, since they are concerned with how we treat pure nature. In the next section, I draw out the implications of this on determining the ethical implications of geoengineering.

3.2 Implications Concerning Geoengineering

Having recognised that adopting Katz's account of how artifacts come into existence leads us to conclude there is vanishingly little nature left, this section goes on to consider what the implications of this are on our ability to condemn geoengineering.

Central to understanding whether Katz's argument for nature preservation can be successfully deployed against geoengineering is the question of the atmosphere. The atmosphere is directly or indirectly involved in every natural process on Earth. Depending on how far we think 'natural entities' extend, (and bearing in mind Katz's ecological holism that sees 'whole systems of entities' as deserving moral concern) it's perfectly plausible to think that if the atmosphere became an artifact, most every other process it interacts with would be artificial too.[258] The atmosphere, as we are all too aware, shows the marks of human influence in its composition of CO_2. Katz might plausibly claim that we never *intended* to alter it, after all the process was begun unintentionally by persons who had little or no idea that burning coal would be able to affect the whole atmosphere. We might think this argument is quite tenuous today, since we know full well that every lump of coal or litre of oil we burn changes the atmosphere's composition: I think we might very well reasonably say we are intentionally deciding that the atmosphere should have a higher CO_2 concentration because it's worth the trade-off for the benefits using those fuels brings.

Katz would likely be unwilling to concede this, given the disastrous consequences of doing so for his argument. A less controversial example would be the artificial fixation of nitrogen, which since 1913 has been intentionally altering the composition of nitrogen in the air to make fertilisers and explosives. In 1971 the Environmental Protection Agency officially legislated that the concentration of nitrogen dioxide in the air should be kept at an average of 0.053 ppm over the course of a year, something which according to Gorman had 'profound' implications, since humans would '…become an active component of the biogeochemical system that regulated concentrations of reactive

[258] Katz, (1997) Buffalo-Killing and the Valuation of Species. p. 55.

nitrogen in the atmosphere'.[259] The conclusion that the atmosphere has been intentionally altered, made into an artifact, seems inescapable. If this is the case, Katz would seem unable to respond to would-be geoengineers, who might claim that his argument for nature preservation simply does not apply here, as the atmosphere is – regrettably of course – already artificial.[260] All that geoengineering is doing is altering, and improving, one of our artifacts to make it more useful to us.

The arguments presented here are a real challenge to the ability of Katz's argument to support Preston's presumption against geoengineering. If we accept Katz's definition of 'nature' then we are forced to admit that there is vanishingly little nature left at all. However, since the crux of Katz's argument is that nature cannot be recreated once it is lost, we appear to be in a situation where there is both essentially no nature and no hope of recovering it. Within this context, Katz seems to have very little to offer us in terms of action guiding principles. We are required to preserve what nature there is (possibly none at all), but Katz does not give us any guidance on how we should treat those parts of the world which are already artificial. If we accept that the climate (or the relevant 'entities and systems' which govern climate) that geoengineering will act upon are already artificial (something I think we must do if we accept Katz's understanding of nature), then Katz does not seem to be able to tell us why we are obligated to preserve them unmodified. If we already live in an artificial climate, then Katz does not appear to be able to show us why geoengineering violates a duty to preserve nature. Recognising that large parts of the Earth are artificial does not commit Katz to saying that there are no longer any restrictions on how it is treated. After all, we will still have obligations and duties to our fellow human beings. However, once we recognise that an entity is no longer natural, it does mean that Katz no longer has non-anthropocentric reasons for its preservation. Geoengineers seem able, fairly, to argue that all that they are doing is altering or improving an artifact we have (for better or worse) already created. If they can create something better able to protect, for instance, human and animal wellbeing, then Indeed, notable early proponent of geoengineering, the astrophysicist Lowell Wood argues very much along these lines when he says, 'we've engineered every other environment we live in – why not the planet?'.[261]

4.0 Challenges to Katz 2: Nature's Interest in Autonomy

In this section I present a second challenge to Katz. I argue that Katz is unable to establish premises 5: loss of [nature's] autonomy constitutes a form of domination (as domination entails a denial of autonomy), and premise 6: this 'domination' wrongs nature. In including nonhuman 'entities and systems' as potential victims of domination, Katz adopts an insufficiently robust account of domination. Katz's understanding of domination extends to all cases of an agent exercising their power to constrain autonomy. While this allows him to describe the constraint of nature's autonomy as domination, it fails to exclude paradigmatic examples where exercised power to constrain freedom is usually thought to not be domination because it is used in a manner which accords with the best interests of the 'victim'. That domination involves power that does not track the victim's interests is attested to by numerous philosophers who have written on the topic, notably Phillip

[259] Gorman, H., (2013) *The Story of N: A Social History of the Nitrogen Cycle and the Challenge of Sustainability*. New Jersey, Rutgers University Press. p. 137. We might also think about the ban of CFCs which was enacted to control damage to the Ozone layer.

[260] Note that this argument is not reliant on anything special about the 'atmosphere': I choose it as just an example of the kind of entity or system Katz might think is threatened by geoengineering. We could substitute in 'climate', 'carbon cycle', 'energy balance' or whatever entity you think a prohibition on geoengineering would preserve in a natural state and the argument would continue to work. Additionally, while many forms of geoengineering do not directly work in the atmosphere, such as iron fertilisation or BECCS, their purpose is still to alter the concentrations of atmospheric gases, notable CO_2

[261] Quoted in: Hamilton C., (2013) Geoengineering: Our Last Hope, or False Promise? *The New York Times*. May 26th.

Pettit, Ian Shapiro, Eva Kittay, Amy Allen, Steven Lukes, Thomas Wartenberg, and Cécile Laborde.[262] We do not need to become too heavily involved in the nuances of differing accounts of domination here though, nor should we let this account of domination be justified just by the weight of the theorists attached to it. Instead, I will argue that it is enough to show that adopting an account of 'domination' that does not involve tracking the interests of the 'dominated' results in a loss of the distinctive moral characteristic of domination, and leaves Katz unable to show either Premise 5 or Premise 6 of his argument.

I argue that adopting an understanding of domination which includes the notion that domination must not be in the interests of its victims has major implications for Katz's argument. I argue that since non-conscious aspects of nature have no interests, it follows that they cannot be dominated. We may even accept Katz's account of the autonomy of these non-conscious entities and systems, and still deny that they can be dominated, since they have no interest in the continuation of that autonomy. Continuing to use domination to describe these instances of nature's autonomy being constrained would be to rob the term domination of its normative content: the fundamental understanding that, as Pettit puts it, domination is 'a complaint'.[263] This is to say, whatever we think domination entails, one necessary feature of it is that it is morally wrong. If it was not morally wrong, it would not truly be domination.

Having shown that it is implausible to think that domination applies to non-conscious nature, I consider whether Katz or a supporter of his might be able to rescue his argument by appealing to the interests of the conscious parts of nature, i.e., the nonhuman animal inhabitants of the natural world. I conclude that this is not enough to save Katz's arguments, as artificial environments, which is to say environments created by constraining nature's freedom, at least occasionally do track the best interests of their nonhuman inhabitants; the paradigmatic case of this might be instances of environmental restoration. The conclusions to draw from this section are that when an account of domination which includes the importance of the victims' interests is applied, Katz cannot show that constraining nature's autonomy entails domination, since much of nature has no interests to be tracked, and those parts of it which do have interests do not always have an interest in nature remaining truly natural rather than artificial. Based on this, I conclude that Katz has failed to show that we are obliged to preserve nature's autonomy because that autonomy is valuable to nature.

[262] Pettit, P., (2006) The Determinacy of Republican Policy: A Reply to McMahon. *Philosophy and Public Affairs*. Vol. 34. Is. 3. pp. 275–283.; Shapiro, I., (2012) On Non-Domination. *University of Toronto Law Journal*, Vol. 62 Is. 3. pp. 293–335.; Allen, A., (1999) *The Power of Feminist Theory*. Boulder, Westview Press.; Kittay, E., (1999) *Love's Labor: Essays on Women, Equality and Domination*. New York, Routledge.; Lukes, S., (2005) *Power: A Radical View*. London, Palgrave Macmillan.; Wartenberg, T., (1990) *The Forms of Power: From Domination to Transformation*. Philadelphia, Temple University Press. ;Laborde, C., Republicanism and Global Justice: A Sketch. In Niederberger, A., Schink, P., (eds) (2013) *Republican Democracy: Liberty, Law and Politics*. Edinburgh, Edinburgh University Press. pp. 276–301.

[263] Pettit, (2005) The Domination Complaint. pp. 87-117.

4.1 Katz's Account of Autonomy and Domination

Let us recap Katz's accounts of both autonomy and domination. Katz believes that nature is autonomous: in fact, it is nature's autonomy that makes it natural rather than artificial. Nature's autonomy is a function of its independence from intentional human manufacture or design. Natural entities and systems are those entities and systems which can trace their provenance back through an unbroken chain of purposeless development and evolution without ever having purposeful design enter into that chain of causation. As Keekok Lee (a philosopher with a closely allied position to Katz) puts it, saying nature is autonomous means:

> *What has come into existence, continues to exist, and finally, disintegrates and decays, thereby going out of existence, in principle, entirely independent of human volition or intentionality, of human control, manipulation or intervention….* It is self-sustaining and self-generating.[264]

I think the comments on self-sustaining and self-generating nature are helpful here to understand this notion of autonomy. Autonomy is being used in quite a different manner to how it might typically be used in political philosophy in her understanding of nature's autonomy.[265] Natural entities and systems have a trajectory which they take between their coming into formation and their disintegration and decay out of existence. A lake, for instance, may form as tectonic plates shift or a landslide blocks the route of a river. So long as rainfall and evaporation remain at a particular balance the lake persists, until eventually, it may dry out, become a swamp, and in time cease to exist entirely as terrestrial plants fully colonise it. Provided that human agency does not come into play at any point during the trajectory of a natural entity or system (for instance, if the lake was created by damming the river), the entity or system is autonomous.[266]

Another way of explaining this conception of autonomy is in terms of teleology. As we have seen Katz and Lee both use the notion of external teleology to explain what is meant by the autonomy of nature. Artifacts have an 'external teleology': a purpose given to them by a human designer. Natural things, both living and non-living, have no external teleology. Living things might have an internally generated teleology: that is to say, they might be goal oriented towards survival or reproduction. However, this is not the same as a purpose given to them by someone else. Katz writes:

> The anthropocentric instrumentality of artifacts is completely different from the basic characteristics of natural entities, species, and ecosystems. Natural entities exist independently from human purpose or design. Living natural entities and system of entities evolve to fill ecological niches in the biosphere, not to meet human needs or interests. More clearly, non-living natural entities, such as rock formations, rivers, canyons, soils (and so on), simply *exist,* without any evolutionary 'fit' at all. Non-living natural entities, although subject to change, do not 'evolve' or adapt to changing conditions in their natural ecosystems. It is thus difficult even to ascribe the notion of function or purpose to natural entities.[267]

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[264] Lee, K., Is Nature Autonomous? In Heyd, T., (eds) (2005) *Recognising the Autonomy of Nature*. New York, Columbia University Press. p.59. Emphasis in original. Note that while Preston does not directly count Katz as a supporter of the presumptive argument, he does cite Lee.

[265] Lee, K., Is Nature Autonomous? p. 60.

[266] Ned Hettinger also uses this idea of trajectory to explain nature's autonomy. Hettinger, N., Respecting Nature's Autonomy in Relationship with Humanity. In: Heyd, T., (eds) (2005) R*ecognising the Autonomy of Nature.* New York, Columbia University Press.

[267] Katz, E., Artifacts and Functions. p. 123

This notion of purpose and function is important for understanding why Katz thinks that 'domination' is the appropriate descriptor of altering nature. When nature becomes transformed into an artifact, it has a purpose imposed upon it, and ceases to be autonomous. Making nature into an artifact constrains the free development of nature, alters its trajectory so as to serve the purposes of human beings – in other word: it dominates. There is a face-value similarity here between the 'domination' of nature and the domination of persons. The dominated person has their autonomy constrained; they are not free or able to pursue their projects as they would have had they not been dominated.[268] Likewise, nature, once it has been 'dominated' (i.e., made an artifact), no longer develops along its trajectory as it would have done had it been left to its own devices (so to speak).

4.2 The Moral Significance of Nature's Autonomy

Despite some prima-facie similarities between Katz's account of nature's domination and more standard notions of domination, I think there are good reasons to reject Premise 6. I believe that in expanding the term domination to capture the constraint on non-sentient nature's 'autonomy', Katz loses sight of what it is about domination which makes it a moral 'complaint' in its typical usage.[269] What is lost in Katz's account is that domination is not a constraint of any and all 'autonomy', but constraints on a subject / entity's autonomy which are not done in accordance with their interests. I take it to be implausible that non-conscious natural entities (rivers, canyons, woodlands, protozoa, etc) have (morally relevant) interests. In virtue of not having interests that can be acted in accordance with, constraining their autonomy does not entail wronging them. They cannot be dominated. By expanding the notion of domination to capture all constraints that are placed on entities autonomy, Katz divests it of its moral content.

The problem with Katz's understanding of domination is over-extension. Katz thinks of domination as a curtailment of freedom, of the freedom for nature to pursue its 'trajectory' unhindered for certain, but also presumably of human freedom. The problem with this understanding, however, is that we do not typically think of domination as being *only* a curtailment of freedom. We can illustrate this by considering a scenario. Imagine that I, having left my friend's birthday party inebriated, decide to ride my bicycle over the busy roads and steep hills home. Despite my insistence that I will be fine, my friend confiscates my bike, and perhaps forcefully puts me in a taxi home. No doubt in this instance my freedom has been curtailed, but we would surely be reticent to say that I had been a victim of domination. Another scenario: suppose that (despite my sobriety) I have a collision on my bicycle that renders me unconscious. Having been rushed to the hospital, the doctors make the decision to perform surgery to save my life. Again, despite the fact I never made a choice about whether or not to accept the surgery, I think most would be unwilling to suggest I had been a victim of domination. What could explain the fact that these examples of curtailment of freedom would not generally be viewed as domination?[270]

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[268] Though, read on. This is not necessarily the best way to understand domination; I use it to illustrate the plausibility of Katz's comparison here.

[269] Pettit, (2005) The Domination Complaint. pp. 87-117

[270] It might be objected that these examples are only plausible because they are *individual events* rather than *systemic occurrences*. Afterall, 'domination' is often understood as a repeated pattern of behaviour, and admittedly it is rather less plausible that I would not be dominated if my friends continually prevented me from drinking alcohol on the account of 'my best interests'. Typically, the response to this is that these cases can be resolved by invoking the fact that I have an interest in my own freedom of decision making, which my friends' well intentioned actions violates. However, for our sakes here, we need not even invoke this kind of explaination – as Katz does not employ an account of domination which is reliant on it being a systematic curtailment of freedom. The examples given above are in line with how Katz is understanding domination, and

The answer, I believe, lies with the notion of interests. In both cases my freedom was curtailed in such a way as to track my best interests. While in each case, others were in a position of power over me, and exercised their power in the limitation of my freedom of choice, their doing so did not constitute an act of domination because it was done in accordance with my interests. What I think these examples illustrate is that domination is more than simply power exercised to constrain another's freedom.[271] Having Katz's understanding of domination as mere curtailment of freedom means admitting these examples into your definition of domination. This is something we ought to be reluctant to do. Instead, I believe the examples given should prompt us to adopt an understanding of domination that includes in its definition that the exercised power of the potential dominator is done in a manner which does not accord with the best interests of the victim. That an important component of what makes an action 'domination' is its relation to the interests of the dominated has major repercussions for Katz's argument. The corollary is that to be a victim of domination, to make the complaint of being dominated, you must possess interests that can be either acted in accordance with or not. The question that we must ask now is whether it is plausible that non-sentient natural entities possess interests?

I think there are three major problems for Katz here. Firstly, Katz needs to establish that certain non-sentient entities have interests. Many philosophers simply reject this possibility, claiming that for an entity to have an interest, it must have certain cognitive capabilities such as the ability to form a desire or make assessments of its own wellbeing. Non-conscious entities (such as rocks) simply lack the necessary cognitive capabilities to be said to have interests. Secondly, while some philosophers occasionally moot a non-consciousness-based account of interests, (as we have seen in Chapter 3) this does not necessarily solve the problem for Katz either. Such an account could be formulated like so: an entity has an 'interest' if it has a purpose which can be advanced or hindered. With this formulation, certain non-conscious entities might be thought of as possessing interests too: for instance, a sunflower has an 'interest' in being watered and receiving sunlight even though it does not experience those interests as any kind of affective mental state. Suppose that this is a plausible account of interests. The trouble is that this account of interests does not seem to be morally relevant in the way that the charge of domination would require. Here it's useful to consider the famous formulation by Joseph Raz on what it means to possess 'rights'. Raz explains that rights exists where beings possess interests whose strength is sufficient to hold another under an obligation.[272] While we are not strictly speaking about 'rights' here, this principle is a useful illustration of the general point. We are not obligated to respect any and every interest – some interests clearly matter more than others; some are utterly trivial.

So, while on this account a sunflower might be thought of as possessing interests, this is not on its own sufficient to know whether its interests matter in any morally relevant sense. We must establish what it is about interests that make some of them morally demanding while others trivial. While this is evidently too great a task for this chapter alone, it seems that a plausible answer is that some interests, when they are not fulfilled, produce negative or undesirable affective states. If I am denied water and food, I feel thirsty, and hungry, and will eventually perish, which runs counter to many of my life plans. This requires certain cognitive capacities, which crucially, appear to be lacking in non-conscious entities. While the sunflower might have an 'interest' in being regularly watered, it seems

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therefore are perfectly adequate counter examples. Moreover, we might also think that while I – a human person of ordinary cognitive abilities – have an interest in my freedom of decision making which prevents systematic in-best-interest interventions in my life, the kinds of entities which Katz is considering to be plausible candidates for domination very likely do not. I come to this point in greater detail shortly.

[271] We do not at this juncture need to settle on exactly what domination does entail: e.g., for Pettit the condition of being subject to the exercise of arbitrary power. It is sufficient for the case I am making to show that Katz's understanding of domination is untenable.

[272] Raz, J., (1988) *The Morality of Freedom*. Oxford, University Press. p. 166.

to lack the reflective capabilities for its interests to matter to it. To the extent that plants, protozoa, mountains, gravel, rivers, coral, manure, or the atmosphere can be characterised as having interests, the fulfilment of those interests is entirely trivial to them, they could not care whether they are fulfilled, they simply lack the capability to do so. So even with an altered account of interests, Katz still seems to be unable to show why nonconscious things could be dominated.[273]

Additionally, we may note, adopting this teleological account of interests might lead to other conclusions that Katz would be reluctant to accept. As discussed in Chapter 3, extending interests beyond conscious entities seems to open the possibility that nonconscious nonnatural entities might have interests too, and could potentially be the subjects of domination. For instance, a car might be thought to possess an interest in being well maintained: having a regular oil change, tyres reinflated, rust treated, etc so that it can continue serving its function as a means of transport. Given the centrality of the natural / artificial boundary in Katz's ethics, this will be an unwelcome conclusion for him to accept.[274]

Additionally, let us suppose that a plausible account of nonconscious interests could be established, which would additionally show that those interests were morally relevant. This would still not establish what Katz needs in order to say that nonconscious nature can be dominated. Because in addition to possessing interests generally, in order to be dominated we need to have an interest in maintaining our autonomy. I have argued that 'domination' implies more than just curtailment of freedom, but curtailment of freedom that does not track the subject's morally relevant interests. Additionally, following Pettit, it is a complaint – something morally concerning has happened when domination occurs. So, if an entity can be dominated, it must have a non- trivial interest in its own autonomy. Even supposing there are non-trivial interests that non- conscious entities can possess, why should we suppose that this is one of them? Certainly, there will be occasions where transformation into an artifact frustrates the interests of a nonconscious living thing – a tree doesn't 'want' to be made into a table in the sense that such a thing would kill it and we must assume if any interest is non-trivial it must surely be self-preservation. But here it seems that the interest the tree has in maintaining its autonomy (to live and grow as a tree rather than become a table) is entirely conditional on the fact that autonomy is a step to achieving some other interest – i.e., self-preservation. But I put it to Katz, that there will be occasions where the curtailment of 'nature's autonomy' (the imposition of human purposes and transformation into an artifact) seems to have no effect on its ability to satisfy any of its other interests at all. I might decide to use a tree as a signpost by non-intrusively hanging a sign from one of its branches. Katz will say that this transforms the tree into an artifact – it has had human intentions imposed upon it, but it's entirely unclear why we should think that any interest the tree had has been frustrated. What we should conclude from this, I take it, is that if the tree had an interest in remaining autonomous from human purposes, that interest was entirely trivial, and thus is not demanding of any substantive moral consideration. Thus, it is a mistake to describe this activity as 'domination' since it lacks the essential moral character which makes 'domination' a complaint above mere curtailment of freedom.

[273] Incidentally this also shows why the examples of non-consensual interference which are detailed on page 26 are pertinent. If you found yourself worrying that my chosen examples could not provide a generalised account of non-dominating-interference because I was not in possession of my normal mental faculties, you have to accept that many of the entities which constitute nature have far lower mental faculties than even myself in an impaired state.

[274] Gary Varner offers some thought-provoking discussion of this problem, and suggests it might be avoided by adopting a notion of non-conscious interests which only admits interests which are generated from biological goods. I find this answer highly unsatisfying and lacking justifications of its own (an argument would have to be shown why biological interests are deserving of this special treatment). Varner, G., (1998) *In Nature's Interests?* Oxford, University Press. p. 68. In any case, this would not extricate Katz from the problem either, since his ethics is not limited to biological things, and includes also non-living non-conscious entities too.

It worth stating explicitly just what Katz requires us to believe in order to support his conclusions. Let us consider exactly what Katz's argument would entail for identifying the moral harm caused by geoengineering. For the sake of illustration here, let us focus on carbon dioxide removal by direct air capture: removing CO_2 from ambient air by reacting it with particular chemicals inside a purpose-built machine, and later storing it deep underground. Putting aside the caveats from the preceding section about whether the atmosphere really is still 'natural', Katz's objections to carbon removal will be that it makes the cycling of carbon through the oceans, atmosphere, and biosphere an artifact rather than a purposeless and autonomous natural feature.[275] By intentionally choosing to regulate that system, through direct air capture, the carbon cycle is now being *purposefully directed* to achieve a particular atmospheric concentration which (some) humans find preferable. This purposeful direction deprives the carbon cycle of its autonomy; its ability to develop purposelessly and as it might have had humans never gotten involved. Finally, this deprivation of autonomy is a moral harm inflicted upon the carbon cycle, equivalent to the moral harm done to a person who is dominated.

The reason, I hope to have shown, why Katz's argument appears to reach such a deeply counter-intuitive conclusion, is because Katz is reliant on an untenable understanding of domination. By reducing domination to any constraint of freedom, Katz ends up identifying domination in cases where the constraint of a person's freedom is not morally troubling: divorcing the word domination from its commonly understood normative charge. To rectify this problem, Katz must include a notion of tracking the victim's interests back into his definition of domination. But once we add the importance of interests back into the definition of domination, we can no longer use the term in reference to constraints on the autonomy of non-conscious natural entities, since these entities do not possess interests of any kind. Moreover, even if we adopt an expanded sense of interests that can accommodate nonconscious nature (e.g., being able to be helped or hindered in achieving internally directed teleological goals), this will still not show that these interests are morally relevant, or even that there are interests in maintaining autonomy.

4.3 The Interests of Conscious Nature

So far, I think I have successfully shown that it is implausible to think that non-sentient aspects of nature (e.g., the carbon cycle), can be the victims of the particular wrong of domination, on account of their not possessing interests, or at the very least morally relevant interests in one's own autonomy. However, we should probably note that Katz's understanding of nature is not limited to non-sentient entities but also includes many conscious non-human entities: the myriad animals that occupy natural areas and partly constitute the natural entities and systems that Katz thinks are worth preserving. Nonhuman animals certainly possess interests: it is not controversial to suggest they can be treated in ways which are better or worse for them, more or less in accordance with what they would prefer to be happening for instance. Moreover, it also seems likely that their interests are often morally relevant. We need not go into the exact arguments for why this is, but we might for instance think that their capacity to suffer justifies a concern for their interests. It is therefore not prima-facie implausible to think that they could become victims of domination – certainly not on the grounds of lacking interests in the same way canyons or atmospheric processes would. It therefore seems possible that Katz might be able to mobilise a defence of their interests, as parts of nature, to ground his argument.

Such an argument might go like this. Nature, according to Katz, is the 'entities and systems' that exist in the world and have never had an external teleology imposed on them by human beings. While many of these entities and systems are unconscious, since they are collective entities (such as an ecosystem, comprised on many different biotic parts and potentially some abiotic parts) many of

[275] Katz refers to the 'entities and systems' which make up nature. I see no reason to doubt that he would apply his argument to the carbon cycle as a natural system.

them will have conscious components (I.e., the animal inhabitants of that entity or system). So, while the (lack-of) interests of the unconscious whole prevent an attribution of domination, we can still talk about the domination of the morally relevant conscious interest-holders within the collective. Thus, when we transform an ecosystem or natural area into an artifact, we wrong (dominate) the nonhuman animal inhabitants.

Certainly, this line of thinking avoids the trouble caused by invoking the carbon cycle's (or whatever the relevant 'entity or system' is) own interest in autonomy. However, I think it is very likely to encounter problems of its own. First amongst these problems will be showing that the nonhuman animals whose interests are at stake really do have an interest in whether the natural entities and systems which they are a part of remain natural, rather than becoming artifacts. That is to say: by transforming certain natural areas to suit human needs (making them an artifact), a curtailment of freedom (to develop autonomously) has occurred which fails track the interests of the sentient parts of that natural area (nonhuman animals); implying domination of the natural area and its sentient inhabitants has occurred. There is a kind of prima-facie plausibility to this. It is surely uncontroversial to say that certain individual animals have a strong interest in their homes remaining natural, in so far as, say, a biodiverse natural forest is better able to provide for their needs (food, shelter etc) than a uniform stand of conifers in a forestry plantation.

I argue however that this illustrates the implausibility of Katz's argument. We must remember that Katz is also arguing that 'restored' natural environments are dominated as well, they reflect the human desire for 'restored environments' and are not truly autonomously developing nature. Imagine two identical woodlands, both rich and biodiverse and able to sustain flourishing communities of nonhuman animals within them. One of these woodlands is 'natural', it developed as a result of an unbroken chain of natural evolution and natural processes spanning back into the interminable past. The other was formerly a woodland much the same as the first, until it was inadvertently damaged when human hikers brought a fungal disease with them on their boots from a foreign holiday, inadvertently causing a number of trees to die off and leaving a denuded and depopulated woodland in its wake. However, a committed team of environmentalists reintroduced the missing species of trees from a closely related population which were naturally immune to the fungal infection, and after a number of years each of the missing species had returned and the forest was more or less identical to how it had been before the infection. Katz is going to need to explain why the second restored forest is the product of domination, by referring to the interests of the nonhuman animals who occupy it. Remember that because the event that caused the forest to become denuded was unintentional, it would not count as an instance of domination according to Katz. Humans were not trying to implant their designs upon it; trying to constrain its autonomous development. The only time human designs came into play when the conservationist took to returning it to a state where it best supported the lives and needs of its animal inhabitants. Are we to believe that it was not in the best interests of the forest's inhabitants that the restoration work went ahead? Bear in mind of course, that the animal inhabitants will likely have no conception of the difference between the artificial and the natural forest: comprehending such a difference being certainly beyond the limits of nonhuman animal cognition.[276] If you, like me, think this account of the forest inhabitants' interests is implausible, we must reject the argument that they are dominated when their forest home becomes an artifact. Again, even with this argumentative tangent, Katz would be unable to show that making nature artificial implies domination.

To summarise the argument that I have made in this section: Katz's ability to show why geoengineering would be wrongful is based on his claim that all constraints of autonomy entail domination. However, as I have shown, this account of domination that is flawed in the sense that it

[276] We should also note that many nonhuman animals likely lack an interest in their own autonomy. For a defence of this point, see Cochrane, A., (2012) *Animal Rights Without Liberation*. New York, Columbia University Press.

cannot exclude paradigmatic instances where a constraint of freedom does not imply a moral wrong. In order to show that nature is wronged by its 'domination', he must adapt his definition to include a notion of the morally significant interests of the victim, and whether or not the power being exercised is in accordance with those morally significant interests or not. However, as I have argued, this causes a major problem for Katz. Most of all, his understanding of nature as 'entities and systems' includes numerous non-conscious entities which on traditional accounts of interest-theory do not have interests and thus cannot be the victim of domination. Adopting an expanded notion of interests, that accounts for the 'interests' of nature in pursuing internally directed teleological goals does not help either, since we would both need to qualify why those interests are morally relevant, and additionally show why those teleological interests included an interest in maintaining one's own autonomy. On the latter point, it does not seem evident that nonconscious entities have this kind of interest in preserving autonomy, thus cannot be wronged by any curtailment of their autonomy. Moreover, Katz's argument cannot be rescued by appealing to those aspects of nature which *do* have interests, nonhuman animals. Even assuming that nonhuman animals have an interest in autonomy, it is not clear that all instances of making nature artificial (constraining its autonomy) cannot be in their best interests. Indeed, it is the example of nature restoration, the bug-bear that Katz sets out to explain the harm of, which makes this conjecture most clear. Surely the interests of nonhuman animals are better served by a flourishing but 'restored' ecosystem or climate than a denuded but natural one. We can go along with Katz as far as accepting that nature restoration constrains nature's autonomy, but still deny that this constraint of autonomy implies the particular complaint of domination, because it is (at least in some cases) in the best interests of non-human animals. Overall, we must conclude that Katz has failed to show that constraining nature's autonomy is a moral problem because of a harm to nature itself.

5.0 Conclusion

This chapter has offered an evaluation of the philosophical project of Eric Katz and its ability to justify a moral condemnation of geoengineering. Katz's ethics purport to show why transforming nature into an artifact entails the wrong of 'domination'. If this could be shown, it would undoubtedly be able to offer a generalised case against geoengineering: able to show why all acts of intentional climate change, no matter how beneficial they would potentially be, involve some amount of wrongdoing. This is because geoengineering, by its very nature, involves making intentional changes to nature, changing what was once a natural climate into an artificial one. Thus, while Preston does not specifically cite Katz as one of the supporters of a presumption against geoengineering in environmental ethics, there are strong reasons to think that his ethics (if successful) would also condemn geoengineering.

Unlike the previous chapter on Taylor and Regan, I have not tried to show here why some forms of geoengineering might be compatible with their ethical theories. Instead, I have tried to show why Katz's theory cannot show why geoengineering entails wrongdoing. I made two arguments to this effect. Firstly, I argued that by characterising nature as untouched and unaltered by humans, Katz has inadvertently made his theory unable to guide actions. After so many years of human history, there simply cannot be significant amounts of the 'natural' world which meet such restrictive criteria. Limiting the application of his theory to such a tiny pool of potential candidates inadvertently gives licence for further transformation of the (what we would usually term) natural world, since the harm already having been done, there is no additional moral cost to continuing to alter what is already artificial.

Secondly, I have argued that Katz fails to support premises 5 and 6 of his argument schema: that (5) '[nature's] loss of autonomy constitutes a form of domination' and following from this (6) 'Domination wrongs nature'. In order to show that nonconscious nature can be dominated, Katz

needs to give an account of domination that can accommodate the fact that the subject of domination [I.e., nature] has no interests. However, typical accounts of domination usually rely on the interests of the subject to distinguish 'real' domination, from mere 'constraint of autonomy'. The problem for Katz, I have argued, is that this weakening of domination severely degrades its purported moral seriousness. This was shown by illustrating occasions where Katz will be forced to say that 'domination' occurred in scenarios we would typically see as morally unproblematic. This leaves Katz with two options. He must either alter premise 5 so that the result of nature's loss of autonomy is something other than 'domination'. However, if he does this, he will no longer be able to rely on the intuitive sense of wrongdoing we have with 'domination' to explain why nature is wronged. Or he can accept that his account of domination includes scenarios we think of as unproblematic, and fail to establish Premise 6. While there are metaphorical uses of 'domination' which have no moral connotation (e.g., Celtic dominated Rangers), accepting that the 'domination of nature' has no moral meaning to it completely undermines Katz's ethical project. Thus, whichever option is taken, Katz's theory becomes unable to show what the wrongdoing of geoengineering is, and thus would not support a presumption against geoengineering.

However, this is not necessarily a full refutation of the worry we might have that geoengineering 'dominates nature'. As we have discussed, Katz understands the mechanism of domination in a particularly novel way, which occurs in the specific action and occasion that previously untouched nature becomes an artifact. It goes without saying that this is not the only way that domination of the natural world might be understood. In the following chapter I explore the notion of 'the domination of nature' as an ideological feature of societies, rather than as a specific action, as the idea is found in the work of Frankfurt School scholars Theodore Adorno and Max Horkheimer.

Chapter 5 - Dominating Nature and Geoengineering: the argument from Adorno and Horkheimer in Dialectic of the Enlightenment

1.0 Introduction

In the previous chapter I explored whether an argument could be made against geoengineering based on the specific charge of 'dominating nature'. Throughout that chapter I examined and evaluated how nature is claimed to become dominated within the ethics of Eric Katz. I argued that Katz's ethics leads us to some untenable conclusions and ultimately rejected it as a way of determining what our obligations to nature vis-a-vis geoengineering are. However, the problems with Katz's work need not lead us to reject entirely the worry that geoengineering might entail the specific wrong of domination; other models of dominating nature do exist, and Katz is certainly not the only author to build an ethical theory around the concern over nature's domination. It is therefore possible that a robust argument for explaining the wrongdoing of geoengineering in terms of 'dominating nature' might exist elsewhere than Katz. This chapter investigates this possibility: that a stronger explanation of dominating nature can be found elsewhere, and in particular in the work of the Frankfurt School scholars Theodore Adorno and Max Horkheimer.

As we have seen in the previous chapter, Katz understands the domination of nature as being a specific, temporally bound occurrence, which comes about when humans intentionally impose their designs onto natural entities, and in that moment disrupt their teleological trajectory by making them into artifacts. In contrast, Adorno and Horkheimer use the term to refer to a trait of 'modern' or enlightenment society. Precisely what is meant by this will be examined in greater detail in Section 2.1. This understanding of the 'domination of nature' as a cross-societal attitude or ideology seems closer to the way the term has been expressed in critiques of geoengineering. For instance, Dale Jamieson writes that both geoengineering and climate change are '[the] central expression of the human domination of nature'; and that even if geoengineering were successful in arresting the mal-effects of climate change, it would still 'reinforce… the view that the proper relationship with nature was one of domination'.[277] Preston suggests that a 'culpable attitude of domination' is the driver of geoengineering.[278] This line of thinking might also be drawn out of renowned environmental activist Greta Thunberg's comments on 'Solar Geoengineering', that '…when you're stuck in a hole, stop digging. We cannot move out of this crisis with the same mindset that got us into it' – the implication being that the kind of attitude that drives the development of geoengineering is the same as the one which drove climate change.[279]

The Frankfurt School sought to investigate how an expansion of science and reason (the ability to acquire knowledge or mastery over the natural world) during the 'Enlightenment' within certain societies failed to deliver on its promise of delivering humans from their misery and privations (from material scarcity, and superstitious beliefs); and instead led to the 'collective madness' of modern times.[280] They argue that the promise of the Enlightenment was that the new methods of scientific and rational inquiry would give humankind the power to liberate themselves from *natural* suffering - from famine, disease, and from the arbitrary 'natural' rule of monarchical bloodlines. Moreover, this was understood as being a kind of ability to 'dominate' nature - not necessarily in a pejorative sense

[277] Jamieson, (1996) Ethics and Intentional Climate Change. pp. 323–336.

[278] Preston, (2012) Beyond the End of Nature. p. 462.

[279] Geoengineering Monitor (2021) #SayNoToSolarGeo Video. *Geoengineering Monitor*. July 21st 2021.

[280] Horkheimer, M., (1947, 2008) *Eclipse of Reason*. Massachusetts, MIT Press. p. 176.

of 'dominate' but as the acquisition of mastery, or the ability to bend it to our will and have it serve whatever ends that we set it to. But acquiring the knowledge of how to dominate nature, they argue, required alienation of the human subject from its natural object of study. This process 'disenchanted' nature – stripping it of any inherent value it was once thought to possess. Thus the 'Domination of Nature' is a condition, attained in modernity, where 'nature' is treated entirely instrumentally, rather than as an end-in-itself. Crucially however, this process of 'disenchantment' explains why the Enlightenment project failed to liberate human beings. Since humans are natural too, they also required 'disenchantment'. Thus, the same processes which stripped nature of its moral worth became applied to human beings too, and humans like nature became subject to entirely instrumental calculations of their worth. So, while Enlightenment reasoning provided great power at achieving technical ends such as the manufacture of new technologies (the mastery of nature), the power to do this required the 'disenchantment' of the subject - a denial of any moral worth it might have. This in turn left modern societies unable to deliberate over what ends these technical powers should be set to. A kind of 'instrumental' means-to-an-end reasoning was pursued over an 'objective reasoning' that could consider the purposes that society was directed toward. Thus, in what Horkheimer terms the 'Revenge of Nature', an increased power to dominate nature comes home to roost in a comparably increased ability for some humans to dominate others.[281]

An initial sketch of how this line of thinking might motivate a critique of geoengineering could go as follows. Modern societies seek to dominate nature: they seek the power to organise and arrange it to meet human needs. Geoengineering is an example of an activity beholden to this view of nature: it treats the natural world in the exclusively means-to-an-end manner that the Adorno and Horkheimer would say typifies nature-dominating modern societies. There are (at least) three reasons why dominating nature might be undesirable or wrongful: (P3a) because nature is the kind of entity that is wronged by domination (a non-anthropocentric reason), (P3b) because it is harmful to oneself as a dominator, or (P3c) due to a causal relationship between the domination of nature and the domination of persons. The successful establishment of one of these premises leads us to conclude that we ought not engage in practices which further the domination of nature. Therefore, since geoengineering involves dominating nature, this entails that we ought not to geoengineer (That is of course with the proviso that this conclusion could be outweighed by sufficiently strong countervailing considerations). This is sketched below:

P1) The application of instrumental (rather than objective) reasoning to nature results in its domination.
P2) Geoengineering is indicative of an entirely instrumental valuation of nature.
C1) Therefore: Geoengineering dominates nature [from P1 and P2]
P3) It is wrong to dominate nature…
  a) … because doing so wrongs nature itself.
  b) … because doing so is harmful to oneself/unvirtuous.
  c) … because doing so results in the domination of humans.
C2) Therefore, it is wrong to geoengineer [from C1 and P3]
C3) Therefore: we ought not geoengineer (absent strong countervailing reasons) [from C2].

This chapter sets out to analyse the success of this argument. In section two I investigate the argument leading to C1. Section 2.1 gives an account of Adorno and Horkheimer's argument for P1, explaining their understanding of 'instrumental' reason and the role it plays within their philosophical theories. Throughout this chapter I largely assume the plausibility of P1 for the sake of argument. As with other chapters in this thesis, I am more interested in whether a condemnation of geoengineering follows from environmental ethics principles, rather than (initially) critiquing those principles themselves. Section 2.2 goes on to show how these principles (Frankfurt School understandings of dominating nature) have been used to critique geoengineering development, thus

[281] Horkheimer, (1947) *Eclipse of Reason*. pp. 65 – 91.

showing that at least some commentators claim that P2 is true. I argue that P2 is a natural interpretation of geoengineering for someone who accepts P1. Thus, having accepted P1 for the sake of argument, and having shown that P2 is a plausible reading of geoengineering development, then C1 can be accepted.

While Adorno and Horkheimer's theory might characterise geoengineering as 'dominating nature' , knowing that it is characterised in this way does not immediately show us why it will be wrong to geoengineer. In order to know this, we have to know why Adorno and Horkheimer's account of 'dominating nature' entails wrongdoing. In Section 3, I investigate three arguments that purport to show this. I conclude that P3a and P3b both suffer from the same critique that I levelled against Katz in chapter 4: they fail to give a sufficient explanation for why non-conscious nature possesses non-instrumental moral worth. Additionally, I argue that the magnitude of wrongdoing implied by the success of P3b is so slight, while they show C2, they fail to show why this entails C3: that we ought not geoengineer. P3c however does seem to show a more successful path for attributing wrongdoing, by claiming that there is a link between 'dominating nature' and the domination of human beings (whose moral relevance is uncontroversial). I tentatively accept this claim about the wrongness of dominating nature, though I argue (as for P3b) that accepting this conclusion does not necessarily lead to the adoption of C3, since the wrongdoing implied by geoengineering is not qualitatively different from many different non-geoengineering actions which occur in 'modernity'.

2.0 The Role of 'Domination of Nature' in the philosophical project of the Frankfurt School, and its application to geoengineering.

This section aims to explain why Adorno and Horkheimer hold P1, and then, why holding P1 gives reasons for accepting P2. This then establishes that accepting the argument made by Adorno and Horkheimer entails adopting C1 – that geoengineering 'dominates nature'. In 2.1 I give Adorno and Horkheimer's arguments for P1, that the application of instrumental reasoning (at the complete expense of objective reasoning) to nature results in its domination. I do not evaluate this argument here, but accept it for the sake of argument, so as to discuss what it would entails for our ability to support or condemn geoengineering. In 2.2 I then seek to establish why we ought to think accepting P1 leads to P2. I present a number of commentators who make this argument. I argue that the modern development of geoengineering as a method for responding to the challenges of anthropogenic climate change is a phenomenon which would be understood by Adorno and Horkheimer as dominating nature. I conclude in 2.3 that *if* Premise 1 is accepted, then Premise 2 reasonably follows, and therefore we should accept (Premise C1) that, within the characterisation of the Frankfurt School geoengineering would dominate nature.

Before beginning this investigation, it is necessary to give a brief commentary on the texts used in this chapter. This chapter focuses mainly on the argument found in Adorno and Horkheimer's 'Dialectic of the Enlightenment'.[282] Further clarification on the points made in that text are drawn from Horkheimer's companion piece 'The Eclipse of Reason'.[283] These texts make up the key parts in the middle period of the careers of both scholars, the period which has proved highly influential and most relevant to the project undertaken here, containing the important discussion on the 'domination of nature'. While predominantly this chapter is focussed on the arguments found in these works, and from these authors, where appropriate comments from other Frankfurt School scholars, particularly Herbert Marcuse are also used.

[282] Adorno, T., Horkheimer, M., (1944, 1947*) The Dialectic of the Enlightenment*. London, Verso.

[283] Horkheimer, (1947) *Eclipse of Reason.*

2.1 History and Development of the Concept of Nature in Frankfurt School's Thought

This section explores the development of Frankfurt school thinking on 'the domination of nature'. It presents Adorno and Horkheimer's project and introduces their argument for why 'modern' societies dominate nature, through the subsummation of 'objective' reasoning to 'instrumental' as a result of the Enlightenment project. This is in essence the argument Adorno and Horkheimer put forward for P1 in the argument schema. I do not evaluate this argument here, something which would be well beyond the scope of this chapter. Instead, I accept their justifications of P1 for the sake of the argument. Nonetheless, it is still necessary to understand how Adorno and Horkheimer understand the 'domination of nature' so we can evaluate how they would interpret geoengineering (P2) and reach C1. Thus, it is essential that we get a good understanding of the relevant points of their argument here.

2.1.1 Enlightenment and Modern Crisis

The Frankfurt School were a school of Marxist social philosophers, founded in and around the Institute for Social Research at Goethe University during the interwar period, and later in exile, typically in the United States. The work of the school attempted, through the application of 'critical theory' to reveal the historical and ideological content of seemingly immutable social conditions, as well as highlighting their contradictions and points of crisis. Members of the school engaged in what they termed 'immanent critique': a critique of society by holding it up to its most cherished values. The two authors we will look at predominantly here, Theodore Adorno and Max Horkheimer, applied this technique to a study of 'reason' – the central value of 'Enlightenment Societies', and the modern capitalist culture they critiqued in the 1930s and '40s.[284]

The Enlightenment usually refers to a period of scientific and philosophical development around the early and mid-eighteenth century. Following the rise of new scientific practices and discoveries in the 16th and 17th centuries and their success in challenging theologically imbued understandings of the natural world (for instance, the geo-centric model of the solar-system in the Copernican Revolution), the philosophical enquiry of the Enlightenment sought to similarly challenge and disenchant the legitimacy of the late-feudal European regimes by dispelling metaphysical justifications for traditional authority.[285] Throughout its development, enlightenment thinkers held that their project was one of 'Intellectual Progress'. It was their sincere belief that the dissemination of knowledge and the replacement of metaphysics and faith with the application of *reason* would improve society and all individual human lives. It is from this period that we first get the phrase 'domination of nature'. As William Leiss explains in his seminal book on the topic, for the thinkers of the Enlightenment the 'domination…', 'control…' 'mastery…' or 'conquest of nature' was not a pejorative term but meant to signify the final achievement of the enlightenment project.[286] No longer would humans be left at the unpredictable whims of nature for their worldly satisfactions – the promise of new scientific methods for understanding the secrets of the natural world promised an end to famine, poverty, and indeed social ills too. The expansion of scientific thought and rationalistic philosophy during the Enlightenment was thought by its contemporaries as making the 'domination' of nature possible, at last giving humankind the power for a kind of self-determination free from material scarcity and rule by arbitrary 'natural' authority.

[284] A good, recent, introduction to the Frankfurt School's work is provided by Gorden, P.E., Hammer, E., Honneth, A., (2019) *The Routledge Companion to the Frankfurt School*. London, Routledge.
[285] For a broad overview of 'the enlightenment' as a relatively coherent philosophical movement (rather than as a political moment or a historical time-period), see: Bristow, W., (2017) Enlightenment. In: Zatla, E.N., Nodelman, U., (eds) *The Stanford Encyclopaedia of Philosophy*. Fall 2023.
[286] Leiss, W., (1972) *The Domination of Nature*. Montreal, McGill-Queen's.

It is the failure of the Enlightenment project to live up to its aims of liberating humans from their privations that Adorno and Horkheimer investigate through their work. As they write in their introduction to 'Dialectic of the Enlightenment': 'Enlightenment has always aimed at liberating men from fear and establishing their sovereignty. Yet the fully enlightened earth radiates disaster triumphant'.[287] Writing as they were in the mid-nineteen forties, they were not, of course, referring to the looming spectre of climatic change and ecological collapse as their 'disaster triumphant' – but their words seem equally grave reading them today. The question for us to investigate here is: what precisely is it about the nature of 'enlightenment' that leads us to 'disaster triumphant'? Why is it that the Enlightenment project failed to 'liberate men from fear and make them sovereign', and what has any of this to do with nature and how we ought to treat it?

2.1.2 Argument in Dialectic of Enlightenment

The central thesis of the Dialectic of the Enlightenment is that the failure of the enlightenment to achieve its humanist aims is not because those aims were dropped or became corrupted, but because of a paradox central to 'enlightenment' itself. The enlightenment's search for truth in a scientific understanding of nature and human relations, Adorno and Horkheimer argue, inevitably works to subvert and invalidate the humanistic goals it was supposed to achieve – it is contradictory. Horkheimer and Adorno argue that by alienating humans from the natural world, the enlightenment set the conditions for humans themselves to become dominated in the same way that we dominate nature. Let us examine their argument here.

Horkheimer and Adorno create a (pseudo-) historical account of the enlightenment, contrasting it with a premodern 'mythic' period. During mythic (premodern) times people had a 'mimetic' relationship with the non-human world: they saw themselves as an inseparable part of nature and expressed that connection in the rituals, worship, and their use of magic. Conversely, the enlightenment saw a transformation in the way persons saw their relation to external nature. Various strands of enlightenment thinking sought to sever the mythic connections people felt to nature. Just as liberal political thought replaced the natural rights of particular lineages to act as monarchs and rulers; philosophers developed secular ethical systems that cut their reliance on divine codes of conduct and super-natural forces; and the first natural scientists developed a new methodology for studying the external world by establishing a critical 'objective' distance between themselves and their object of study. Nature became 'disenchanted': it lost the value that it was imbued with by pre-modern persons and was conceptually transformed into a purely instrumentally valuable material substance. Any constraints placed on nature's use by its mythic value were now removed: as dis-animated matter the natural world was freely available to be used as humans saw fit and had the skills to manipulate. The task set for the natural sciences was therefore to discover how we might best transform the natural world to satisfy our needs. As Adorno and Horkheimer put it: 'what men want to learn from nature is how to use it in order wholly to dominate it and other men. Nothing else counts.'[288]

For Adorno and Horkheimer, the break between the Enlightenment and Myth involves a change in the way society reasoned. Adorno and Horkheimer distinguish between two forms of reasoning 'instrumental' and 'objective'. Instrumental reasoning is means-to-an-end reasoning, and it concerns questions of how to achieve certain ends. Objective reasoning involves questions over desirability of ends themselves, i.e., what instrumental reasoning should be aimed towards. Objective reasoning is something more akin to the project of Plato in the Republic: the questions it seeks to answer are about the just and good organisation of a world, and how we might best organise society to achieve

[287] Adorno, Horkheimer, (1944, 1947) *The Dialectic of the Enlightenment*. Emphasis added.

[288] Adorno, Horkheimer, (1944, 1947) *The Dialectic of the Enlightenment*. p. 4

flourishing, the ultimate goals of human life. These are questions not only about the means and the route to the end, but also of the specific desirability of the end itself.

Because of the Enlightenment's disenchantment of the world, Adorno and Horkheimer argue that within modernity instrumental reasoning has been promoted completely at the expense of the objective. In its desire to gain power over nature through its demystification, enlightenment thinking stripped the world of any inherent value it was once thought to possess. This is the crux of Adorno and Horkheimer's argument. While the enlightenment sought to gain power over nature in order to liberate humanity, its method of doing so meant that it became unable to deliberate over the desirability of ends. Moreover, Adorno and Horkheimer argue that the same processes which 'demystified' nature and stripped it of inherent value also came to be applied to human beings. Humans too became 'demystified' – a process that Horkheimer termed 'the revenge of nature'. So while the Enlightenment sought to liberate humanity, its final result was the total devaluation and domination of human beings. Instrumental reasoning and the enlightenment that promoted it turns against itself – reason becomes irrational, and what was meant to liberate humanity leads to ever greater domination.

Note here that 'instrumental reasoning' systems do have 'ends', but these ends are argued by Adorno and Horkheimer to be perversely irrational. For Horkheimer, the general end to which instrumental reasoning systems are set is 'self-preservation', i.e., the continued replication of that reasoning system itself.[289] This is apparent in perhaps the instrumental reasoning system sine qua non, capitalist modernity. Within the internal logic of capitalism, returns on investments are sought to be reinvested in turn to generate further capital. Clearly an 'end' is present here (self-preservation via the continued generation of capital). However, for Adorno and Horkheimer, this is still an 'instrumental' reasoning system because there is no mechanism for deliberation over the desirability of the particular end. Horkheimer writes that liberal capitalist societies see individual self-preservation as the end, but stripped of the individual's non-instrumental worth the only way this self-preservation is expressed is in the 'the conservation and multiplication of their own property'.[290] Thus, instrumental rationality does not describe the lack of an end, but rather the lack of ability to deliberate over the value or desirability of an end. Moreover, the subject of critique is not the simple act of deliberating the best means to achieve something, but a world - 'modernity' - where this form of reasoning is pursued totally at the expense of deliberation of the value of ends.

It is also important here to recognise that there are two senses of 'instrumental reasoning' in use, and Adorno and Horkheimer's critique is only applicable to one of these. In the first sense, 'instrumental reasoning' can be used to simply describe the process of choosing a method to achieve a particular end. If I want to achieve a goal, I may pick a number of different methods for getting there, and I use instrumental reason to decide between them. There is, of course, nothing particularly morally troubling about this – in fact it is hard to imagine what a world without such reasoning would even look like. It is of course not this kind of reasoning in and of itself that Adorno and Horkheimer were concerned about. Instead, Adorno and Horkheimer use 'instrumental reasoning' in a second sense, to describe reasoning systems which are unable to deliberate over the value of ends.

So, what precisely is the 'domination of nature' for Adorno and Horkheimer? Partly it is the project that enlightenment knowledge sought – the ability to fully comprehend nature so that it could best serve to liberate humanity. But it is also a feature of enlightenment societies, a state that has been reached once nature became demystified. It can also be thought of as a situation that occurs in

[289] Adorno and Horkheimer argue that this itself is a paradox of the enlightenment: the only end that can survive demystification is self-preservation, and this is presumably because it is 'natural'.
[290] Horkheimer, M., (1933b) Materialism and Morality. In: Horkheimer, M., (1991) Hunter, F.G., Kramer, M., (trans). *Between Philosophy and Social Science: Selected Early Writings*. Massachusetts, MIT Press. p.19.

modernity, when nature has been stripped of any non-instrumental value it has, and where it is treated entirely in instrumental terms – strictly as a means to an end and never as an end-in-itself. Instrumental rationality in a demystified world, it should be stated, *requires* the domination of nature – as nature becomes purely an instrument for human self-preservation, it can never be an end-in-itself. Nature's entire value is a use-value for the satisfaction of the only remaining end of self-preservation and is thus 'dominated' to the extent that it can be used without restriction for that purpose.

P1 of the argument structure states that: 'The application of instrumental (rather than objective) reasoning to nature results in its domination'. In this section I have presented the arguments given by Adorno and Horkheimer which support this claim: that is because the purely instrumental treatment of nature fails to consider it as an end in itself.[291] This section has not attempted to evaluate the success of their argument, instead, I have simply attempted to show why they think this, in order to later establish what follows from accepting this view. I also have not examined why this purported domination entails 'wrongdoing'. This will be done in Section 3. However, first I will turn to demonstrating how the line of thinking outlined by Adorno and Horkheimer could be mobilised to critique modern geoengineering development.

2.2 Application to Geoengineering

In the previous section I argued that, for Adorno and Horkheimer, the domination of nature is a phenomenon which occurs because nature is subjected entirely to instrumentalist reasoning. Establishing C1 of the argument, that geoengineering dominates nature, therefore requires the establishment of Premise 2: that geoengineering applies this kind of instrumentalist reasoning to nature. Establishing Premise 2 is therefore the purpose of this subsection.

A major evidentiary factor in attributing the guidance of instrumental reason to geoengineering is geoengineering's close association with the needs of capitalism. Adorno and Horkheimer's subject of critique is very particularly *capitalist* modernity. For Adorno and Horkheimer, the reasoning system employed by capitalism is totally instrumentalist. Capitalism's internal reasoning structure is unable to countenance any other goal than the maximal production of profit (which in turn is the self-preservation of the system). For Adorno and Horkheimer, capitalist reasoning is a prime example of instrumentalist reasoning. A tremendous amount of rational calculation is put in to determining the most profitable organisation of a demythologised nature, but capitalism has no systematic way of attending to any goal other than self-preservation through the accumulation of further capital. It cannot make any determinations on whether the world that generates the most profit is actually a desirable world that meets human needs. This is the point on which the entirety of the Dialectic of the Enlightenment turns: the pursuit of power over nature through demystification of its inherent value in turn renders us powerless to make decisions based on the treatment of humans or nature as ends in themselves. Establishing Premise 2 of our argument then can be done by showing the ways in which the reasoning driving geoengineering development is beholden to this kind of specifically capitalist instrumental reasoning.

Attributing causal responsibility for modern geoengineering development to specifically capitalist imperatives or attempts to secure the continued existence of 'business-as-usual' politics is nothing new.[292] This section considers the claims of scholars who have specifically applied Frankfurt School inspired analysis (critical theory) to explain geoengineering. A major contributor in this area is Ryan

[291] Though note that what precisely treating nature in this way entails has not been explored.

[292] See for instance: Surprise, K., (2020) Gramsci in the Stratosphere: Solar Geoengineering and Capitalist Hegemony. In: Malm, A., Sapinski, J.P., Buck, H.J., (eds) *Has it Come to This? The Promises and Perils of Geoengineering on the Brink*. USA, Rutgers University Press.

Gunderson, along with his co-authors Diana Stuart and Brian Peterson.[293] Over a course of several papers, these authors examine the ideological assumptions of geoengineering, drawing particularly from the work of Frankfurt School author Herbert Marcuse. They argue that an investigation of the argumentative case for geoengineering reveals that it is often based on two aspects of instrumental rationality: the economic and the technical.[294] The 'economic' rationality in this instance is of course capitalist rationality – i.e., the course of action which is maximally profitable. Indeed, many proponents of geoengineering openly praise it as the economically rational[295] option compared to the alternative of rapid emissions mitigation. This is evident from relatively early on in the history of geoengineering. David Keith for instance is well known for his comments on Solar Radiation Management, and its potential as a 'cheap tool that can green the world.'[296] Paul Crutzen touted Solar Aerosol Injections as being 100 times cheaper than reducing emissions.[297] The point that Gunderson et al make here is that quotes like these show us that proponents of geoengineering argue for its implementation based on a line of reasoning ('cheapness') that is in line with the instrumental reasoning of capitalism.

The second form of instrumental rationality that Gunderson et al draw upon is what Marcuse termed 'technological rationality'. Technological rationality for Marcuse refers to the role that technology plays in furthering the domination of nature and of persons. Marcuse argued that technologies tend to be value-laden expressions of the societies which produced them, thus in modernity, technologies tend to reflect a purely instrumental rationality too. Famously he argued that the most notable way this is expressed is the failure of new technologies to live up to the Enlightenment promise to liberate humanity from toiling (something which would have been an objectively reasonable goal), but instead generate new forms of labouring instead. As Gunderson et al put it, there are two main reasons why Marcuse was critical of technological rationality: (1) technology primarily serves and is shaped by dominant interests which may be irrational, and (2) technological rationality demotes or masks social alternatives.[298]

Moreover, they argue, geoengineering and the discourse surrounding it seems to demonstrate both of these features. The first is evident in the way in which technological rationality depicts nature as utterly demystified material, or as Marcuse puts it: 'raw material for the expanding and exploiting administration of men and things'. This way of understanding the world finds its way into the arguments of geoengineering proponents, for instance in depictions of the Earth and geoengineering's effect on it as being mechanistic. Nerlich and Jespal find that various metaphors used by geoengineering experts tend to depict the Earth as a machine needing to be fixed.[299] On this point Gunderson et al also quote David Keith, who writes 'we may use these powers [of climate modification] for good or ill, but it is hard not to delight in such tools.'[300] The implication here is that,

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[293] See for instance: Gunderson, R, Peterson, B, Stuart, D., (2018) A Critical Examination of Geoengineering: Economic and Technological Rationality in Social Context. *Sustainability*. Vol. 10. Is. 269. pp. 1-29.
Gunderson, R., Stuart, D., Petersen, B., (2019) The Political Economy of Geoengineering as Plan B: Technological Rationality, Moral Hazard, and New Technology. *New Political Economy*. Vol. 24. Is. 5. pp. 696-715.
Gunderson, R., (2016) Environmental Sociology and the Frankfurt School 2: Ideology, Techno-Science, Reconciliation. *Environmental Sociology*. Vol. 2. Is. 1. pp. 64–76.

[294] Gunderson, Peterson, Stuart, (2018) A Critical Examination of Geoengineering. pp. 1-29.

[295] Note paid here of course to the social construction of what gets to count as 'economically rational'.

[296] Keith, D., (2013) *A Case for Climate Engineering*. Boston, MIT Press. p. x.

[297] Crutzen, P.J., (2006) Albedo Enhancement by Stratospheric Sulfer Injections: A Contribution to Resolve a Policy Dilemma? *Climactic Change*. Vol. 77. pp. 211– 219.

[298] Gunderson, Stuart, Petersen, (2019) The Political Economy of Geoengineering as Plan B. p. 699.

[299] Nerlich, Jaspal, (2012) Metaphors We Die By? pp. 131-147.

[300] Keith, (2013) A *Case for Climate Engineering*. pp. 173-174.

as Marcuse himself notes, the production of new technology becomes an end in itself, often crowding out non-technical alternatives.

On the second point, geoengineering as a climate strategy seems almost designed to 'mask social alternatives'. Geoengineering offers a way of handling climate change without needing to resort to the behavioural changes needed for emissions mitigation. If temperature can be controlled through SRM and any emissions re-captured by CDR, then we don't need to change our patterns of consumption, reduce consumption or, crucially, question the economic system of consumption driven growth. For this reason, Gunderson et al conclude that the justificatory discourse around geoengineering development is what the Frankfurt School would predict a technology guided by instrumental reasoning would look like.

Another contribution comes from Marxist environmental-historian Andreas Malm. He offers a critique of liberal and left-wing advocates of solar radiation management. In a section of this essay following a description of the technicalities of stratospheric aerosol injection, he summarises thus:

> We might pause briefly and reflect on what is going on here. Scientists steeped in the instrumental rationality of bourgeois civilization are seriously discussing whether to use guns and diamonds to offset the effluvium from a process of capital accumulation they (and many others) cannot imagine being brought under control.[301]

Here, Malm clearly claims that instrumental rationality is driving geoengineering development. For Malm, what we could term the 'objectively reasonable' answer (reducing emissions so that solar radiation management is not needed) is not considered as a reasonable answer since it does not serve the end of capital accumulation. Instead, almost fanciful and likely dangerous solutions are promoted in its place. Note that 'objectively reasonable' here is used not as 'able to deliberate over the desirability of ends', but as the type of end that would be pursued had the promise of the Enlightenment (i.e., liberating people, seeing them as fully valuable ends-in-themselves) been realised. Such a society, Malm suggests, would not countenance a strategy of dimming the sun's rays with a cocktail of toxic chemicals[302] to handle climate change – it would instead be free to question the system of 'capitalist accumulation' that led to climate change to begin with. Instead, 'bourgeois civilisation' is unable to deliberate over any end other than self-preservation, even where that means relying on 'guns and diamonds' to preserve itself rather than question the ability to accumulate and profit-make indefinitely.

As seen in Chapter Two (S3.2), Dane Scott also makes an argument much like this in a short article entitled 'Geoengineering and Environmental Ethics'.[303] He argues, following Drengson, that geoengineering is a 'technological fix' for climate change, developed within an 'instrumentalist worldview' that is predisposed to only ever seek technological solutions to its problems, each further 'successful' fix generating new problems further down the line that seem to necessitate further technological fixes.[304] To this end, Drengson argues that humans must abandon their belief in themselves as 'Masters and controllers of nature'. Scott, applying this line of thinking to geoengineering, argues that:

> This [geoengineering] technological fix for climate change would reinforce the destructive tendencies of a misguided worldview… Since geoengineering is a technological fix for energy technologies, what will be the technological fix for geoengineering, and so on? Where does

[301] Malm, A., (2023) The Future is Termination Shock. *Historical Materialism*. Vol. 40. Is. 4. pp. 3-53. The 'guns and diamonds' refers to a proposal to use large cannons to deliver sun-shading particles to the upper atmosphere, and to one proposed material for the particles themselves.

[302] Sulphur dioxide is a more likely substance than diamonds to be sure, something not lost on Malm.

[303] Scott, (2012) Geoengineering and Environmental Ethics. p. 10.

[304] Drengson, A., (1984) The Sacred and the Limits of the Technological Fix. *Zygon*. Vol. 19. Is. 3. pp. 259-275.

> it stop? …it [is] imperative to get at the root of the problem, which is moral and political, not scientific and technical.

Scott's critique of geoengineering is clearly inspired by Frankfurt School thinking. The instrumental character of technological rationality is used to explain why geoengineering is pursued as a solution to climate change over the alternatives. Real solutions can only be achieved once a 'misguided' worldview (i.e., instrumental rationality) is abandoned in favour of a new one.

This section has shown that amongst commentators who accept P1, there is a broad acceptance on P2. Many commentators appear to defend P2 based from an Adorno/Horkheimer inspired world view. While I later go on to evaluate P2 in more detail (Section 4), acknowledging that there is such support in favour of P2 shows that it can be interpreted as a reasonable response to accepting P1.

2.3 Conclusions: Geoengineering 'Dominates Nature'

This section has investigated how an argument for C1 – geoengineering dominates nature - can be formulated by drawing on the work of the Frankfurt School. I have presented Adorno and Horkheimer's view that the application of instrumental (rather than objective) reasoning to nature results in its domination (P1) – an account that I accept for the sake of argument. Adorno and Horkheimer argue that nature becomes dominated when it is treated entirely instrumentally - something which occurs once it has been demystified. Moreover, I have shown how many commentators draw on reasoning inspired by the Frankfurt School to present arguments in favour of P2: geoengineering development involves this kind of application of instrumental reason. Accepting P1 for the sake of argument, and showing that P2 follows once we understand the domination of nature in the way that P1 suggests, allows us to accept C1 – that according to Adorno and Horkheimer's theory, geoengineering will dominate nature.

3.0 What is 'Wrong' with Dominating Nature?

In the previous section we established how Adorno and Horkheimer's theory can be used as a basis for a claim that geoengineering 'dominates nature'. But an important question remains: does this mean it is 'wrong' to geoengineer, or that we ought to not geoengineer? More specifically, this is a question about why 'domination', in the way that Adorno and Horkheimer conceive of it, implies wrongdoing. As we have seen in the previous chapter on Eric Katz, the move to extend the concept of 'domination' beyond its traditional use in inter-personal (human) ethics runs the risk of divorcing 'domination' of its normative content. I agree with Pettit that 'domination' necessarily implies wrongdoing – it is 'a complaint'.[305] However, as Stone also notes, Adorno and Horkheimer are reluctant to explain why 'dominating' nature is wrong beyond analogy with human domination.[306] If we want to develop a robust basis for an environmentalist claim that we ought not geoengineer because of a risk of (furthering) the domination of nature, we need to show that the new sense of domination has the same moral charge as the traditional one: i.e., that it implies wrongdoing.

[305] Pettit, (2005) The Domination Complaint. pp. 87–117.

[306] Stone, A., (2006) Adorno and the Disenchantment of Nature. *Philosophy and Social Criticism*. Vol. 32. Is. 2. pp. 231-253.

I investigate three potential routes for identifying the wrongdoing in dominating nature. Premise 3 suggests three plausible reasons which might explain why 'dominating' nature would be wrong. These are:

> P3a Because nature itself is wronged when it is dominated.
>
> P3b Because doing so is harmful to oneself/unvirtuous.
>
> P3c Because dominating nature results in the domination of [human] persons.

I conclude that only P3c gives us a plausible account of the wrongdoing of dominating nature, as both P3a and P3b implicitly require an explanation for why the nonhuman (including nonconscious nature) is wronged when we dominate it, and this explanation does not appear to be forthcoming. Conversely, P3c can avoid this by drawing a link between domination of nature and the domination of uncontroversial morally considerable entities: namely, human beings. This is significant, as it shows that unlike the other theories that I have analysed in this thesis Adorno and Horkheimer are able to give us reasons to think that geoengineering is wrong, assuming we accept C1. These are, admittedly, anthropocentric reasons – the nonanthropocentric arguments for the wrongness of dominating nature seem to be subject to similar criticisms to those I have deployed in chapters 3 and 4. Thus we might still think that this explanation still fails if our aim is to discover non-anthropocentric explanations for why geoengineering would be wrong.[307] Nonetheless, while conceding that this argument succeeds at identifying why geoengineering involves wrongdoing (C2), I argue that the magnitude of wrongdoing it implies is insufficient to justify C3.

3.1 Is Nature Wronged When it is Dominated?

3.1.1 Adorno and Horkheimer as Non-Anthropocentric Theorists

The first view I assess here is that domination of nature is a non-anthropocentric wrong – entailing a wrong directed at nature itself. This is an atypical reading of Adorno and Horkheimer (and other members of the Frankfurt School), defended occasionally by ecological readings of the Frankfurt School corpus; notably by Cook, Stone, and Denham.[308] This makes this explanation worthy of consideration, even if it is contentious whether Adorno and Horkheimer intended it themselves.[309]

Alison Stone provides an account of how Adorno might have understood domination of nature and the wrongdoing implied thereby. It is worth quoting Stone at length here to highlight how she interprets Adorno and Horkheimer as having a view similar to that of Katz, whose argument we examined in Chapter 4. Stone writes:

> to dominate a being, for the Frankfurt School generally, is to 'prescribe' to it 'goals and purposes and means of striving for and attaining them' which differ from those that the being would spontaneously adopt… Living natural beings, then, are dominated when they are forced out of the courses of development and behaviour which they would

[307] After all, there are many conventional anthropocentric arguments to be made against geoengineering!

[308] See: Stone, (2006) Adorno and the Disenchantment of Nature. pp. 231-253.; Cook, D., (2011) *Adorno and Nature*. London, Routledge. ; Denham, H., (1997) The Cunning of Unreason and Nature's Revolt: Max Horkheimer and William Leiss on the Domination of Nature. *Environment and History*. Vol. 3. Is. 2. pp. 149–175. William Leiss is a notable detractor from this view. See Leiss, (1972) *The Domination of Nature*.

[309] We should note the influence that the Frankfurt School had on the development of 'mature' environmental ethics: particularly on ecofeminist thought and the 'social ecology' of Murray Bookchin and others. Note, however, that despite their influence on his thought, Bookchin strongly denounced reading Adorno and Horkheimer as ecological thinkers. See: Bookchin, M., (1986) Freedom and Necessity in Nature. In: Bookchin, M., (1996) *The Philosophy of Social Ecology*. Montréal, Black Rose Books.

> spontaneously pursue. Calling this 'domination', not merely 'control', implies that it is undesirable; this, for Adorno, is because living beings suffer (*leiden*) from having their spontaneous tendencies thwarted.

And:

> … Since this bodily suffering 'ought not to be' when it occurs in human beings, the same suffering ought not to arise in non-human living beings, and any practice – such as disenchantment – which causes or exacerbates such suffering deserves criticism. Even non-living natural things suffer in an extended sense from our transforming them; moreover, this transformation of non-living things is also objectionable because it can only occur as part of the broader project of [domination of nature] and is therefore inseparable from the suffering of living nature.[310]

The similarities to the argument made by Katz should make us immediately sceptical of the success of this argument. In Chapter 4 I gave several reasons why we should doubt that constraining nature's autonomy (to the extent it even makes sense to consider nature 'autonomous') wrongs it. In fact, the argument presented in Chapter 4 is more applicable in the case of Adorno's understanding of dominating nature, because like Katz, he does not limit his account of 'dominatable' nature only to living things. As Stone goes on to explain, while Adorno is principally concerned by the domination of living nature, he often speaks of the domination of nature as such, including, by implication, the domination of non-living natural things. But assuming non-living things cannot suffer, how can they be dominated? According to Stone, Adorno believes that transforming non-living things out of their original forms (e.g., when stone is made into a pillar) approximates to the activity of controlling living beings, and, correspondingly, that when we transform non-living things we inflict upon them a condition which approximates to that of suffering in living beings, and which may therefore also be called 'suffering'.[311]

The Domination of Nature involves domination in so far as the transformation of nature is analogous to constraining its autonomy.[312] The Kantian influences on Adorno are apparent too. It is out of respect for their autonomy that we treat human persons as ends-in-themselves. A similar story appears to be told here – instrumentalist reasoning treats nature only ever as a means to some (human determined) end, rather than as an end in itself, which would require us to be considerate of nature's own autonomy. The endgame for Adorno and Horkheimer then might be that a shift to an objectively reasoning society will be a shift to a society which is able to take nature's autonomy, and suffering, into account.

3.1.2 Is Nature itself Wronged by Domination?

Practically I think we have at least two good reasons to reject this line of argument. Primarily, I disagree that non-living beings 'suffer' in any kind of sense when they have their 'spontaneous development… thwarted'. In particular 'suffering' seems to entail an affective state that it is prima facie implausible to claim that non-conscious nature can possess. If we read Adorno and Horkheimer as literally suggesting that dominating nature is wrong because it causes nature to 'suffer', then it is self-evident why this argument cannot work. While it is certainly true that certain aspects of nature can suffer, e.g., nonhuman animals, it is clear that Adorno and Horkheimer do not limit their conception of nature to these entities. Their conception of nature is much broader than this and is clearly intended to encompass entities which have no affective capacities of any kind. Thus, we must

[310] Stone, (2006) Adorno and the Disenchantment of Nature. pp. 236-237.

[311] Stone, (2006) Adorno and the Disenchantment of Nature. pp. 236-237.

[312] i.e., as in Katz, 'spontaneous development' being nature's autonomy.

reject this line of argument if the explanation for the wrong of domination depends on the claim that it literally causes nature to 'suffer'.

If it is not literal suffering that occurs, then we need to be presented an argument for why 'suffering' is an apt analogy for what occurs when we thwart nature's 'spontaneous tendencies'. However, it's not clear what this analogous state could be. The ability to 'suffer' is a plausible mechanism for grounding the moral relevance of an entities interests because suffering is an inherently bad experience – if it was not bad it would not be suffering. This is recognised by Adorno in the quote from Stone above – 'it ought not to be'. As I have argued throughout the thesis, while might generously read a non-conscious entity as having interests (e.g., the interests of a geranium to be moved into the sunlight, or of a bicycle in being regularly oiled), simple possession of 'interests' does not on its own show why those interests are morally relevant. The job 'suffering' does is linking the fulfilment of interests to an inherently bad experience.

In order to show that 'suffering' is an apt analogy for whatever Adorno and Horkheimer posit dominating nature causes, they must show that it too is an inherently bad experience. The major challenge for doing this is that many of the entities Adorno and Horkheimer think are 'nature' and can be dominated lack the capability for affective states. It is simply not evident what this could be. Unless a plausible argument can be made for an inherently bad, non-affective state, that follows from 'dominating nature', we must reject P3a as a means for showing why dominating nature is wrong.

3.2 Is it Unvirtuous to be a Dominator?

3.2.1 Explanation

P3b identifies a second route to identifying 'wrongness' in dominating nature. This is that it is simply of poor moral character, perhaps unvirtuous, 'wasteful', 'tasteless'[313], or 'unappreciative'. This might also align with attempts to characterise geoengineering as 'hubristic'.[314] This account implies that are two instances of wrongdoing which occur when we dominate of nature. In the first instance there are harms done to others: the misery and suffering caused by domination of either just humans or humans and nature itself (as in P3a and P3c). However, there is additionally a second kind of harm that occurs, that is, a self-directed harm that we do to ourselves when we act wrongly or with poor moral character. This is potentially a of failing to fulfil an inherent human potential.

One way to think about this might come from the work of Stephen Gardiner. In one of the first papers on the ethics of geoengineering, Gardiner argues that geoengineering is a kind of 'Marring Evil'.[315] Gardiner, following noted virtue ethicist Rosalind Hursthouse, argues that there are some situations which agents find themselves in which have no morally acceptable outcome: i.e. even a perfectly virtuous agent, acting well, cannot do right.[316] The agent who faces the choice is, so to speak, 'damned if they do and damned if they don't'. In these situations where there is no 'correct' outcome to the moral dilemma, the agent who faces the dilemma is expunged from having made

[313] What I'm trying to capture with 'tasteless' is that treating nature as nothing more than a storehouse of commodities-to-be shows a lack of acknowledgement of the beauty or wonder that experiencing nature perhaps ought to provoke.
[314]Meyer, K., Uhle, C., (2015) Geoengineering and the Accusation of Hubris. *THEYs Discussion Paper*. No. 2015 p.3.

[315] Gardiner, S.M., (2009) Is Arming the Future With Geoengineering Really the Lesser Evils? In: Gardiner, S.M., Caney, S., Jamieson, D., Shue, H., (eds) (2010) *Climate Ethics*. Oxford, Oxford University Press.
[316] Hursthouse, R., (2001*) On Virtue Ethics*. Oxford, Oxford University Press.
Meyer, Uhle, (2015) Geoengineering and the Accusation of Hubris. p.3.

the 'wrong' choice, but they might nonetheless be 'marred' by their decision.[317] For Gardiner, geoengineering in the context of dangerous climate change might be one of these 'marring evils'. Gardiner writes that '[it] will be a sad and shameful day in the life of humanity when such a decision [to geoengineer] is made, that (if the choice is 'forced' as a lesser evil) such a decision mars the lives of those who make it, that it blights those who bring about the nightmare situation, and perhaps even that it tarnishes humanity'. [318] This is not quite the same as our argument – Gardiner and Hursthouse suggest that no wrongdoing occurs in situations where there are no good options even a well-intentioned agent could take. But the idea that there are implications for ending up in these situations (marring evils) does seem to suggest, like P3b suggests, a cost to doing wrong.

Part of this claim might seem to be reasonably morally intuitive. The idea that we ought to act morally because it is good for ourselves in some way when we do has a long and prestigious pedigree within ethical thought, particularly within Plato and Aristotle and later amongst virtue ethicists. The basis of this argument is that there is a kind of desirable good/ends, generally thought of in terms of *eudaimonia* (flourishing), that is only achievable by living a moral life. The natural corollary of this line of thinking is that, in addition to the wrongs that they do to others, wrongdoers wrong themselves when they do wrong. When you do wrong you fail yourself by failing to live up to your own internal demand to be a virtuous individual; you set yourself back on course to achieving some *eudaimonic* good.[319] Putting this in terms of domination, what this view requires us to believe is that part of wrong done by domination is that the dominator wrongs themselves by failing to live up to their duty to be a virtuous person. In typical i.e., between two human-person cases, they of course wrong their victim too, most likely in ways far worse than they wrong themselves. But the point remains that you wrong yourself when you make yourself into a dominator.

For Adorno and Horkheimer this might cash-out into a condemnation of 'dominating nature' like this: Society governed entirely by instrumental reasoning dominates nature by seeing it only in terms of its exchange value, rather than as an end-in-itself. It would be better for all of us if we lived within a system that allowed us to appreciate nature for what it *really* is, i.e. something that's imbued with aesthetic value or some other kind of moral worth beyond its exchange value.[320] However, the cruel logic of the system denies this to us: anyone out there considering nature in its fullest form will be driven out of business by those who are prepared to be more ruthless.[321] Those sympathetic to the beauty of a forest or ocean won't be able to keep the same bottom line as those who view them only as lumber or an effluent dump. If you think a) taking this attitude to nature is unvirtuous, and b) when we perform unvirtuous actions, we harm ourselves, then it seems that modernity is a kind of collective action problem that requires us to harm ourselves continually by creating a system that where acting wrongfully is inevitable. As Gardiner puts it, there are no good choices to be made, and we are continually being 'marred' through the dominating relation we are placed in over nature.

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[317] The ultimate progenitor of this kind of view might be Aristotle: in his discussions of Priam of Troy he argues that while Priam acted virtuously, he failed to live a flourishing life. Aristotle, Crisp, (2000) *Nichomachean Ethics*. 1100a5.

[318] Gardiner, (2009) Is 'Arming the Future' with Geoengineering Really the Lesser Evil? p. 21.

[319] I.e., the kind of goodness associated with living a *flourishing* life, in accordance with the virtues: in this case, a particular virtue of eco-sensitivity perhaps. We do not necessarily need a complicated account of the relationship between virtue and flourishing here. It is enough for us that it is plausible that a life lived in accordance with at least one specific virtue benefits the possessor of said virtue. This is not necessarily a physical benefit (wealth, success, happiness) but a benefit as a steppingstone towards a flourishing life.

[320] This does not rely on there really being some intrinsic moral worth to nature. This could also follow from Norton-esque weak anthropocentric principles i.e., it is virtuous to act *as if* nature possessed this intrinsic value regardless of whether or not it really does. See: Norton, B.G., (1984) Environmental Ethics and Weak Anthropocentrism. *Environmental Ethics*. Vol. 6. Is. 2. pp. 131 - 148.

[321] That capitalism wrongs the dominant class too has a strong, if somewhat contentious, pedigree in Marxist scholarship. For a recent treatment of this argument, see Mau, S., (2023) *Mute Compulsion*. London, Verso.

3.2.2 The Weight of Self-Directed Harms

Suppose for the sake of argument that we are convinced by the account of wrongdoing above. The question remains however whether we think the gravity of this self-directed wrongdoing is so significant that it would prohibit us from geoengineering. Returning to our argument schema, this is not necessarily a rejection of P3b, but a question other whether C3 (we should not geoengineer) can follow from P3b and C1.

One important thing to consider might be the relative directions of the wrongdoing in either case. This argument suggests that the (or one of the) harms of geoengineering is a harm done to oneself by becoming a dominator (of nature). Conversely, not alleviating the harms of climate change is a, potentially very serious, harm directed at others. Suppose that geoengineering is necessary to prevent, or is the best method to alleviate, the harms of climate change. If we choose to do it, we further the domination of nature, and in doing so, wrong ourselves. However, we also prevent significant harm being done to others – famine, displacement, exposure to extreme heat, habitat destruction etc. It seems likely that, no matter what weight you place on that self-directed harm, there are going to be plausible circumstances where the harm that geoengineering could prevent are going to outweigh it.

In assessing the potential weight of the self-directed wrong, we also need to consider the context it occurs in. For those who accept P1 (which is necessary for P3b to follow), the domination of nature is ongoing condition within modern society. Within this context, we have to assume that there is constant wronging occurring. Geoengineering does not appear to be any novel example of how nature is dominated, and thus there is no reason to think that geoengineering would incur any special wrong if we chose to perform it (at the very least, no argument has been shown to suggest that geoengineering is a special kind of wrong). What we should infer from this is that at worst geoengineering represents an additional to what is no doubt an already substantial history of wrongdoing. It may not represent a particularly significant *change* in how much wrong has been inflicted.

If we accept that there are self-directed harms that result from dominating nature, I argue that these are unlikely to be sufficient to ground a prohibition on geoengineering, all else being equal. If geoengineering is able to alleviate the very direct harms of climate change (displacement, heat, exposure to extreme weather, habitat loss, food system disruption etc.), then the imperative to perform it is certainly more powerful than any desire to avoid 'marring' harms done to ourselves. This is of course in line with Gardiner's original positions concerning 'marring evils'. Marring evils mar us despite the fact that they were the best course of action within an altogether morally tragic context. For Gardiner, geoengineering is such an evil: something that would be wrong to do but is nonetheless still the lesser evil to failing to use geoengineering in circumstances where it can prevent still greater harm. This is in turn ultimately similar to Preston, who always thought the presumptive argument was 'defeasible' by the lesser-evil argument. The tragedy, for Gardiner, is the fact that the situation was ever allowed to get so desperate that geoengineering has become the lesser evil. But given that we may soon be (by Gardiner's assessment) in that situation, then it is clear that the harm of acting unvirtuously when we geoengineer is insufficient to outweigh the potential benefits a well-managed geoengineering program could potentially bring. Thus, allowing temporarily that P3b is an accurate account of ethical costs of geoengineering, this would still not lead us to the conclusion (C3) that we must prohibit geoengineering.

3.2.3 (Im)Plausibility of Self-Directed Harms

Part of the appeal of P3b is that it could show the existence of a wrong done to an uncontroversially morally relevant entity follows from dominating nature. Even if, as I have argued in 3.1, nature itself cannot be directly wronged by the domination of nature, P3b seems to show that there is a

wrongdoing done to ourselves when we place ourselves in the position of dominator over nature. So far, I have not questioned whether these additional secondary self-harms exist, but in this section I will do so. I have argued that even if P3b was plausible it would not entail that we should not geoengineer, because the magnitude of wrongdoing it implies is lower than the potential benefits geoengineering might bring. However, in this section, I argue that a non-anthropocentric version of P3b is implausible. P3b depends upon an argument like so:

1. When you commit a wrong, you also wrong yourself.
2. You commit a wrong by dominating nature.
3. Therefore, you wrong yourself by dominating nature.

It at least seems plausible that (1) a kind of self-wrongdoing occurs when humans dominate other humans, but what is up for debate is whether (2) such a wrong occurs where it is only non-conscious nature that is the subject of 'domination'.[322] In this subsection I argue that while there may be kind of harm a dominator inflicts upon themselves, that self-wrong is reliant on the primary wrong of wronging another morally considerable subject (via domination or otherwise) which is not possible in cases of 'dominating' non-living nature.

The claim that we wrong ourselves when we dominate nature follows from a general argument that wrongdoers wrong themselves when they wrong. I concede that this general argument has some plausibility to it. If I rob my neighbour, it's clear that I have done them wrong, but it also seems plausible that I've made my own life worse (even if I never face the consequences of my actions – I'm never, for instance, punished). I have wronged myself by failing to live up to what was expected of myself. Perhaps I have impeded my own ability to achieve some kind of good that would only be achievable by living a morally outstanding life. We do not need to go into a detailed defence of this point here. We can therefore accept for the sake of argument (1).

My argument is that *even if* you think a self-directed wrong occurs when you wrong others, we cannot conclude (3) that this wrong occurs when we dominate nature, unless (2) dominating nature entails wrongdoing. In other words, the presence of a self-directed wrong in cases of wrongdoing is entirely dependent on you doing something wrong in the first place! The reason why we might think I've wronged myself when I stole from my neighbour, is because stealing from my neighbour is wrong. My neighbour is a morally relevant entity, who can be wronged, notably by being a victim of theft. But if instead of my (human) neighbour, the 'victim' of my wrongdoing was some part of nonconscious nature, which as I have argued in S3.1 cannot be directly wronged, then it follows that there cannot be any self-directed wrongdoing. If I have not done any wrong by dominating nature, I have not wronged myself through dominating it either.

Now, certainly we might think I can do wrong when I 'wrong' nonconscious nature. For instance, if I poison a local river, there are going to be all manner of harms done to morally relevant entities. I will harm many non-human inhabitants of the river for starters, and I might indirectly harm those to whom the river was instrumentally valuable too. For those instances of wrongdoing there might well be an attendant self-directed wrong. This I do not dispute. But the appeal of this argument was that it, like P3a, would be able to show why even harmless actions that nonetheless 'dominated nature' would be wrong. Being able to show that this kind of wrongdoing applies where the only 'victim' of domination is non-conscious nature would require a robust proof that non-conscious nature really is

[322] We should note that if P3c succeeds in showing the domination of nature wrongs human persons, then a version of P3b (which I term the anthropocentric version) necessarily follows too (if you accept that doing wrong wrongs yourself). However, this version of the argument is of much less interest to us, as anthropocentric version of the argument already invokes a wrong directed at an uncontroversially morally relevant entity (human persons). It does not require the self-directed impact to show why dominating nature would be wrong.

the kind of entity which can be the legitimate claimant of an obligation not to be dominated. This proof, as I have argued in section 3.1 and the previous chapter, does not seem to be forthcoming. So in the absence of a compelling argument for (2), we cannot conclude (3) that we wrong ourselves by dominating nature.

3.2.4 P3b Conclusions

I have argued that any secondary self-wrongdoing that is associated with being a dominator is necessarily reliant on there being an actual primary wrongdoing accompanying it. In the case of dominating (non-conscious) nature, it simply is not obvious why this is wrong. Therefore, unless a robust argument is forthcoming to show why persons have obligations which are owed directly to non-conscious nature, it is implausible that there is a secondary self-directed wrong that comes from 'dominating' it.

Moreover, I have argued that even if such a proof could be found, it isn't clear that this self-wronging is sufficiently significant to ground a prohibition against geoengineering. For instance, in circumstances where there would be significant harms to others associated with not geoengineering, it's unlikely that a self-inflicted harm could outweigh the imperative to prevent harms to others. This account seems to align with Gardiner's argument on the 'marring evil' of geoengineer. Gardiner's argument does not purport to show that such 'marring evils' are reason alone not to geoengineer. Rather, his paper argues against developing geoengineering technologies, lest we enter a scenario where they are the only option left available - thus marring us if we use them. Again, we can see the parallels between Gardiner and Adorno and Horkheimer here - geoengineering is wrong, but this is mostly as an act done within a context of wrongdoing. Geoengineering could never have gotten on the table if it were not for a series of (objectively) irrational yet instrumentally reasonable actions that lead to 'objectively reasonable' options being ignored.[323] Nonetheless, the implication of Gardiner's argument is that whatever the weight afforded to the harm of continuing the domination of nature via geoengineering is, is not sufficient on its own to prevent its use in scenarios where geoengineering is the best or only remaining option to prevent harms of unabated climate change. What can be concluded from the argument I have presented is that even if we accept that geoengineering would be unvirtuous, cause us to wrong ourselves, or even be a 'marring evil', this does not on its own should that we ought not do it. C3 states that we ought not to geoengineering, *absent strong countervailing considerations.* In the case of the comparably minor self-wronging of dominating nature, and the potentially great minimising of harm that geoengineering could offer, there are evidently strong countervailing considerations here.

3.3 Does Dominating Nature Result in Dominating Persons?

3.3.1 Explanation

In this subsection I consider the major thesis put forward by Horkheimer and Adorno in the Dialectic of the Enlightenment. This is that the Enlightenment demystification of nature laid the foundation for the demystification and subsequent domination of persons too. Accepting this line of argument, could identify a plausible reason for thinking that geoengineering is wrong. If geoengineering continues the domination of nature, then it helps facilitate the domination of persons too. Since people ought not be dominated, humanity ought not dominate nature, and therefore ought not geoengineer.

As I have shown, in the Dialectic of the Enlightenment Adorno and Horkheimer argue that the Enlightenment ushered in a changed way of valuing nature. The same process, the dominance of

[323] Gardiner makes this point himself too. See: Gardiner, S.M., (2009) Is Arming the Future with Geoengineering Really the Lesser Evils? p.19, footnote 100.

instrumental reasoning, which transformed nature into mere matter, worked on the valuation of humans too. Enlightenment 'disenchants' nature – ascribing it no supernatural or metaphysical-value greater than the subjective value that it potentially holds for satisfying human interests. However, as humans too are natural, their interests too must require disenchantment. While the promise of enlightenment was to employ its methods in service of humanistic aims, these humanistic aims themselves cannot survive the process of disenchantment. Enlightenment's 'instrumental' form of reasoning, by refusing to countenance any notion of objective value, is unable to deliberate over what the ends of instrumental reasoning ought to be. The only end that seems to require no greater justification, Horkheimer and Adorno argue, is that of individual self-preservation – and this is because it is a presumably 'natural' drive of human beings.[324] Thus, through the process of disenchanting nature, ostensibly in the pursuit of humanistic aims, it is those aims themselves that have lost their foundation and the only remaining source of value is itself 'natural'.

The dialectic here is the mechanism through which the domination of nature becomes the domination of persons. Enlightenment reason, once it has been empowered to demystify and dominate nature, also strips human beings of their inherent worth, and they become treated no different than the pure material of the natural world. Adorno and Horkheimer write that 'everything – even the human individual – is converted into the repeatable, replaceable process, into a mere example for the conceptual models of the system'.[325] This is then the second account of the wrong associated with dominating nature (P3c) – that dominating nature is wrong because it is causally responsible for the domination of morally relevant persons. By seeing the natural world in a particular kind of domineering fashion, enlightenment thinking inadvertently create a system that also treats humans in a domineering way too. That is, once stripped of their inherent worth, humans are afforded no special place within the ordering structure of modernity: there is no systematic consideration of their wants or needs as they are considered only for their instrumental potential. This is significant – provided we accept C1, P3c does seem to entail C2 – that dominating nature is wrong. This was one of the major failures of Katz's theory of dominating nature as explored in Chapter 4 – while his theory ascribed 'domination' to acts of transforming nature into an artifact, he did not sufficiently explain why doing so was wrong. Here though Adorno and Horkheimer, by drawing a necessary linkage between dominating nature and dominating persons, have to the extent that we can accept their theory, shown why dominating nature is wrong. What remains to be shown however, is whether the kind of wrongdoing they show is sufficient to ground a prohibition on geoengineering C3.

3.3.2 Is Geoengineering Qualitatively Different from other acts that Dominate Nature?

Here we have our third attempt at showing the 'wrongdoing' implied by dominating nature. Dominating nature is wrong because it is the precursor to dominating morally relevant persons within modernity. Whether we accept this argument or not, I think we have a few reasons to doubt why this thesis alone is sufficient for a prohibition on geoengineering. In this section I argue that the wrongdoing implied by P3c is insufficient to ground C3. This is because the kind of wrongdoing invoked by P3c would also apply to almost every act done within 'modernity'. P3c, I argue, does not pick out any feature particular to geoengineering. It does not show that there is anything qualitatively different about geoengineering.

It is first necessary to consider what kind of relationship Adorno and Horkheimer see between the domination of nature and the corresponding domination of persons. Adorno and Horkheimer give an explanation of how a particular form of domination (of persons) occurs within modernity via the demystification of the human subject and their subjection to a purely instrumentalist system of valuing their worth. But it is certain that Adorno and Horkheimer do not think that the

[324] Adorno, Horkheimer, (1947) *The Dialectic of the Enlightenment*. pp. 26-27.

[325] Adorno, Horkheimer, (1947) *The Dialectic of the Enlightenment*. p. 84.

Enlightenment and the corresponding dominance over nature was the origin of all human domination. People were evidently also dominated in pre-modern times too –and in ways just as savage as modernity. Famously, Adorno and Horkheimer view the Enlightenment as leading directly to the Nazi deathcamps – the example *sine qua non* of rationalised efficient slaughter.[326] Nevertheless, it seems that pre-modernity was equally capable of savagery. For instance, the roots of new world slavery and its justifications in Aristotle's discussions of 'natural slaves'' or the biblical curse of Ham are evidently pre-modern.[327] Given this, what we must conclude is that what Adorno and Horkheimer offer us is an account of the origin of a particular *kind* of domination within modernity, and not a trans-historic account of the origins of *all* domination. Adorno and Horkheimer are not saying that the 'domination of nature' *caused* the domination of people in the sense that it is the overall origin of domination. Rather, the Dialectic of Enlightenment shows how Enlightenment *failed to live up to* its promise to *liberate* humans from domination.

Geoengineering is a product of a culture which dominates nature, and appears to allow the reproduction of domination. However, if there is a route out of domination, the answer is not discovered by Adorno and Horkheimer themselves. What this entails is that within modernity the domination of nature is potentially impossible to avoid. Intentionally modifying the climate is 'wrong' because of the role it plays in reproducing domination within modernity, not because of anything inherent in the activity of 'intentionally modifying the climate'. This is certainly not something which is unique to geoengineering. Thus, is we are prohibited from performing wrongful actions, it seems that we would be prohibited from doing a whole plethora of things that it would be implausible to stop doing.

It seems possible to accept (C2) that geoengineering entails wrongdoing, but short of upturning the entire system of enlightenment reasoning and instituting a completely new system of valuing humans and nature, and given the extremely permissive definition of what 'dominating nature' entails it is difficult to see how it might do otherwise. Within this context, a better standard for whether geoengineering should be permissible or not, would be to compare its likely benefits and harms with its alternatives. Given that geoengineering at least has the potential within our world to be useful, it does not seem implausible that there might be occasions where it can be the least bad option. Geoengineering is not *only* useful for system reproduction (though it most certainly is), but in this instance, it seems that the demands of system reproduction at least partially align with the objectively reasonable demand for a habitable climate. To the extent that geoengineering is actually able to produce that end, it seems like it will still be justifiable, if an unpalatable choice. We can return to Gardiner's idea of a marring evil. Geoengineering allows modernity to reproduce itself, by stabilising the climate and allowing capitalist modernity to continue to exist, and through that causes the domination of persons. But even that looks like the better option than the alternative of not doing it and allowing the harms of climate change to continue unchecked, if geoengineering was indeed a useful or required method of doing so.

It is still worth recognising that even accepting C2, that geoengineering wrongs by dominating people, is not a guarantee that C3 follows. Given that accepting the P3c route to evidencing C2 entails accepting that a huge range of actions ultimately result in the continuing domination of persons, means that geoengineering has no particularly special, qualitative difference. Given this, I take it that when we make an evaluation of whether we should or should not begin (or continue) geoengineering, the decisive factor in making that decision will not be whether geoengineering dominates nature. Within this understanding of what 'dominating nature' is, geoengineering seems no more morally problematic than quarrying, agriculture, chemical refining, or anything else that is

[326] Adorno, Horkheimer, (1947) *The Dialectic of the Enlightenment*. pp. 168 - 209.

[327] Of course, there were also uniquely modern post-enlightenment justifications for slavery too e.g. so-called 'scientific racism'. For a detailed history of the justifications of slavery, see: Blackburn, R., (1997) *The Making of New World Slavery*. London, Verso.

guided by an instrumentalist vision of the value of nature. What it takes to *not* dominate nature is more than simply refraining from pursuing any particular course of action. It requires essentially nothing less than the complete overthrow and making-anew of the whole institutional reasoning mechanisms of modernity. What we should draw from this, I take it, is that deciding whether we should prohibit or allow geoengineering (C3) cannot be practically obtained simply from a recognition of C2, or else a wide variety of essential activities would also need prohibiting. Any decision to prohibit geoengineering has to be made based upon an independent evaluation of a geoengineering programs merits and failing. Moreover, given that geoengineering at least has the potential to alleviate human and nonhuman suffering (even at the cost of continuing a system that treats nature instrumentally), there is no obvious reason to reject it out of hand.

3.3.3 Could Geoengineering be Objectively Reasonable?

While I take it that the arguments presented in the previous section are sufficient to show why Adorno and Horkheimer do not provide sufficient grounds for ruling out geoengineering, it is tempting here to suggest that a stronger response could be made, based on a rejection of P2: 'that geoengineering is indicative of an entirely instrumental valuation of nature'. It might be thought that, given that Adorno and Horkheimer provide a critique of a particular kind of modern society, beholden to an instrumental valuation of nature, then their argument is limited to critiquing the particular form of geoengineering which has arisen within that system, but cannot extend their critique to one that picks out *general* features of geoengineering (i.e., intentional climate modification) that could apply cross-culturally. Put another way, is there reasons to think that a different society, one which did not treat nature entirely instrumentally (P1), would never choose to geoengineer (not-P2)? If the answer to this was no, then this entails is a revision of P2, to P2*: '*existing* geoengineering is indicative of an entirely instrumental valuation of nature'. However, making this revision also entails a revision of C1 to C1* '*existing* geoengineering proposals dominate nature' and finally even with the success of P3c, you fail to get C2 'it is wrong to geoengineer' since there may be real or hypothetical geoengineerings that do not dominate nature.

It is not possible, for the limitations of space, give a full defence of this idea here. I do discuss it to an extent in the following chapter (6). However, I will briefly sketch how this argument might work. What we can first recognise though is that it would not be sufficient to simply claim that a society with the ability to objectively reason might choose to deploy geoengineering in a situation of grave danger, or to protect the non-instrumental value of humans or nature in a situation where that was threatened by climate change. Adorno and Horkheimer's argument is more sophisticated than this, and they could likely retort that geoengineering could only have been developed by a society which views nature entirely instrumentally, and thus set into motion the inevitable contradiction of the Enlightenment which results in the domination of persons. On this account it simply contradictory to say that an objectively reasonable society might geoengineer. We might still refute this argument, but it would require a more thorough argument against the very central claims of The Dialectic of the Enlightenment than simply a rejection of P2, and this thesis is not the correct place to begin that discussion.

A more plausible refutation along these lines is to deny the link between C1 and C2 via P3c. In the previous subsection I argued that P3c plausibly identified the wrongdoing of geoengineering because of the role it plays in the reproduction of a social-order (modernity) that dominates persons. But it could reasonably be asked whether it's true that all geoengineering programs must play this system reproductive role? I discuss this further in the final chapter, but we might think if a geoengineering program was designed in such a way as to be antithetical to the aims and values of modernity then it would not be correct to say it played a role in system-reproduction. If this was true, then we might also think it would not be accurate to say that it *wronged* by allowing a system that dominates people to persist. This is not on its own enough to say it was an objectively reasonable program, or even that it was playing a role in ushering in an objectively reasonable social order i.e., one which

does not dominate humans or nature. But by not playing a role in reproducing modernity, we might think it has broken the link between dominating nature and wronging people. I sketch some geoengineering programs that might do something like this in Chapter 6 Section 3.2.3. However, it is worth recognising for our sakes now that a stronger argument against P3c might exist based on identifying potential geoengineering methods or program designs that deny that all geoengineering programs play the same role in system-reproduction.

3.3.4 P3c Conclusions

This section argued that contrary to all of the other explanations of dominating nature, including that of Katz examined in the previous chapter, P3c does succeed at explaining why the domination of nature entails wrongdoing. Thus, provided we accept Adorno and Horkheimer's argument (including P1 which we have left unanalysed), we do appear to have a route to condemning geoengineering – a notable achievement. This is, however, a qualified success. As I have argued, this explanation of the wrongdoing of geoengineering does not pick out any special features of geoengineering itself. Rather, geoengineering entails wrongdoing in the same fashion as many other actions within modernity do – by treating nature wholly instrumentally, and by allowing the injustices of modernity to continue as the system is allowed to reproduce itself. What this means is that simply acknowledging that geoengineering entails wrongdoing via the domination of nature is not a decisive factor in deciding whether we should utilise it or not. Instead, we still have to make an independent assessment of the costs and benefits of geoengineering. Moreover, given that it seems at least plausible that geoengineering might be useful in preventing the harms of climate change, to both humans and nonhumans, simply acknowledging that P3c entails C2 does not give us grounds for accepting C3 – that geoengineering should be prohibited.

In 3.3.3 I also sketched a potential route to a stronger counter-argument. I suggested that the scope of Adorno and Horkheimer's argument might be limited in scope to a critique of *existing* geoengineering programs – as they have been developed under the dominant culture of modernity. I suggested that a hypothetical geoengineering program might be designed that would not play a system-reproducing role. This would not show that it did not dominate nature, but it might break the link between dominating nature and dominating persons, if that relationship is determined by the extent that any action allows modernity to reproduce itself. I discuss this idea further in the following chapter.

5.0 Conclusions

This chapter investigated another way an argument against geoengineering could be made based on the account of 'dominating nature' found in the works of Horkheimer and Adorno. First, I explained why geoengineering appears to dominate nature, on this account. Then I considered three ways an account based on their thinking might explain how geoengineering, in virtue of being an expression of the domination of nature, would be wrong: P3a in virtue of wronging nature itself, P3b by putting humans in a vicious position of a dominator, or P3c by leading to the domination of humans.

Route P3a I rejected as it falls prey to the problems encountered with other non-anthropocentric accounts of domination encountered and discussed in chapter 3 and 4. Route P3b, I argued, had an implausible account of the harm of being a dominator. While I argued it is possible that the dominator harms themself when they dominate, this is only the case if the victim of domination is a morally considerable subject - something which is not clear when it comes to dominating (unconscious) nature. If the subject of 'domination' cannot be wronged, it does not follow that an attendant wrong happens to the dominator (not-C2). Even if it could be shown that self-wronging occurs through geoengineering, I argued that this would still unlikely be sufficient to ground a prohibition against geoengineering (C3) in cases where geoengineering is the best option to prevent significant climate change induced harms to others. This is in line with Gardiner's argument on

marring evils, which while a real harm, are defeasible if necessary to prevent the other harms of climate change. I argued Route P3c can identify a wrongdoing (C2), provided that we accept P1 and P2. This is significant, because no other argument I have examined in this thesis has definitively been able to show such a general case against geoengineering. However, like P3b, I argued that the kind of wrongdoing this implies is unlikely to be significant enough to support C3, as Adorno and Horkheimer do not see any special kind of wrongdoing in geoengineering. The harms that geoengineering might cause by allowing a system of domination to reproduce itself are still unlikely to outweigh the costs of not geoengineering if geoengineering is essential to preventing significant likely harms of failing at conventional mitigation efforts. What should be concluded is that, provided that we accept P1 and P2, existing geoengineering proposals can be said to dominate nature (C1). In the case of P3c, they also seem to show that geoengineering involves wrongdoing (C2). However, I have argued that they fail to ground a prohibition on geoengineering (C3). Additionally, I suggested that a stronger argument against P3c might exist based on denying that all possible geoengineerings play a system-reproductive role, and thus entail wrongdoing by allowing an unjust system to persist. I develop this idea further in Chapter 6.

While Preston does not cite Adorno and Horkheimer as supporters of his presumptive case, their theory of dominating nature (and theories that draw heavily upon it) remain influential in explaining the purported wrongness of geoengineering. In the following chapter, I go on to discuss further how we might employ the lessons gained here to influence the design of geoengineering programs that can meet a demand to 'live with' or 'respect nature'. It is worth stating that the argument examined here, at least in its anthropocentric form, was a significant improvement on Katz who we examined in the previous chapter. Katz's argument also relied on an account of 'dominating nature' to explain the wrongdoing of geoengineering – however, his argument we were forced to reject.

Chapter 6 - Towards an Environmentalist Geoengineering

1.0 Introduction

Throughout this thesis I have questioned whether there is a presumption against geoengineering found in a broad range of environmental ethics positions. I have argued that some forms of geoengineering are compatible with core perspectives in environmental ethics. This means that environmental ethicists can advocate for at least some forms of geoengineering without compromising their principles. In this chapter I ask a slightly different question. Having accepted that many environmental ethics theories can accommodate (some) geoengineering, can we draw on these theories to develop specific, 'environmentalist' principles to govern the research and deployment of geoengineering technologies? Whether, and how, geoengineering is deployed is still an open question, and one that 'environmentalists' have a stake in contributing to. One strategy for contributing to this debate could be the development of a 'desiderata for environmentalist geoengineering': a set of principles that any geoengineering program set for development would be required to adhere to in order to be legitimate. While developing a full set of principles is beyond the scope of this chapter, the aim here is to identify what and where our discussion from the preceding chapters can contribute to developing such a set of criteria.

In Section 2 I give a brief overview of past efforts to develop governance criteria for geoengineering, particularly focussing on the few occasions where they have addressed environmental ethics-oriented concerns. To this effect, I look in detail at the sets of principles put forward by Dale Jamieson, and Stephen Gardiner and Augustin Fragnière. I argue that where they have provided specific environmental ethics principles, these principles lack specificity and require improvement. In Section 3 I then attempt to improve two of these principles: that geoengineering should be 'reversible' (3.1) and that geoengineering must 'Live-With or Respect Nature' (3.2) and provide insight into what they might require in practice, drawing upon our readings of environmental ethics positions from Chapters 2 through 5.

I conclude that there is urgent further research to be done in this area. It is still very much an open question as to how and whether or not geoengineering, Solar Radiation Management especially, is deployed. This needs to be discussed and debated in the here and now as it will be much easier to advocate for an environmentalist geoengineering before there is significant deployment under way. Moreover, the possibility of geoengineering proceeding without effective ethical guidelines in place should be a dire concern of all. Simply creating a desiderata for what an environmentalist geoengineering should look like does not need to be an advocation of geoengineering. An intellectually honest desiderata can also be used to identify whether any forms of real-world geoengineering can meet its benchmarks, and if none do, then climate strategy can be adjusted accordingly. Therefore, environmentalists need to identify what principles they can advocate for in order to effectively shape discussion.

2.0 Existing Proposals

In this section I review existing proposals for the governance of geoengineering as a starting point for our investigation. Despite the widespread public concern over the environmental ethics of geoengineering, this has not yet permeated mainstream governance proposals. However, this does not mean that these concerns have been completely ignored. After reviewing typical governance proposals, I turn to the ethics literature to look at two proposals which do include environmental ethics concerns in their desiderata for good geoengineering; namely proposals by Dale Jamieson, [328]

[328] Jamieson, (1996) Ethics and Intentional Climate Change. pp. 323–336.

Stephen Gardiner and Augustin Fragnière,[329] In 2.1 I introduce the history of proposals for governing geoengineering. In 2.2 – 2.3 I give an overview of Jamieson, and Gardiner and Fragnière proposals and identify the parts of their work that specifically incorporate environmental ethics concerns. I show that these authors agree with my contention that environmental ethics concerns do not rule out some forms of geoengineering, or geoengineering in some circumstances. I also identify the weaknesses of their proposals, typically this is a lack of specificity. I conclude that while these authors should be commended, there is still significant room for improvement.

2.1 History of Geoengineering Governance Proposals

The earliest attempt at governing climate modification came over 50 years ago with the ratification of the United Nations' Environmental Modification Convention (ENMOD) legislation, which prohibited the hostile use of climate control technologies in a treaty modelled on nuclear non-proliferation acts. However, after this early foray, geoengineering became more or less a taboo topic within climate research until a special edition of the Journal Climatic Change was published in 2006 on the possibility of using Solar Radiation Management technologies in the fight against climate change.[330] Reflecting this taboo status, relatively little in the way of attempts to influence the governance of geoengineering were published between the ENMOD treaty and the 2006 Special Edition. The other notable piece of legislation at this time was the 2008 UNEP Convention on Biological Diversity Decision IX/16 that effectively placed a moratorium on geoengineering field trials, especially in the wake of fears about ongoing experiments into Iron Fertilisation.[331]

Attempts to influence the governance of geoengineering development and implementation began in earnest with the 2009 Royal Society Report.[332] This was followed by a slew of other proposals as researchers as well as international organisations scrambled to establish the legality of, as well as good governance principles for, the development of geoengineering – partly in response to controversies over the 'moral hazard' problem.[333] Proposals from this time include: The Oxford Principles (2010/13),[334] The Asilomar Conference (2010),[335] The Solar Radiation Management Governance Initiative Report (2010),[336] The Bipartisan Policy Centre Report (2011),[337] the Kiel Earth

[329] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. pp. 143-174.
[330] Crutzen, (2006) Albedo Enhancement by Stratospheric Sulfer Injections. pp. 211– 219.
[331] UNEP, (2008) *Conference of the Parties to the Convention on Biological Diversity*. Decision IX/16.
[332] Shepherd, J., et al., (2009) *Geoengineering the Climate: Science, Governance and Uncertainty*. London, The Royal Society.
[333] On this question, see: Gardiner, (2009) Is 'Arming the Future' with Geoengineering Really the Lesser Evil?
[334] Rayner, S., Heyward, C., Kruger, T. et al., (2013) The Oxford Principles. *Climatic Change*. Vol. 121. pp. 499–512.
[335] Asilomar Scientific Organizing Committee., (2010) *The Asilomar Conference Recommendations on Principles for Research into Climate Engineering Techniques*. Washington DC, Climate Institute.
[336] Solar Radiation Management Governance Initiative. (2010) *Solar Radiation Management: The Governance of Research*. London, Royal Society Publishing.
[337] Bipartisan Policy Center (2011) *Geoengineering: A National Strategic Plan for Research on the Potential Effectiveness, Feasibility, and Consequences of Climate Remediation Technologies*. Washington DC, Bipartisan Policy Center.

Institute report (2011),[338] The Woodrow Wilson Centre Report (2011),[339] The Ecologic Institute Report (2014),[340] and the two-part National Research Council Reports (2015).[341,342]

A substantial meta-review of these reports and others was conducted in 2017 by David Morrow.[343] Morrow analyses the recommendations of each of the prior reports to create a 'synthetic' set of criteria for ethical geoengineering by drawing out the points of substantial agreement found in each. This work is illustrative of the general points of agreement and concern of all previous reports. Morrow identifies 6 points that find near universal agreement:

1. Geoengineering if deployed must be *in addition* to traditional mitigation and climate adaptation.
2. New governance mechanisms are needed to supplement existing laws and institutions.
3. A general moratorium on [geoengineering] research is advisable.
    - Though there is widespread agreement that this is unenforceable, and what such a moratorium should prohibit is unclear (i.e., all research, field trials, unilateral, or outright deployment).
4. Whatever governance structures are put in place, they must be designed to encourage international cooperation, and coordination of [geoengineering] research.
    - Perhaps implemented as shared voluntary norms, or as a formal international research program.
5. If research does proceed, transparency and openness are critical.
    - Especially in solar radiation management.
6. Public engagement desirable.

Additionally, 4 further points receive significant support and little or no opposition:

1. Governance should be proactive rather than reactive.
    - We ought not wait until [geoengineering] research progresses before establishing a governance regime. Governance should come first.
2. These governance regimes must be flexible and adaptive.
3. Informal, soft-law approaches to governance are preferable *for now.*[344]
4. Governance must strike the right balance between legitimacy and effectiveness. (Balance between inclusive and deliberative governance, and swift-moving adaptive governance to respond to the fast pace of change in the field).

To the extent that the 10 points Morrow identifies here can be taken as synoptic of these attempts to influence geoengineering governance, what we should conclude is that there is a general lack of engagement with environmental ethics concerns. Despite the evidence that the general public have

[338] Rickles, W.G., Klepper, G., Dovern, J., Betz, G., Brachatzek, N., Cacean, S., Guussow, K., et al (2011) *Large Scale International Interventions into the Climate System? Assessing the Climate Engineering Debate. Scoping Report Conducted on Behalf of the German Federal Ministry of Education and Research (BMBF).* Kiel, Keil Earth Institute.

[339] Olson, (2011). *Geoengineering for Decision Makers: Science and Technology*. Washington DC, Woodrow Wilson International Center for Scholars.

[340] Bodle, R. S., Oberthur, S., Donat, L., Homann, G., Sina, S., Tedsen, E., (2014) *Options and Proposals for the International Governance of Geoengineering.* Berlin, Ecologic Institute.

[341] National Research Council (2015a) *Climate Intervention: Carbon Dioxide Removal and Reliable Sequestration.* Washington DC, National Academies Press.

[342] National Research Council (2015b) *Climate Intervention: Reflecting Sunlight to Cool Earth*. Washington DC, National Academies Press.

[343] Morrow, D.R., (2017) International Governance of Climate Engineering: A Survey of Reports on Climate Engineering, 2009-2015. *FCEA Working Paper Series*: 001, June 2017.

[344] Note these reports cover a period 2009-2015.

what we would identify as environmental ethics worries about geoengineering, they have as yet not clearly influenced reports on how geoengineering ought to be conducted. Moreover, given that this concern really does exist, there is an important task at hand to rectify this absence. In order to think through how to do this, I will next turn to considering two papers from the ethics literature which also try to develop principles for ethical geoengineering.

2.2 Jamieson's Principles

In 1996, Environmental Ethicist Dale Jamieson published a prescient article on the ethics of what he termed 'Intentional Climate Change'. In his article Jamieson proposes four conditions 'which must be satisfied for [a geoengineering] project to be morally permissible'.[345] These were:

1. the project is technically feasible.
2. its consequences can be predicted reliably.
3. it would produce states that are socio-economically preferable to the alternatives.
4. implementing the project would not seriously and systematically violate any important, well-founded ethical principles or considerations.

It is evidently point 4 that is of the most interest to us here. Jamieson offers 3 subprinciples which he thinks can be derived from this:

a. The Importance of Democratic Decision-making
b. The Prohibition Against Irreversible Environmental Changes
c. The Importance of Learning to Live with Nature

Jamieson intends point (a) to be attentive to the concerns of environmental ethics, because he explicitly takes 'democratic decision-making' to include non-humans, citing Rolston's arguments in favour of this.[346] However Jamieson does not provide much more guidance than this on how deliberative inclusion of non-humans might work, other than noting that it compounds what would certainly already be an 'unwieldy' democratic process.[347]

Points b. and c. speak more directly to environmental ethics concerns though. Jamieson makes an anthropocentric case for point b, arguing that irreversible environmental changes deprive future generations of alternatives. He writes:

> For many environmental conditions and states, once they are lost, they can never be restored (at least not on timescales of interest to human beings). Irreversible environmental changes deprive future people of choices and opportunities that they otherwise would have had. If the effects of [geoengineering] were irreversible, then those who made the decision to undertake [geoengineering] would be choosing one climate path for future people rather than another.[348]

We should note the similarity to the argument of Rolston III and Hargrove (Discussed in Chapter 2). Rolston for instance wrote that a reason for protecting nature was that it provides 'the profoundest historical museum of all, a relic of the way the world was during 99.9% of past time'.[349] The reason for avoiding irreversible changes is that some value that nature had in its untransformed state is lost

[345] Jamieson, (1996) Ethics and Intentional Climate Change. p. 326.
[346] Rolston III, (1988) *Environmental Ethics*.
[347] Jamieson, (1996) Ethics and Intentional Climate Change. p. 330.
[348] Jamieson, (1996) Ethics and Intentional Climate Change. p. 330.
[349] Rolston III, (1988) *Environmental Ethics*. p. 14.

and cannot be used or appreciated by generations who come after the change was made. There also seems to be an implied opportunity cost to those later generations too.

Jamieson notes that the requirement for reversibility does not straightforwardly rule out geoengineering. However, he is sceptical of its ability to be reversible in practice: while any geoengineering technology might be stopped (space mirrors removed, iron fertilisation stopped, carbon capture machines switched off), the real challenge to reversibility, he notes, is the climate effects. I discuss a requirement for 'reversibility' further in 3.1.

Jamieson's point c is the most obviously relevant to environmental ethics concerns. Jamieson requires that any geoengineering project not violate the ethical demand to 'learn to live with nature'. Jamieson explains the problem as responding to a tendency towards 'excessive intervention' in the management of nature. He writes:

> Many of our environmental problems flow from attempts to manipulate nature in order to make it conform to our desires rather than forming our desires in response to nature… Although it is not possible or desirable for humans always to 'let nature take its course', there is a growing sense that modem societies have erred on the side of excessive intervention.[350]

However, Jamieson himself notes that an argument has not been provided here to show that geoengineering must be one of these 'excessive' interventions. Nonetheless, the moral thrust of this line of argument seems to be that while geoengineering might, under certain circumstances (imminent peril perhaps) be justifiable, it would nevertheless still entail the wrongdoing of: 'reinforcing… the view that the proper human relationship to nature is one of domination'.[351] As I noted in Chapter 4, Jamieson's concerns about the domination of nature appear similar to Adorno and Horkheimer's. While geoengineering might be a justifiable response to climate change, there would still be a wrong to doing it because it reinforces rather than challenges the system of wrongdoing it exists within. Geoengineering does not challenge a fundamentally unjust way of viewing and valuing nature. While we can imply then that 'living with nature entails a shift in the way nature is valued, Jamieson does not tell us what 'living with nature' means in practice or why it is preferable to the 'paradigm of domination' (or to put it another way, what the purported wrong of dominating nature is). I investigate what this principle might entail for geoengineering project design in Section 3.3.

Jamieson concludes that from his knowledge of the state of the research these four criteria were not currently met and emphatically argues against trying to implement geoengineering. Nonetheless Jamieson's principles clearly include considerations of what an environmentally ethical geoengineering might look like. However, his environmental ethics principles lack elucidation.

2.3 The 'Tollgate' Principles

Despite being an early effort, Jamieson's work saw little engagement in the geoengineering governance literature until recently. In 2018, Stephen M. Gardiner and Augustine Fragnière published a set of ten recommendations they term the 'Tollgate Principles'. These principles were intended not as a new set of principles, but as 'Ethically Robust' improvements of two previously published efforts – the 'Oxford Principles' - an early set of governance principles for geoengineering predominantly focussing on procedural concerns about the legitimation of geoengineering schemes,[352] and Jamieson's principles. While primarily focussed on updating the Oxford Principles,

[350] Jamieson, (1996) Ethics and Intentional Climate Change. p. 331.
[351] Jamieson, (1996) Ethics and Intentional Climate Change. pp. 323–336.
[352] Rayner, Heyward, Kruger, et al., (2013) The Oxford Principles. pp. 499–512.

the last four of the ten Tollgate Principles are updated versions of Jamieson's four principles, with added detail and guidance for implementation. However, as I argue, there is still substantial room for further clarification and specificity.

As noted, there are ten Tollgate Principles, each with a varying degree of relevance to environmental ethics concerns. The first six of these (framing, authorisation, consultation, trust, and ethical accountability) are modified versions of the original six Oxford Principles. In their original forms these principles had no obvious link to specifically environmental ethics concerns. However, in the 'Tollgate' revisions, these principles are consciously expanded in their scope from ensuring broad human participation in geoengineering decision-making to also potentially including non-human entities as decision-makers too. For instance, the first Tollgate principle asks that geoengineering 'be administered by or on behalf of the global, intergenerational *and ecological public*.'[353] The fourth asks that: 'geoengineering policy should be organised to facilitate reliability, trust, and accountability across nations, generations, *and species*'.[354] So here, what were originally proposals to govern ethical interactions between human persons (and collectives of human persons e.g. nations) have been broadened to apply to non-human entities too.

While Jamieson does acknowledge (Principle 4a) that democracy and accountability in geoengineering decision-making might be expanded to non-humans, it seems that through their repetition that the 'Tollgate' principles place a greater emphasis on this point. However, despite continually making reference to their principles applying to an 'ecological public' the authors are not clear on how an expansion of democracy beyond humans might to be done. Moreover, there even appears to be conflict within the paper itself over whether it is even possible. For instance, at one point the authors write '[there might be ways] to take the interest of future generations and nonhuman beings into account, such as *appropriate representative institutions*.'[355] At another they suggest that while 'special concern' should be given to 'future generations and nonhuman nature', this is because they 'cannot be effectively represented'.[356] Thus while the Tollgate Principles make overtures to correct the lack of inclusion of nonhumans in geoengineering decision making, it remains unclear how the authors think this should, or whether it could, be done.[357]

The discussion of nonhuman democratic or representational inclusion in decision making certainly addresses some environmental ethical concerns. But perhaps of greater interest is the discussion surrounding Principle Ten. This principle requires that:

[353] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 152. emphasis added.

[354] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 158. emphasis own.

[355] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. pp. 153-154. emphasis own. The authors offer two footnotes here for clarification, but both pertain to representative organisations for future generations, so it is unclear what the implications for nonhumans are.

[356] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 158.

[357] A charitable reading might take note of the fact in the first instance the authors say 'nonhuman *beings*' [emphasis own] and in the latter 'nonhuman *nature*' [emphasis own]. We might choose to read them as saying that representative organisation could work for nonhuman animals (as beings) but cannot be effective for non-living nature like mountains or rivers (that are not beings as such). There is no indication though that the authors are using these terms in that specific way and given that there is still tension over whether future generations are deserving of representation or mere special concern, I am compelled to think there is genuine tension here.

> Geoengineering policy should respect well-founded ecological norms, including norms of environmental ethics and governance (e.g., sustainability, precaution, respect for nature, ecological accommodation).[358]

Here the Tollgate Principles essentially ask that geoengineers consider the work of environmental ethics, and do not violate any of its 'well founded norms'. Some guidance on what these 'well-founded' norms are is offered and worth considering here.

The authors give four examples of 'norms' to be respected. The first two of these are 'sustainability: [that] interventions should be compatible with and promote the long-term survival and flourishing of human and nonhuman life' and 'Precaution: [that] where there are threats of serious or irreversible harm, a lack of full scientific certainty should not be used as a reason for postponing suitably effective measures'[359]. These are presented as responses to Jamieson's criterion of 'no irreversible [ecological] changes' – a principle the authors state they 'lacked confidence' in.[360] I discuss this further in Section 3.1.

The latter two norms are, as the authors note, norms which deal with 'humanity's relationship to nature'. This is the most purely environmental ethics relevant area of the Tollgate principles. These two norms are 'Respect for Nature: respect natural organisms, ecological communities and wild places' and 'Ecological Accommodation: Seek to live within, among, and together with the rest of nature'. These principles are intended as an improvement on Jamieson's requirement to 'live with nature', but Gardiner and Fragnière also cite Jamieson's other work here, where he advocates specifically for adopting Paul Taylor's principles of 'respect for nature' (discussed in Chapter 3).

The connection between the demand here for 'Respecting Nature' and a specifically Taylor-ite ethics is notable – the Tollgate authors do not mention Taylor directly here, although they do so indirectly via the citation of Jamieson; so, it is unclear whether they are asking us to read the requirements of 'Respecting nature' as adhering to Taylor's ethics or not. The lack of direct mention suggests not, in which case, precisely what it means to 'respect nature' remains unclear. The same is true of the requirement to 'Live within, among, and together with nature'. The only further point the authors provide that might add clarity is the suggestion that the principle's 'spirit' is 'violated' when 'some call for the wholesale *domination* of and annexation of nature for the sake of human aggrandisement'.[361] The reference to domination and annexation here clearly suggests a link to certain kinds of environmental ethical theories (e.g. Katz, or Frankfurt School inspired approach), or at the very least to negative rights inspired readings of obligations to nature. The comments on human aggrandisement might hint at a virtue inspired account too (would the domination and annexation of nature be legitimate if it were for a different reason, such as human flourishing?). We should be careful not to read too much into this thought, as the authors themselves note, these principles lack precision and how putting these principles into practice might be done is, they write, 'a matter for subsequent discussion'.[362]

2.4 Conclusions

While over the last 10 to 15 years there have been numerous attempts to provide governance criteria for geoengineering development and deployment, most of these attempts have not sought to attend to concerns about environmental ethics. This is notable because, as I have argued in Chapter One, there is robust and growing evidence that the general public is concerned about how

[358] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 166.

[359] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 165.

[360] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 165.

[361] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 166. emphasis own.

[362] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 166.

geoengineering programs treat the natural world and change the human relationship with it. This concern manifests itself in language of 'messing with' or 'tampering with nature'. While the governance literature for geoengineering does not contain any substantive treatment of environmental ethics concerns, there has been some attempts at developing criteria for just geoengineering programs from the ethics literature. I reviewed two attempts by Dale Jamieson and Gardiner and Fragnière - the 'Tollgate Principles'. Both Jamieson and the Tollgate Principles agree with the argument I have put across throughout this thesis – that at least in principle some forms of geoengineering can be legitimate according to various readings of environmental ethics. In the following section I attempt to take the lessons learned throughout this thesis and apply them to improving and further specifying the demands for a 'reversible' geoengineering, and what a demand to 'live with or respect nature' might entail for geoengineering.

3.0 Improving Environmentalist Principles

3.1 Reversibility

That a geoengineering program ought to be 'reversible' is a relatively common demand, that feature's frequently in both the ethics and the good-governance literature. The 'Royal Society Report' on geoengineering governance recommends that geoengineering techniques be assessed for their 'reversibility'.[363] The Keil Earth Institute report argues that successful geoengineering regulations must strike a balance between being able to prevent 'moral hazard' problems (where geoengineering fails to arise despite being relied on to offset emissions), while ensuring that geoengineering deployments can be 'terminated'.[364] The EuTrace report argues that a factor in deciding how much pre-caution need be applied when testing or deploying a particular geoengineering technique is the potential 'reversibility of the potential impact'.[365] In Robert Olson's principles for a 'softer' geoengineering, he requires that a project be 'rapidly reversible'.[366] Further, as we have seen 'reversibility' appears in Jamieson's principle 4 where amongst his list of ethical norms he puts a 'prohibition on irreversible changes'. We should note however that while Gardiner and Fragnière suggest that a geoengineering policy proceed with 'precaution' whenever there is a risk of *irreversible* harm, they do not believe the possibility of irreversible harm should rule out a geoengineering policy on its own, indicating a reduced emphasis on reversibility being taken forward from Jamieson. It is also clear why 'reversibility' is an environmental ethics concern too. If we think that we have duties to 'preserve' nature in an unmanaged state, then ensuring that geoengineering can be reversed could be a way of ensuring that modifications made are temporary and can be rectified. Or if we think that geoengineering wrongs nature through an imposition of dominating control, then ensuring that that imposition can be withdrawn may be a significant mitigating factor in the gravity of the wrongdoing.

In this section I identify different ways that to interpret what a demand for reversibility could mean and discuss these interpretations in turn. I identify two broad ways to interpret a demand for reversibility: (1) 'reversibility' as cessation, and (2) reversibility as 'no irreversible changes'.[367] I argue

[363] Shepherd, Caldeira, Cox, Haigh, Keith, Launder, Mace, et al. (2009) *Geoengineering the Climate*. p. 59.
[364] Rickles, Klepper, Dovern, Betz, Brachatzek, Cacean, Guussow, et al (2011) Large Scale International Interventions into the Climate System? p. 115.
[365] Schäfer, S., Lawrence, M., Stelzer, H., Born, W., Low., S., et al. (2015) The European Transdisciplinary Assessment of Climate Engineering (EuTRACE): Removing Greenhouse Gases from the Atmosphere and Reflecting Sunlight Away from Earth. p. 109.
[366] Olson, (2012) Soft Geoengineering. p. 30.
[367] This is not intended to be an exhaustive list of how 'reversibility' could be understood. Another sense of 'reversibility', commonly used in Science and Technologies Studies (STS) is used to describe the extent to which the development of a technology forecloses on alternatives. Applied to geoengineering we might say

that our reading of Taylor's ethics of Respect for Nature in Chapter 3 can help inform our discussions of how reversibility can be incorporated into geoengineering governance and project design. I argue that geoengineering projects designed to be 'self-obviating' would be amenable to a Taylor-ite form of environmental ethics.

3.1.1 Reversibility as Cessation of Geoengineering

One sense in which reversible can be used can be that a geoengineering project is reversible if it can simply be halted or ceased. This is evidently the intention as it is found in Olson – 'rapid reversibility if problems do arise'. It is for this reason as well that I include the Kiel Earth institute's demand that geoengineering deployments can be 'terminated' into the discussion of reversibility. There is nothing, I would suggest, particularly controversial about this demand. However, we should consider some of the implications of this idea: particularly how we should interpret when a geoengineering program 'can be ceased' and what forms of geoengineering it might permit or prohibit.

There are at least two aspects of what geoengineering cessation might involve which are worth discussing in further detail: a) the technical feasibility of halting a regime, and b) the social, political, or economic barriers to bringing a program to its end. The primary sense asks whether or not it is physically possible to stop a geoengineering program. In many cases the answer to this is simply yes, but even this most minimal of criteria might pose a challenge to certain geoengineering techniques. Direct Air Capture carbon capture seems like an archetypal example of a form of geoengineering that can be easily halted – without wanting to oversimplify, these devices can simply be 'switched off'. Indeed, the cessation of DAC is so simple that it can meet Olson's criteria for 'Rapid Reversibility'.[368] There are other forms of geoengineering where they appear to be technically possible to halt, but fail to meet the more demanding 'rapidly reversible' criteria. Enhanced rock weathering can be halted swiftly in the sense that it is very easy to *not* spread basaltic rocks onto farmland. But because the carbon capture action is slow, simply stopping new depositions will not immediately stop the effect. Enhanced weathering works as basaltic sands 'weather', and travel through the soil, into watercourses, and eventually out to sea. This process takes a considerable amount of time. So, while Enhanced Weathering is technically possible to cease, the delayed effect adds an additional element of complexity.[369] Finally, some forms of geoengineering might be genuinely difficult to halt and may be prohibited under even the most permissive standard of understanding a demand for cessation. Space-mirrors might be technically challenging to halt: they're highly inaccessible and might require specialised equipment, labour, or time-consuming techniques if they required maintenance. While it might in theory be possible to deorbit or otherwise deactivate them remotely, there remains concerns over potential loss of communication.[370] Additionally, while Stratospheric Aerosol Injections might be trivial to halt

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that geoengineering was 'reversible' if researching it did not imperil our ability not to use it, perhaps if it was developed to the expense of pursuing traditional mitigation. While this is clearly a useful question to ask when considering the ethical acceptability of geoengineering, I do not evaluate this use of reversibility here as it is clearly not incompatible with the senses that I do consider. A geoengineering program could be STS reversible, but still make irreversible environmental changes, for instance. For the original account of STS reversibility, see: Collingridge, D., (1980) *The Social Control of Technology*. Oxford, Oxford University Press. I thank Professor Nicholas Pidgeon for bringing this to my attention.

[368] Olson notes three of the five technologies he reviews meet the rapid reversibility criteria: Microbubble Shading, Albedo modification on polar ice, and Direct Air Capture. Olson, (2012) Soft Geoengineering. p. 38. Note though that even this trades on some ambiguities on what 'halted' means. It's trivial to stop capturing additional carbon, but in a DAC scenario, some of the already captured carbon will be stored, perhaps in underground cavities which once housed oil. It's not clear what 'reversing' DAC entails for how we should interact with these stores. I'm grateful to Dr Emily Cox for this point.

[369] Lawford Smith, Currie, (2017) Accelerating the Carbon Cycle.

[370] Note that while deorbiting satellites is common procedure, at least some space-based geoengineering techniques call for inert objects, such as dust and debris from the moon to be used to shade the Earth. This would certainly be difficult to reverse.

(aerosols will naturally fall back to earth and must be continually replenished to work, thus halting replenishments will end the intervention), the risks of 'termination shock' (a rapid and dangerous rise in temperature hypothesised to occur if an SRM project is terminated before greenhouse gas concentrations have been reduced) mean that in general there are dangers associated with ending SRM geoengineering projects if there has not been a corresponding drop in emissions or increase in carbon capture capacity.

The second way to think about a demand for cessation goes beyond just asking whether it is technically possible to end a geoengineering program, but whether there may be other kinds of impediments to doing so that result from the way the project was designed. We have already considered the risks of 'termination shock' that could follow from ending an SRM project without a reduction in emissions and total CO_2 in the atmosphere. This problem seems to straddle the line between the two senses – it is a technical feature of SRM that 'termination shock' can occur, but it's a problem which arises under particular social circumstances where there have been inadequate emissions reduction and removal efforts. Similarly, we might consider here the risk of emissions deterrence. Geoengineering programs offer an alternative to immediate emissions reductions as they offer ways for altering temperature without a gross decline in the amount of greenhouse gases being released. In a scenario where either carbon capture or solar radiation management is used to 'offset' emissions then there will be great pressure to continue these geoengineering programs, perhaps indefinitely, due to the costs of mitigation efforts.

This way of thinking about cessation does not seem to inherently rule out any particular methods of geoengineering, but satisfying it will require us to think about how geoengineering programs are designed and governed. One step that could be taken is ensuring that both carbon removal and solar radiation management are separated from mitigation efforts, perhaps by putting either limits on how much emissions can be 'offset', or by completely prohibiting their use as an 'offset'. Olson makes this suggestion in the Wilson Centre Reports, which recommends that governance programs 'Do not allow [geoengineering] to be used as a source of carbon offsets, because this would divert efforts from emissions reduction'.[371] Measures that prevent geoengineering being used to offset emissions are useful not only for ensuring that mitigation actually occurs, but similarly it also makes it easy to cease geoengineering by reducing the social pressure to continue.

3.1.2 Reversibility as No Irreversible Changes

The second way reversibility can be understood is as a demand that the *effects* of geoengineering can be reversed. This sense is evident in Jamieson's understanding of reversibility as a prohibition on irreversible environmental changes, in the Tollgate Principle's concern over causing irreversible harms, and in the EuTRACE report's recommendation of assessing the reversibility of geoengineering's 'impacts'. Here the concern is not strictly over whether the geoengineering technology can be stopped from functioning, but additionally once it has ceased functioning, no effects remain which cannot themselves be removed. This latter expanded sense of reversibility is without a doubt the most environmental-ethically relevant of the two senses. It does after all make distinctly normative judgements about the way the world ought to be. A very reasonable question we might ask is why should we not make 'irreversible' changes? For a geoengineering project to meet the irreversible changes criteria, it seems that is must first meet the cessation criteria. After all it is self-evident that if a geoengineering program remains *in effect* it will continue to be making a change to the environment/climate system etc. Therefore, Reversibility as No Irreversible Changes imposes an *additional* challenge on top of Reversibility as Cessation.

We also need to consider what kinds of changes need to be reversible. After all, the change that Carbon Capture makes is the removal of carbon dioxide from the Earth's atmosphere. But we surely

[371] Olson, R., (2011). *Geoengineering for Decision Makers: Science and Technology*. Washington DC, Woodrow Wilson International Center for Scholars.

do not think that a demand for reversible geoengineering is a demand that we return that CO_2 to the atmosphere! What we must infer is that 'no irreversible changes' is a demand that there are no irreversible changes, other than the irreversibility of the technology's prior effects on reducing climate change. This is a rather complicated condition to understand. For instance, it appears to rest on an unexamined assumption about what the desirable climate state is that geoengineering programs should be aiming to restore the climate to, presumably a 'natural' default state that existed prior to substantial anthropogenic CO_2 emissions which we might term the 'Pre-Industrial Climate'. We might think that the way the assumption works is that climate change deviated from the pre-industrial climate and geoengineering's job is to correct that deviation while creating no new deviations of its own. Currently CO_2 exists in the atmosphere at a concentration of roughly 421ppm. Estimations of the pre-industrial concentration are typically ~280ppm. Thus, a carbon capture program would cause no irreversible changes if it lowered concentrations back to 280ppm, and in doing so did not cause some other irreversible effect (such as a comparative uptick in another atmospheric chemical or permanently altered weather patterns).

It is relatively easy to see how geoengineering technique could fail at this condition. Climate is very complicated, and its effects are not always easily predictable. It is plausible to imagine a situation where a 30-year period of Solar Radiation Management has, for instance, effects on precipitation patterns, that do not return to their pre-geoengineering state after the SRM program was ended. The end result might be the same average temperature or average CO_2 PPM of a 'natural' climate, but could potentially have different local/regional patterns than anything which existed historically. In this case, while the geoengineering technology could be halted, the effects of it might not be ceased.

But questions remain as to whether this is a useful or justifiable understanding of reversibility. In the following subsection I consider two objections to understanding 'reversibility' in this way. The first, from Gardiner and Fragnière, claims that the fact the atmosphere is already unnatural negates the need for a prohibition on new changes. The second argues that a prohibition on irreversible environmental changes is not justified by the environmental ethics literature.

3.1.2.1 Does the Unnatural State of the Atmosphere Show that Prohibition on Irreversible Changes Cannot be Justified?

The first challenge to understanding reversibility as requiring no irreversible changes comes from Gardiner and Fragnière, who write: 'given the rapid pace of climate change, it is not clear why [reversibility] it is a particularly salient concern'.[372] This argument seems to be that, given the changes to the world-environment already caused unintentionally by climate change, there is no reason to think that the additional irreversible changes caused by geoengineering cannot be legitimate *if* they result in a state which is otherwise *preferable* to climate change continuing unabated. While we may in general have a duty to preserve the environment in a 'natural' state, the possibility of doing this has already been foreclosed by climate change. Therefore, if there was ever going to be a moral obligation to create no irreversible change, this occasion has already passed. Therefore, there is no need to demand that geoengineering create no irreversible changes.

In evaluating this argument, our discussions of Katz from Chapter 4 can be of use. Katz's argument against geoengineering is that geoengineering would violate a duty to preserve the value only present in unmodified nature. As the aspects of nature that geoengineering modifies have never been (intentionally) altered, they still possess this value. Therefore, we ought not geoengineer. Katz's position is stronger than Jamieson's argument for no irreversible changes – Katz would instead require we make no changes simpliciter. 'Reversible changes' are, as per his argument against nature

[372] Gardiner, Fragnière (2018) The Tollgate Principles for the Governance of Geoengineering. p. 165.

restoration, an impossibility, if we think the aim of reversibility is to 'restore' a natural climate. Nonetheless, we should note the similarities between the argument Gardiner and Fragnière present to 'no irreversible changes' to the argument that I levelled against Eric Katz in Chapter 4 Section 3.1. There I argued that if we think that climate change is an intentional modification of the atmosphere then we would seem to have no reason to refrain from geoengineering, since the object (the atmosphere) that geoengineering works on has already been transformed from a morally valuable natural state to an artificial one. It is tempting to conclude that, while Katz's position is not exactly the same as Jamieson's, if we accept my critique of Katz we should by virtue of their similarity accept Gardiner and Fragnière's critique of Jamieson. That is to say, given that we already inhabit an unnatural climate (due to climate change), we should abandon a requirement to avoid making new irreversible changes. After all, the value that a prohibition on irreversible changes is designed to protect has already been lost.

However, the argument I presented in C.4 S.3.1 was intended to show that Katz's general argument against geoengineering fails upon its own grounds. But, if we doubt Katz's core presumption that nature's value is lost once modified and cannot be regained, we might still see a benefit to making no irreversible change. A requirement that geoengineering only make changes that can be reversed appears to follow from a belief that we can restore the value of denuded nature through restoration efforts. Thus, geoengineering aims to restore the value nature had before it was altered by climate change, and we ask that it makes no additional changes that cannot be altered either. If we have that kind of view of nature, then it seems that Gardiner and Fragnière's critique misses the mark. While it might be true that the atmosphere is currently unnatural, the fact that the value it once had can be restored shows that simply recognising it has been altered before does not give us a *carte blanche* to make whatever modifications we desire. We can therefore conclude that just recognising that the atmosphere/climate is already unnatural does not mean that a prohibition on irreversible changes could not be justifiable.

3.1.2.2 Does the Permissibility of 'Novel Climates' Show that Prohibition on Irreversible Changes Cannot be Justified?

Having argued that a simple recognition that the climate has already been altered does not entail abandoning 'reversibility as no irreversible changes', I will now discuss a second potential objection. As discussed in 3.1.2, one of the implications of 'no irreversible changes' appears to be that the aim of a geoengineering project is to return the climate to a prior (implied to be unmodified) state – most like the pre-industrial climate. However, we have not yet seen a justification for why that is. If it could be shown that this was not necessary, then it would call into question why geoengineering is required to make no irreversible changes of its own. Put another way, if there is nothing inherently preferable about the 'natural' pre-industrial climate to a climate which has been modified (what I will term a 'novel climate'), then a blanket prohibition on making irreversible changes would not be justified.

We must first consider what is possible in trying to return a climate to a prior state. There is to a certain extent an inevitability that whatever climates we aim at creating will fail to be perfect reproductions of historic climates. Even in a scenario where carbon capture brings down the concentrations of atmospheric carbon to precisely the levels they were at (averaged, globally) in pre-industrial times, the climate is still likely to be different for the simple fact that the conditions which produce 'climate' are too complex and complicated to be reduced to any single factor such as concentration of CO_2.[373] The best that we are likely to create is an inexact reproduction, which might resemble a pre-industrial climate in certain features (for instance globally averaged temperature)

[373] Moreno, C., Speich Chassé, D., Fuhr, L., (2016) Beyond Carbon Metrics – Global Abstractions and Ecological Epistemicide. *Heinrich Boell Foundation Publication Series Ecology*. Vol. 42. pp. 1 - 52.

but at the same time the result will likely be an entirely novel constellation of climate features – a 'novel climate'.[374]

While in the scenario above, a novel climate is the outcome of an earnest attempt to recreate as closely as possible a previous 'natural' climate, we should note that this is not the only circumstance in which a novel climate might arise. The same tools that allow us to manipulate the climate to counter the effects of climate change also allow us to alter the climate for other reasons too, including intentional creation of 'novel' climates. While geoengineering discussion today is almost entirely limited to reverting the changes unintentionally made through the burning of fossil fuels, previous generations upon discovering climate altering techniques participated actively in discussions of the possibility of intentionally creating novel climates. This idea was reasonably prominent in earlier discussions of geoengineering. A prominent theme in justifying research into climate modification techniques in the former Soviet Union was the possibility it had to rid the peoples of Siberia of the troubles of extreme cold, for instance.[375] While it is unlikely that such a scenario would be preferable, we might reasonably ask whether any intentionally designed climates, should they be feasible to create, might be just as preferable as an accurate recreation of any past state?

It is worth stating explicitly here that it is *unlikely* that any truly novel climate (i.e., one which diverges in a substantial way from the pre-industrial climate, or isn't at least a facsimile of it – the kinds which early research into climate modification imagined) is very unlikely to actually be ecologically as-good-as, or preferable too climates which resemble the natural Holocene condition. The danger of climate change is that the rate of change is faster than ecological communities can adapt to those changes. While it is evident that there are stable, and arguably beautiful/flourishing novel ecological communities which currently exist, these are typically local examples which are the exception and not the rule.[376] We should not expect it to be possible to plan and reasonably predict the complexities of global climate well enough to seriously design functional novel climates. These debates here, where they applied to seriously novel climates, are then broadly theoretical

With the exception of Katz (whose theories I gave reason to reject), it's not clear from any of the authors reviewed why 'novel climates' might be necessarily less preferable than 'natural' or facsimiles of natural ones. For instance, Richard Sylvan was open to 'ecological improvement' if the implied improvement is done for nature's sake. Again, it is not obvious why (at least in theory) a novel climate as a genuine improvement from nature or the least bad option under the circumstances could not be permitted here. Leopold's maxim 'A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends

[374] A more technical discussion of 'novel climates' can be found in William's and Jackson. They define 'Novel Climates' as climate states without modern or past analogues. See: Williams, J.W., Jackson, S.T., (2007), Novel Climates, No-Analog Communities, and Ecological Surprises. *Frontiers in Ecology and the Environment*. Vol. 5 pp. 475-482.

[375] Many fascinating musings on the potential uses of climate control are found in Rusin and Flit's 'Man Versus Climate' – a popular science book on the topic produced for Soviet and international audiences in 1968. Many examples can be found attesting to the centrality of warming Siberia in Soviet climate control thinking. While considering the climate effects of a dam across the Bering Strait, the authors write: 'The permafrost would disappear and Siberia would become just as warm as the Ukraine. Muskovites would suffer from frosts no longer… orchards would bloom in the extreme north… and there would be no morning frosts.' Rusin, N., Flit, L., (1968) Rottenberg, D., (trans) *Man Versus Climate*. Moscow, Progress Publications. p. 142.

[376] Some examples of these can be found in Peirce, F., (2016) *The New Wild*. New York, Icon Books.

otherwise' seems like it could allow for a novel climate too if such a thing was similarly stable and beautiful. [377]

Given the apparent permissibility of novel climates, it seems we have cause to reject the 'reversibility as restoration' requirement. Geoengineering programs might not be required to restore nature to a facsimile of a previous state, provided that the condition they do create once they are ended is ecologically preferable to the alternatives, and secures the required climatic goods required for the flourishing lives of Earth's human and nonhuman inhabitants.

3.1.3 Reversibility as Self-Obviation

Having rejected the interpretation of reversibility as 'no irreversible' changes, we are left with the interpretation of 'cessation' as being the most justifiable understanding. However, cessation alone is a remarkably permissive criterion. As we have seen, almost all forms of geoengineering seem able to pass the threshold of simply being *possible* to terminate. Additionally, we should not that a simple possibility that a geoengineering project *could* be ceased is no guarantee that it ever will be terminated. Therefore, in this subsection, I argue for a more restrictive account of reversibility as cessation, informed by my discussion of Paul Taylor.

In our discussions of Taylor in Chapter 3, I argued that his second criterion for legitimate restitutive interventions in nature, 'cause no permanent harm', should be interpreted as implying a necessary condition of reversibility for harmful interventions (including geoengineering). I argued that we can understand from Taylor's advocation of captive breeding programs that 'permanent' means that harms can be caused, even on a multi-generation basis, so long as the harmful program's discontinuance conditions are planned for from the beginning and are the aim of the project itself. The technical term for this condition is that a restoration program must be 'self-obviating' – it must work towards a condition where it is no longer needed. Taylor's own example of this is a captive breeding program for endangered species. This program causes harm, i.e., the captivity and intensive management of a population of birds with all the discomfort and suffering this implies; with a duration of potentially many years and generations (of the birds involved). For many of the individual birds involved too, the harm of captivity is no doubt permanent in the sense that they will spend the rest of their natural lives in captivity. However, Taylor argues that such a program is compatible with 'respecting nature'. I argued in chapter one that the likely reason Taylor saw no conflict between this and the principle of causing 'no permanent harm' was because the captive breeding scheme is 'self-obviating'. The aim of the scheme is such that if successful it no longer needs to exist. The success condition of a captive breeding scheme is that there is a healthy population of whichever species is involved outside of captivity, thus removing the need for continued captive breeding and the associated harm.[378] Conversely, a zoo where birds are bred to be displayed has many of the same (permanent) harms but would not be justified because its success condition is not its own elimination.

'Self-obviation' might be a useful way to think about the cessation of environmentalist geoengineering, which is clearly based in Taylor's 'Respect for Nature'. It implies a more demanding criteria than simply the technical or social ability of a geoengineering program to be ceased. Simply being technically feasible to terminate a geoengineering program is a strikingly low bar to pass. For some geoengineering techniques termination may be difficult certainly, but in each case it is technically possible. Carbon capture machines can be switched off, iron fertilisation regimes ended, space mirrors taken down, basalt depositions ended for enhanced weathering etc. But and I think,

[377] Leopold, (1949) *A Sand County Almanac*. pp. 224-5. Note that while Leopold says 'preserve' we know that his understanding of nature can include some intentional transformations, so it does not on its own rule out a novel climate either.
[378] Taylor, (1986) *Respect for Nature*. p. 196.

crucially for Taylor's ability to accept any of these programs, the ability for these programs to cease is no guarantee *that they will be*. As we have seen, there are strong perhaps perverse incentives for geoengineering programs to be continued once they have been begun.

Reversibility as self-obviation rather than as cessation asks instead that not only is it technically possible to bring the program to its end, but that (like the captive-breeding program) the *raison d'être* of the program is that it that it should not be needed, and therefore it aims for its own elimination. In other words, the success condition of the project is the creation of a condition where it is no longer needed. This means creating an incentive structure or governance regime for the program that is managed in such a way as to cut down on or remove the incentives to continue the geoengineering scheme beyond its intended life-span (whatever that might be). We cannot here go into the full details of how this might work in every case – such a task is beyond the scope of this chapter. However, in the case of a carbon capture program one way to remove or limit the incentives to continue running the program semi-permanently would be to ensure that a carbon capture program be kept outside of private ownership as an independent public body. Currently carbon capture technology is heavily invested in by fossil fuel companies, who likely have incentives to continue the use of fossil fuels into the future and bank on carbon capture technology as a way to ensure that can happen. This creates an incentive for carbon capture to be used almost indefinitely, and thus would violate the demand for self-obviation. If on the other hand, a public body regulated carbon capture and set limits on how much would be deployed annually, they could leverage this to ensure that emissions reductions occur. This is of course not a fool-proof system – publics too may well have incentives to prefer high emissions or a slower transition from fossil fuels (for instance, states and publics whose wealth are dependent on fossil fuel industries such as Norway or the Gulf States), but while not sufficient, it may be a necessary step to ensuring a program can be self-obviating.

Here we should anticipate a challenge that a demand to make environmental modifications self-obviating would ask too much, for instance, by entailing a prohibition on constructing new buildings with the intention of maintaining them indefinitely, or permanently establishing agriculture on previously uncultivated lands. After all these are certainly intended to be permanent changes without any self-obviating design. In the first case Taylor might object that these are not 'harmful' in the way that geoengineering would be, thus there is no need to try and legitimate the wrongdoing. However, this is not likely to succeed on its own, as it seems that at least occasionally these modifications are going to entail harm: for instance, via habitat loss in the case of agriculture. Note though that Taylor neither does nor can commit to saying that 'Respecting Nature' entails a commitment to never causing harm (even scratching my nose causes untold harm to the microbial communities thereupon), rather that harm caused must be justified. So, while we might think Taylor will say it is better to have never caused the harm to begin with, he must make some allowances for necessity.

Taylor is still able to respond to these cases without compromising the role 'self-obviation' plays. Taylor's requirement that legitimate interventions 'cause no permanent harm' is only one aspect of what he considers 'respecting nature' to look like. An additional duty is the 'duty of restitution'.[379] In the case of housing or farming, this would mean to the extent these interventions remove nature from one place, there must be an equivalent return elsewhere to compensate. In these cases, the

[379] Taylor, (1986) *Respect for Nature*. p. 189.
While this is likely how Taylor will respond to this challenge, there are questions to be raised here too: particularly Taylor seems to believe that a harm done to an individual entity token (say a pine forest which has been felled) can be recompensed with restitution to the entity type (reforestation of pine forest elsewhere). However, it is not clear why we should think obligations can work this way – I certainly wouldn't feel recompensed if, having been robbed, insurance pay-outs were made to someone who shares relevant characteristics with me.

ability to compensate effectively accounts for the harm done, so there is no additional need to make the harm 'non-permanent'. This is in contrast to geoengineering, where unlike a parcel of land, it is not clear what a fair compensation would entail. Like an endangered species, there is no opportunity to compensate for the loss. We cannot make new species to replace the ones which are lost, just as we cannot commensurate the loss of an unaltered atmosphere with a separate new example. Given that there is no alike substitute for the atmospheric status quo, the best way to rectify the harm is by making sure it is non-permanent and in service of a separate good. Hence, self-obviation becomes a useful way of thinking about how a geoengineering program can meet the reversibility criteria.

We might also think that 'self-obviation' can help alleviate some of the concerns that motivate 'reversibility as non-irreversible changes'. As I argued, 'no irreversible changes' appears to be motivated by a desire to preserve something valuable in (unmodified) nature. However, I have argued this interpretation does not seem to be tenable if we think that the restoration of nature's value is dependent on creating a state which is a material replication of a past state. This said, we might think that nature's value is not a result of its material form (such as a 280ppm atmosphere) that had occurred naturally in the past, but rather is a factor of the relationship between it and humanity. Specifically, we might think that (following Katz) that the value in nature is a factor of its independence from human management. Under this account, what we value in nature is its 'wildness' - absence of human intentional control in its current state. [380] If we accepted this idea, then self-obviation, by requiring that geoengineering interventions eventually relinquish control over the Earth's biogeochemical systems, the value that they had in their unmanaged state can be returned. The importance of reversibility here isn't to reverse the climate to a prior material state, but to a prior relational state – on characterised by an absence, or highly reversed, degree of human influence and control.

Understanding self-obviation as aiming for a reversal of human control over natural processes can also help us think about what 'obviation' may entail in practice. It is important to remember our original definition of geoengineering, as being *intentional* modifications. Thus, geoengineering can be considered ceased if it is no longer occurring intentionally. Unintentional processes that capture carbon, such as natural forest growth, are by this definition not geoengineering. This helps us to understand how a demand for 'self-obviation' can respond to the fact that ongoing carbon capture may be needed to offset the emissions from hard to abate sectors. What the 'self-obviation' demand can be read as saying is that residual emissions from hard to abate sectors have to be reduced to a level where they do not contribute to a rising percentage of greenhouse gasses, because the total emissions they produce are captured entirely by natural processes or sinks. This somewhat matches the understanding of carbon-capture as mitigation in IPCC reporting that was discussed in Chapter One, where geoengineering carbon capture is implied to be emissions captured over a presumed 'natural' baseline contributed by 'natural' un-engineered processes.

3.1.4 Conclusions

'Reversibility' is a recurring criterion for an ethical or otherwise justifiable form of geoengineering. This section has used our discussion of environmental ethics throughout the thesis to inform and interpret what a demand for reversibility actually entails. I have argued that an interpretation of reversibility as requiring a geoengineering program make 'no irreversible changes' is likely unjustifiable. Drawing on various environmental ethics positions, I have argued that our obligations

[380] For a defence of this idea, see: Vogel, (2003) The Nature of Artefacts. pp. 149-168.

Note that while there are parallels with Katz in seeing nature's value as dependent on the degree of human influence in it, Vogel's defence of 'wildness' is a departure from Katz. Where Katz demands a totally absence of human intentional interference at any point in an entities history for it to be 'autonomous', Vogel only requires that an entity is currently out of human control for it to be considered 'Wild'.

to the natural world can likely accommodate at least some irreversible changes, even changes to the climate system. Given that 'novel climates' seem to under some circumstances be justifiable, we should conclude that there is no strong demand that geoengineering projects must produce no irreversible change. I instead argued for a modified and strengthened interpretation of 'reversibility as cessation'. More than just terminable, I argued geoengineering projects must be 'self-obviating'.

3.2 'Living with/Respecting Nature'

3.2.1 Introduction

Both Jamieson and the Tollgate principles demand that geoengineering programs do not violate ethical principles regarding the treatment of nature. For Jamieson the specific ethical principle is that we 'learn to live with nature'. For Gardiner and Fragnière, the principles that geoengineering should not violate is subdivided into two points: a principle that we should 'respect nature' and a second principle of 'ecological accommodation'. However, very little is provided in the way of how to interpret these demands, or even why they are understood to be different from one another. These two demands to 'Live with' or 'Respect' nature most clearly amongst the principles I have analysed here signifies a distinctively environmental ethics demand. Moreover, while they are included in both Jamieson's and the Tollgate Principles, they are frustratingly underdeveloped. Indeed, Gardiner and Fragnière recognise that these principles 'require further specification', and that their inclusion in the Tollgate Principle is simply to acknowledge that questions of environmental ethics need to be considered. So, what, if anything, can we say about a demand for geoengineering to 'Respect Nature'? Is such a thing possible for geoengineering to do, and if so, how will it influence geoengineering governance and design?

In order to proceed with this discussion, we need to further specify how a demand to 'respect nature' is being interpreted. Gardiner and Fragnière specify that their demands for 'Respect for Nature' and 'Ecological Accommodation' are violated when '[geoengineering programs] call for the wholescale domination and annexation of nature for the sake of human aggrandisement'.[381] Gardiner and Fragnière's concern is that failing to 'respect' or 'accommodate' nature involves (following Taylor) failing to recognise some value it has which demands a degree of ethical treatment other than 'wholescale domination and annexation'.[382] Jamieson also appears to understand calls to 'respect nature' as a demand to not dominate it. In a 2009 paper he writes:

> While it may be difficult to say what exactly the duty of respect for nature consists in, it seems clear that where there is such a duty, human domination violates it.[383]

This thesis considered an explanation of the wrongdoing of geoengineering in terms of 'dominating nature' in two place – in Chapter 4, in my discussion of Eric Katz, and in Chapter 5 on Adorno and Horkheimer. In both cases, I argued that non-anthropocentric readings of 'dominating nature' failed to adequately explain the purported wrongdoing. I argued that 'nature', (or at the very least the non-conscious aspects of nature), cannot be 'dominated' in the literal sense of the word.[384] Therefore if an account of 'dominating nature' is going to succeed in showing the wrongdoing of geoengineering, it must either be as an analogy for a different kind of harm, or, by showing 'dominating nature' must necessarily entail an additional harm to an uncontroversial morally relevant subject, such as human persons.

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[381] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 166.

[382] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 166.

[383] Jamieson, (2010) Climate Change, Responsibility and Justice. p. 440.

[384] This is in line with many other environmental ethicists. See, for instance, Leiss, (1974) *The Domination of Nature.*

Nonetheless, even having excluded strictly nonanthropocentric accounts of dominating nature, this thesis has examined other ways of understanding of this purported phenomenon. These correspond to P3B and P3C of the argument presented in Chapter 5 Section 1.1. The former suggests that when we dominate nature we wrong ourselves, because dominating nature is unvirtuous or is the kind of activity that precludes living a full and flourishing human life. The latter suggests that dominating nature inevitably entails or is causally responsible for the domination of persons. It is worth considering both of these interpretations in turn, as each will have different implications for what a geoengineering program that meets a demand to 'live with nature' could look like.

3.2.2 Resisting Human 'Aggrandizement'

Let us consider the first interpretation. 'Living with Nature' involves not dominating it, and dominating nature is wrong because it is unvirtuous or otherwise harmful to oneself to be a dominator. As stated in 2.3 there might be some reason for thinking that Gardiner and Fragnière see the harm of not 'living with nature' in this way. While only offering tentative thoughts on what 'living with nature' involves, they suggest it is clearly violated when 'some call for the wholescale domination and annexation of nature for *the sake of human aggrandizement*.'[385] The use of the term 'aggrandizement' here has obvious virtue-based interpretations. We might notably link it to the vice of hubris – a charge often levelled at geoengineering.[386] The idea here appears to be that acts which increase human power over nature (including geoengineering) result in an inflated sense of human worth or superiority, and thus fail to 'live-with-nature'. Living-with-nature then entails re-evaluating the presumed superiority of human beings and recognising our place (living with) as an equal part with other natural entities.

We should first acknowledge the limitations of this account at explaining the wrongdoing of 'dominating nature'. The trouble, as discussed in Chapter 5, is that such an account simply abstracts the problem with dominating nature. If there is something wrong with 'the total annexation of nature' or failing to treat it with humility, we must explain what that is. I might wrong myself when I wrong my fellow humans, but I likely don't when I 'mistreat' a rock on the beach. The secondary wrong that is incurred to myself is fully dependent on there being an actual original instance of wrongdoing – and if it is not possible to wrong non-conscious nature, then I cannot wrong myself when I mistreat, or fail to 'live with' it. Thus, if this is the correct reading of the Tollgate demand to 'live with nature' further justification for why we should do this will be needed, and as I've argued throughout this thesis, nonanthropocentric accounts of this do not appear to be forthcoming.

The question that we must ask is whether geoengineering's contribution to human aggrandisement is a necessary or simply an accidental feature. This is something we must know if we are going to determine what a geoengineering program that 'lives with nature' will look like. The tantalising prospect in the wording of the Tollgate Principle's is that if geoengineering was not performed for the sake of 'human aggrandisement' it might be compatible with 'Living with Nature'. Perhaps if geoengineering was performed out of a desire to preserve, or act in solidarity with, the other sensible living things for whom climate change presents a threat, it would not be an act of domination. We might think that in such a geoengineering program, humans, recognising themselves to not be superior to, but an equal part of the natural world, might nonetheless employ their distinctly human faculties to prevent harm to their nonhuman neighbours.

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[385] Gardiner, Fragnière, (2018) The Tollgate Principles for the Governance of Geoengineering. p. 166. Emphasis own.

[386] See: Meyer, Uhle, (2015) Geoengineering and the Accusation of Hubris.

Note also that Katz, the subject of chapter 4, makes a link between dominating nature and the vice of hubris too. Katz, (1997) Preserving the Distinction Between Nature and Artifact. p. 77

An interesting parallel case to think about is debates within the conservation movement about 'assisted migration'. Assisted migration refers to efforts or proposals to relocate populations of animals whose current habitats may be threatened (by climate change or otherwise) to new suitable locations where the species is not currently present (and may not have been present historically either). Both assisted migration and geoengineering appear to raise the same concerns for certain strongly non-interventionist environmentalists. Both can be responses intended to reduce the harms of climate change, but attempt to do so by intervening, managing, and or manipulating natural processes. Both interventions, we might think, appear to violate or disrupt a duty to preserve natural systems free from human control.[387] But whatever we might say about the acceptability of assisted migration to conservation strategy, it seems unlikely that we would say it contributes to 'human aggrandisement'. The reason it seems, is that assisted migration seems (at least in some circumstances) to have significant benefits for nonhuman natural entities, and only comparatively limited benefits for humans themselves.[388]

Perhaps some forms specific forms of geoengineering might be morally equivalent or at least relevantly similar to assisted migration. One of these methods might be microbubble reef shading (discussed in Chapter 1, Section 2.2.3). This is a technique for cooling moderate to large areas of relatively shallow water by using water pumps to raise their albedo through generating a layer of tiny bubbles on the surface. Alternatively, reef shading might be achieved by 'seeding' the air above the reefs with sea-salt or other condensation nuclei to increase the formation of shading, low-lying marine stratus clouds. This method has been seriously considered as a method for preserving delicate coral ecosystems. Corals are extremely sensitive to changes in water temperature, and thus their survivability is highly threatened by climate change and there is little practical option for them to relocate to cooler regions. Reef shading therefore seems like one of the few options to preserve these ecosystems.[389]

Reef shading clearly has instrumental benefits for humans. Humans like coral reefs, they often like to visit them, and they pay good money for the privilege. For many, oftentimes indigenous communities, they are a major source of protein. Communities who live alongside reefs may take a great deal of meaning from their relationship with that ecosystem, may even define themselves by the relationship they have with the reefs. On a more abstract level, generally it would feel like a great loss to me if there were no coral reefs, even though I may never see one in person, use it as a source of food, or even have any kind of special communal relationship to an individual reef. Based on all of this it seems that there is clearly instrumental benefit, directed to human persons alone, to using reef shading. Nonetheless it seems that any instrumental gains for human persons are paltry compared to the benefits coral reefs and their inhabitants experience in being preserved from an existential threat. It is difficult to see how an objection based on human aggrandisement would apply here. We might reasonably think of this as an action motivated by a genuine concern for

[387] For an overview of the ethics of assisted migration, see: McCoy, E.D., Berry. K., (2008) Using an Ecological Ethics Framework to Make Decisions about the Relocation of Wildlife. *Science and Engineering Ethics*. Vol. 14. pp. 505–521.
Larson, B., Palmer, C., (2013) Assisted Migration is no Panacea, but Let's Not Discount it Either. *Ethics, Policy and Environment*. Vol. 16. pp. 16–18.
Albrecht, G. A., Brooke, Bennett, C. D., Garnett, S. T., (2013) The Ethics of Assisted Colonization in the Age of Anthropogenic Climate Change. *Journal of Agricultural and Environmental Ethics*. Vol. 26. pp. 827–845.
[388] Of course, there are plenty of instrumental reasons why humans may want to preserve natural environments and may turn to assisted migration to do so.
[389] Anthony, Helmstedt, Bay, Fidelman, Hussey, Lundgren, Mead, McLeod, Mumby, Newlands, Schaffelke, Wilson, Hardisty, (2020) Interventions to Help Coral Reefs Under Global Change. pp. 1–14.

preserving natural value (largely) for nature's own sake.[390] On this account of 'living-with-nature' at least, it seems like some geoengineering options might be reconcilable.

Is it possible then to draw more general lessons? One thing that seems important is not limiting this treatment to especially charismatic and instrumentally valuable ecosystems like coral reefs. If geoengineering can be about genuinely living with (all of) nature, it must strive to be species- or ecosystem- impartial.[391] This might mean extending the protections of technological interventions even when it is significantly costly or inconvenient to do so. This seems to follow from treating geoengineering as a form of reparation (See Chapter 3 Section 2.2) – if geoengineering is to be legitimate it may be as a way of repairing and taking responsibility for the prior harm caused by anthropogenic climate change. Ensuring that protective measures are extended even to cases where benefits to humans are limited ensures that meeting this interpretation of living-with-nature does not simply depend on an issue of how an intervention is discursively framed. It is one thing to claim that a geoengineering intervention is done out of solidarity or reparation to a vulnerable ecosystem, and another thing to prove it by ensuring this is done even when the purely instrumental cost-benefit calculation is unfavourable to human beings.

Additionally, we might moreover think that part of the reason that assisted migration can be legitimate is the ability to make precise and locally specific interventions. Conservationists can determine which species are most in need of relocation, will be least disruptive to the ecosystem they are translocated to, how harms might be best ameliorated. This could be decided on a species to species, or an ecosystem by ecosystem basis. Perhaps this is why it seems compatible with a demand to 'live-with-nature', because doing so requires us to have this intimate knowledge of our co-inhabitants and be able to tailor our interventions to attend to local needs rather than use one-size-fits-all interventions.[392] Microbubble shading on reefs seems remarkably able to attend to this need, given its small(er) scale and locally bound effects. However other forms of geoengineering (which is by its nature large-scale) are less equipped to make such targeted interventions. Nonetheless, occasionally claims have been made for other 'targeted' uses of solar radiation management to ameliorate specific climate change impacts in particular locations.[393] MacCracken for instance considers the use of sub-global scale SRM use, (including but not limited to microbubble shading) to limit arctic ice and permafrost melt, in order to preserve those ecosystems.[394] We should treat these kinds of claim with due scepticism over their possibility of success. However, it is difficult to see how, (provided they succeed) targeted interventions to benefit nature might violate a duty to live-with-nature.

3.2.3 Avoiding the Instrumentalization of Nature

The second way to understand the wrongdoing of dominating nature is through a causal relationship it is purported to have with the domination of humans. I discussed this argument in Chapter 5 on Adorno and Horkheimer. They argued that seeing nature as only instrumentally valuable

[390] It is of course possible to imagine anthropocentric justifications for doing so even when the costs outweigh the instrumental value (look at how powerful out technical skill is – we saved the reef!). My claim here is more modest – that doing so even when the action is costly would be *evidence* that nonanthropocentric motivations are at play.

[391] Taylor places a great deal of emphasis on this point in his formulation of 'Respecting Nature', as do many other environmental ethicists. See: Taylor, (1986) Respect for Nature. pp. 45-46.

[392] This might speak to a Leopoldian demand to not 'Remodel the Alhambra with a Steam Shovel'. See: Chapter 2, Section 4.4.

[393] MacCracken, M.C., (2009) On the Possible Use of Geoengineering to Moderate Specific Climate Change Impacts. *Environmental Research Letters*. Vol. 4. Is. 5. 045107.

[394] Though undoubtedly also because those environments are critical to global climate in a way humans are highly instrumentally reliant. MacCracken, (2009) On the Possible Use of Geoengineering to Moderate Specific Climate Change Impacts. pp. 7-9.

involuntarily creates a system where humans are seen as only instrumentally valuable too. This was evident, they thought, in the lack of an institutional mechanism within capitalist modernity for recognising the value of humans or nature for anything other than the generation of profit, and in doing so, the reproduction of the entire system. Following this interpretation, a call to 'live with nature' becomes a call to alter a mode of production that reproduces domination of humans through the continuing 'domination' of the natural world. 'Living with Nature' might then mean abandoning a system where 'geoengineering' is produced as a solution to the problem of climate change over urgent emissions mitigations efforts.

As Clive Hamilton writes:

> Like a patient who will accept the doctor's diagnosis only if the illness is treatable, a solution to global warming that does not destabilize a person's worldview—but in fact validates it—makes recognizing the problem palatable… geoengineering is the kind of solution to climate change that is … consistent with the ideas of control over the environment and the personal liberties associated with free market capitalism. [395]

We might interpret geoengineering programs as working to structurally buttress capitalist modernity by either eliminating the need for a renewable energy transition, or at least expanding the time allowed for it to happen.[396] It does this, as Hamilton expounds, by allowing the system to respond to the threat posed by climate change in a way which does not fundamentally challenge its governing assumptions. Moreover, it is the role it plays in system reproduction through which geoengineering becomes linked to the continued domination of humans and nature: by allowing a system that does not (and cannot) treat them as ends-in-themselves to persist.

But acknowledging that the wrongdoing of a geoengineering program (within modernity) is linked to its ability to reproduce an exploitative system opens an interesting corollary. The corollary of this is that if a form of geoengineering did not contribute to reproducing modernity, it would not entail wrongdoing. Perhaps this might be a way to understand what a demand to 'live-with' or 'respect-' nature might entail. A geoengineering program that was structurally antithetical to capital would not act to reproduce a system of domination in the same way.[397] While it would not on its own usher in an entirely new means of valuing humans and nature, it might not entail wrongdoing through assisting with the reproduction of an unjust order. Thus, if it could be shown that a geoengineering program could be designed to be antithetical to capital's needs, then the link between dominating nature and the wrongdoing of dominating persons would be severed. This would not show that non-human nature was not being treated entirely instrumentally but rather that the link between dominating nature and dominating persons can be broken. I will now sketch two suggestions for geoengineering project designs that appear to be antithetical to capitalist modernity's needs.

The first comes from Andreas Malm and Holly-Jean Buck.[398] These authors argue that so long as the carbon-capture industry is governed by capitalist imperatives, there is no incentive to store captured

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[395] Hamilton, C., (2003) *Earthmasters: The Dawn of Climate Engineering*. New Haven, Yale University Press. p. 90.

[396] This is not a novel argument. See: Surprise, K., (2018) Preempting the Second Contradiction: Solar Geoengineering as Spatiotemporal Fix. *Annals of the American Association of Geographers*. Vol. 108. Is. 5. pp. 1228 – 1244.

[397] Note that this is likely a necessary but not sufficient condition – Adorno and Horkheimer do not think the 'domination of nature' is a condition only found in capitalist modernity, and it's perfectly possible that other forms of economic organisation might be similarly instrumental in their reasoning. See Marcuse's notes on the instrumentalist character of the Soviet system in One Dimensional Man for instance. Marcuse, H. (1964/2002) *One Dimensional Man*. London, Routledge (Classics).

[398] Buck, H.J., (2019) *After Geoengineering: Climate Tragedy, Repair and Restoration*. London, Verso.

carbon, but instead to find other ways to commodify it (e.g., making it into low-carbon fuels, or using it to frack hydrocarbons out of the ground). Malm writes:

> Just throwing the CO_2 away, locking it up in cellars where it must never again be touched, is no way to accumulate capital. It negates the logic of the commodity, because non-consumption would here be the innermost essence of the operation.[399]

This dynamic, they argue, demands that the state is empowered to impose sweeping nationalisations of these technologies, running them not to make profits for shareholders but as genuine public goods. Suffice to say that the program of state-run decommodification is not, in Hamilton's words, 'consistent with the ideas of control over the environment and the personal liberties associated with free market capitalism'.

The second proposal is that of the global peasant's union *La Via Campesina.* I have argued elsewhere that their design for a carbon capture program seems to be resistive to the needs of contemporary capitalism.[400] They propose that a widespread switch to agro-ecological principles would result in large-scale carbon-capture through the construction of new soil.[401] They also claim that these agro-ecological principles cannot be reconciled with 21st century capitalism's structural reliance on 'cheap' food from the global periphery.[402] If this assessment is correct, then the way their project is designed would hinder the reproduction of capitalist modernity, rather than help it persist into the future. This would make it hard to see how geoengineering in this way would entail wrongdoing via the reproduction of domination (of persons), since the program of carbon capture they envision is simultaneously carbon capture and transformative social change in combination.

What these examples show is that not all geoengineering programs are necessarily amendable to the needs of, and values prominent in, capitalist modernity. If this is the case, then they do not seem to entail wrongdoing through the perpetuation of a system that dominates people. In fact, they seem to hinder its advance. Is this enough to show that they help us 'live with nature'? Just showing that they hinder the reproduction of a system which treats nature instrumentally does not on its own show that they do not have an instrumental valuation of nature as well. However, this does seem like an important stepping-stone to a geoengineering that values nature differently. After all, Adorno and Horkheimer's argument is that capitalist modernity cannot value nature as an end-in-itself. Showing that there are forms of geoengineering which do not reproduce capitalist modernity is therefore a necessary, if not sufficient, step forward. They do not usher in a new way of valuing nature, but they certainly do not help a system that currently fails to 'respect nature' to persist.

3.2.4 Conclusions

Both Jamieson and the Tollgate Principle's include demands to 'live with' or 'respect' nature. They explain these as being related to an imperative to not 'dominate' nature. This is likely not the only way to understand what these demands could involve – for instance, a call to 'respect' nature clearly recalls the work of Paul Taylor, though he does not explain wrongdoing towards nature in terms of domination. Nonetheless, this section has tried to examine what a geoengineering program might do to avoid dominating nature. It looked at two different explanations of what 'dominating nature'

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[399] Malm, A., (2021) *Corona, Climate, Chronic Emergency: War Communism in the Twenty-First Century*. London, Verso. p. 147.

[400] Woodhouse, E., (2021) Ecofeminism, Afforestation and La Via Campesina. In Shübel, H., Wallimann-Helmer Ivo., (eds) *Justice and Food Security in a Changing Climate.* Wageningen, Wageningen Academic Publishers. pp. 77-85.

[401] La Via Campesina, (2010). Position Paper: Small Scale Sustainable Farmers are Cooling Down the Earth. *La Via Campesina Views.*

[402] On the concept of 'cheapness' here, see: Moore, J.C., Patel, R., *History of the World in 7 Cheap Things*. Berkley, University of California Press.

could involve, and tried to draw out how geoengineering programs might be designed in order to ameliorate this concern.

The primary way involved understanding 'dominating nature' as acts which contributed to human 'aggrandisement', by positioning human beings as superiors to the rest of the natural world. I argued that geoengineering techniques might avoid that charge if they were framed, and deployed, as interventions in solidarity with the other morally important parts of the natural world. This was not strictly an issue with how an intervention was framed, but might be evidenced by extending protections via targeted geoengineering interventions to protect threatened species or ecosystems (such as coral reefs) even where the instrumental value to human beings was comparatively low. Such interventions that are costly to humans but highly beneficial to (parts of) nature do not seem to be a project solely of human aggrandisement and might therefore be understood as compatible with 'living with nature'.

The second way of understanding the wrong of dominating nature (and therefore failing to live-with-it) was because doing so entailed wronging other humans. On this Adorno and Horkheimer inspired reading, learning to live with nature is a necessary pre-condition to ending a system or social structure that entails the domination of people. Geoengineering does this, we might think, through allowing capitalist modernity to reproduce itself through the structural crisis presented by climate change. However, I have argued, it is possible to imagine ways of doing geoengineering that seem to hinder, rather than help, this process of system reproduction. If geoengineering was done through a nationalised program, that put measures in place to ensure it could not be used to 'offset' emissions then it seems resistive to the interests of capital. Similarly, the carbon capture program imagined by La Via Campesina seems to be structurally incompatible with contemporary capitalism's reliance on cheap expropriations from the global south. If my reading of these geoengineering proposals is correct, it does not necessarily show that geoengineering is compatible with living-with-nature, but it would de-link geoengineering from the purported harms of dominating nature (the domination of persons).

4.0 Conclusions

In this chapter I have argued that previous attempts to include environmental ethics concerns into policy guidance for the governance of geoengineering have been inadequate. This chapter has attempted to improve on principles included in previous governance desiderata: specifically questions around 'reversibility', and 'living with nature', by putting them in close conversation with central positions in environmental ethics. Of these, no principle seems to fully rule out geoengineering.

Our discussions in 3.1 both broadened and deepened the discussion of 'reversibility' as a condition for ethical geoengineering. I argued that an interpretation of 'reversible' as 'restoring a prior natural state' was untenable. The unexpected conclusion from rejecting reversibility-as-restoration was that environmentalists might be open to intentionally create 'novel' climates – provided they were just as capable of meeting the requirements of their inhabitants as 'natural ones' are. I argued that the most compelling interpretation of 'reversibility' was as 'self-obviation'. Drawing from Taylor's work, I argued that geoengineering projects might be able to meet his standards of respect for nature if they aimed at their own elimination – something which is not a given in contemporary discussions of geoengineering strategy where carbon capture projects may be planned to continue indefinitely into the future. However, with the correct governance mechanisms in place, there is no reason why a geoengineering program should be incapable of meeting this requirement.

In 3.2 I consider what it would take for a geoengineering program to 'live with nature'. I argued that if we understand 'living with nature' as the opposite of 'dominating nature', there are ways in which geoengineering programs could be designed that can ameliorate that worry. I considered that using

targeted geoengineering interventions to protect fragile ecosystems from climate change induced damage, regardless of the instrumental value to humans, did not seem to contribute to human 'aggrandisement', but might instead be seen as an act of solidarity with fellow members of the natural world. Similarly, I argued that geoengineering projects could be designed in a way that are antithetical to capitalist modernity's needs. While this on their own would not show they treat nature in a non-instrumentalist manner (I.e., 'live with nature'), it would show that they do not themselves contribute to perpetuating a system where nature is only viewed instrumentally.

This chapter has aimed at improving already existing proposals for environmentalist geoengineering. However, it cannot on its own resolve all these problems, nor can it in any way be an exhaustive exploration of what an environmentalist geoengineering could involve. Indeed, many of the principles proposed here require a great deal more specification themselves before they could be considered as policy proposals. Nonetheless, I believe the conversations begun here can be a useful starting point for thinking about how environmentalists can contribute to geoengineering governance debates. These proposals will help us consider what a geoengineering program that does not 'mess with nature' might look like.

Chapter 7 - Conclusions

At the time of writing this thesis (2023), an observer from the global north gets a palpable sense of the kind of transition which geoengineering is undergoing. Carbon Capture's days as scientific taboo are well and truly over. Living and working in the UK, hardly a day goes by where the machinery of advertisement you are constantly subjected to fails to serve you up a product which claims to be 'carbon neutral' or professing a 'net-zero' goal. These claims might barely register to the average consumer, but they implicitly rely on ongoing or, more likely, promises of carbon being sequestered now or in the future, facilitated via carbon credit trading or voluntary offsetting. These are the first tendrils of normalisation creeping into everyday life. But there is still no broader organisational strategy around carbon capture, beyond a tacit understanding that our hopes for keeping warming under 1.5 °C rely upon it happening, soon, and on a much greater scale than it is now. The IPCC currently do not recognise any strategies for preventing greater than 1.5 °C of warming which do not include some amount of carbon capture, and most of this is envisioned to be through BECCS. Currently, planning for carbon capture essentially occurs on a national basis, with different governments setting their own net-zero targets and divvying up funds for research and development on that basis. The only international basis for carbon capture is currently the aging legislation around carbon trading, first introduced by the Kyoto Protocol, and inherited under the Paris Agreement.[403] This is widely expected to be undergoing major reform in the near future to better reflect the changing landscape of carbon trading, with new statutory national schemes as well as a fast growing but essentially unregulated private or 'voluntary' market for offsets – the type we see underpinning the claims we find on our protein bars, as optional extras for our flights, or for parcel delivery.

Solar Radiation management too seems like it is on the cusp of a major revolution. The announcement that US start-up 'Making Sunsets' had, however ineffectually, begun making balloon flights to deposit sulphur dioxide aerosols in the stratosphere was something of a wake-up call to many, and injected the previously obscure topic into public consciousness. In the wake of this,

[403] UNFCCC (2018) *The Paris Agreement*. New York, Treaty Section of the Office of Legal Affairs, United Nations Headquarters.

Mexico, where the deployments had occurred, banned field trials of solar geoengineering.[404] However, fears over unilateral geoengineering deployment seemingly coming true do not appear to have rallied other governments to act like Mexico.[405] Quite the opposite in fact, as at the time of writing, the United States has commissioned a major high-level review of Stratospheric Aerosol Injections, the full version of which remains to be published. However, based on the published research plan, the full report is likely to express openness to the possibility of SRM use.[406] The future of SRM geoengineering has not yet been written, but one is keenly aware of how far the field has come from the research taboo that reigned 20 years ago. What this is to say, is that the future of geoengineering is anything but set in stone. While carbon capture is already happening to a certain extent, exactly how it grows and evolves, what form it takes, how it's governed, what its justifications are, are all very much to play for. This is even more true for solar radiation management, where whether deployment occurs is still very much an open question.

It is within this context of uncertainty over the future of geoengineering that this thesis is intended to be read. Geoengineering is a fast-moving field and one only recently coming into the public eye. The parts are still in motion and views and opinions have not yet sedimented. It is within this context that environmentalists need to be able to articulate their views with clarity and confidence. This requires that they gain that clarity on what exactly their beliefs entail vis-a-vis the permissibility of geoengineering, both as a whole and on a technique-by-technique basis. Providing that clarity, or at least providing some of the steps towards it, is what this thesis set out to do. More specifically this thesis set out to explore what a number of core positions within the discipline of environmental ethics had to say about the moral permissibility of geoengineering. It did so against a backdrop where previous attempts at answering this question, especially that by Christopher Preston, argued that there was a widespread 'presumption' against geoengineering to be found in these ethical works. To a certain extent, this thesis can be seen as a refutation of Preston's claims in this area.

Contrary to Preston, this thesis has argued that many of the central positions within the discipline of environmental ethics are compatible with at least some forms of geoengineering. This was found in our reviews of Aldo Leopold, Richard Sylvan, Lynne White, Tom Regan, Paul Taylor, and Adorno and Horkheimer (and by extension those environmental ethicists which explain the charge of dominating nature in a way derived from them). This was an unexpected conclusion. Preston is right to identify that many, if not all, of these authors do seem to have strong *prima facie* objections to geoengineering, especially geoengineering as a system of intensive large-scale management of nature. However, in each of these cases, I have argued that the authors reviewed had second order principles in their ethics that allowed their broad presumptions against large-scale management of nature to be over-ruled. Effectively, these authors acknowledge occasions where duties to maintain nature in an untouched state, or otherwise limit our management of it, can be over-ruled to secure some other good; and it is in these instances which geoengineering becomes defensible for them. This was not the case for every author reviewed. In particular, the work of Eric Katz was an exception to this general rule that second order principles allowed for geoengineering where there was a general presumption against it. Katz's work does seem to thoroughly rule out geoengineering. However, I maintain that the general argument put forward throughout this thesis holds, because

[404] Government of Mexico Ministry of Environment and Natural Resources Communiqué. (Jan 13th, 2023) *Experimentation with solar geoengineering will not be allowed in Mexico.* Joint Press Release No. 3/23. Mexico, Mexico City.

[405] It should be noted that Mexico was previously amongst the most proactive supporters of SRM research, being one of just 11 signatories of a draft UNEA resolution calling for research into governance on geoengineering technologies. United Nations Environmental Assembly (2019) Geoengineering and its Governance. Resolution for consideration at the 4th United Nations Environment Assembly.

[406] Note the above report also considers 'Cirrus Cloud Thinning' which is not strictly speaking solar radiation management.

we have other compelling reasons to reject Katz's argument – in particular, I argue that in order to be able to convincingly rule out geoengineering, Katz proves *too much* and in fact rules out a host of other kinds of environmental modification which we would otherwise find to be morally unproblematic. Put another way, because of the implausibility of his account of our ethical obligations, we should not feel bound to try and live in accordance with Katz's ethics, thus when considering whether we should accept a geoengineering program, we do not need to consult whether Katz would find it legitimate. Katz was not alone in receiving this kind of criticism, I also argued that both Taylor and Regan are open to claims of over-extension and implausibility. However, in those cases, I argued that a plausible version of their ethics could be reconstructed and shown to approve (hypothetically) of geoengineering. This was not possible with Katz, although the chapter on Adorno and Horkheimer did try to illustrate how another system of environmental ethics based around avoiding 'dominating' nature could be advocated.

In general, this thesis has, unlike Preston's work, erred away from considering anthropocentric theories of environmental ethics. This was, in no small part, due to a belief that anthropocentric environmental ethics arguments against geoengineering are reliant on showing that there is human held preference against activities like geoengineering; as was the case in Hargrove, Rolston III and Elliot – who each argued that we have reasons to prefer unmodified nature to extensively managed or altered nature. Arguments of this kind are broadly unconvincing to me and seem at best trivially true – they describe the current state of preference, but do not imagine how preferences might be shaped in the future. The exception to this was Chapter five, which looked at Adorno and Horkheimer. While we did consider a nonanthropocentric reading of them, we found this to suffer from many of the same problems as we had identified in our readings of other strictly nonanthropocentric works, particularly a difficulty in identifying the source of nonanthropocentric value. Instead, we considered them primarily as anthropocentrically concerned, deriving their condemnation of 'dominating nature' from a concern over downstream domination of humans that they purport to follow necessarily from the domination of nature. Nonetheless, I argued that even the nonanthropocentric case fails to sufficiently explain why the scale of wrongdoing implied would entail a requirement to prohibit geoengineering. With this in mind, anthropocentric arguments against geoengineering have been by and large side-lined within this thesis. Further research should be conducted to properly consider whether a more robust argument against geoengineering can be found here.

The final chapter of this thesis considered how the conclusions reached in the preceding chapters can be used to inform and improve efforts at developing ethical guidance for geoengineering projects. Based on the broad conclusion reached by the thesis, that geoengineering is not inherently incompatible with a broad range of core environmental ethics positions, it takes the next logical step and applies their teachings to improving and providing advice for policy makers. I argued that my research into the environmental ethics work could provide useful guidance and improve pre-existing policy around the reversibility of geoengineering, as well as provide useful first steps on how to interpret requirements that geoengineering 'respect nature' or work towards a state where we can 'live with nature'. Necessarily due to the constraints of space, this thesis could not provide a full criteria for the governance of geoengineering on its own, nor could it provide commentary on all the principles that have distinctly environmental ethics relevance. My hope is that this thesis and the research put forward in the final chapter can contribute to future conversations around crafting criteria for a specifically environmentalist geoengineer. My major contention, after all, is that since environmental ethics does not seem to rule out geoengineering, environmentalists should take this pivotal moment in geoengineering development to stake their case and make positive contributions to the policy discussions on geoengineering development. If environmentalists remain at arm's length from these debates or refuse to involve themselves in them out of a (mistaken) belief that intentional climate control is not permitted by their ethics, they run the risk of geoengineering

developing without their useful input. The discussion from this thesis' last chapter can contribute to formulating a specifically environmentalist guideline for geoengineering best practice.

This thesis started by considering the well-attested public concern that geoengineering might 'tamper with' or 'mess with' nature. Within this thesis I chose to interpret this as expressing a moral concern about the normative implications of managing nature on a grand-scale through the use of geoengineering, rather than as a practical/empirical concern over our poor track-record as intentional environmental managers. To the extent that this reading of 'messing with nature' is the correct one (likely both readings are true), then this thesis can be seen as a highly qualified refutation of this worry. If we read 'mess with nature' as 'conflict with the demands of environmental ethics', this thesis has argued that at least some forms of geoengineering will not mess with nature. We must be careful to qualify our statement here – many forms of geoengineering will and/or do conflict with the proper treatment of nature. To this extent, the 'messing with nature' concern is well placed. What I hope to have shown is that there is no general case, in any of the authors reviewed, that they can show why geoengineering will in all instances 'mess with nature'.

What can we say on a more general level about the permissibility of geoengineering? Showing that some forms of geoengineering can meet the demands of environmental ethicists does not on its own show that geoengineering can be permissible. This is based on two grounds. Firstly, the forms of geoengineering that environmentalists can support are ineffective, will not arrive on a useful timescale, are not practical, feasible, etc. This means that while the definition of geoengineering can accommodate forms which would be ethical, those forms do not exist in the material world, at least in our time where the ethical question is of utmost importance. Secondly, it may be that non-environmental ethics concerns, e.g., concerns of interhuman justice rule out geoengineering. Showing that intentional climate modification does not inherently contradict the proper relationship between humans and the nonhuman world does not mean that it automatically passes through all the other ethical checks we must subject it too. If either of these two things was true, geoengineering will remain impermissible, or at best might be permitted as the lesser of two evils.

From where we are currently stood, we cannot know the future of geoengineering: if it will happen, when it will happen, how it will happen. But we must be prepared for every eventuality. We must be able to imagine the kind of geoengineering that would be most amenable to us, lest geoengineering develop in the absence of good guidance. What this thesis hopes to have provided is a stepping stone for environmentalists to begin and plan for a geoengineering that they can advocate for in good conscience.

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