Geological Filmmaking

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I, Alexandra Litvintseva, hereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Signature: Date:

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Abstract

In recent years, media studies has developed theoretical models which consider the material aspects of media technologies. In the context of the widespread ecological crisis, such studies have included analyses of media as products of the extraction of geological materials. My doctoral project of 'geological filmmaking' contributes to this growing set of discourses by experimenting, on a conceptual and artistic level, with the reciprocal relations between geology and film. Building on existing theoretical studies of the geological materiality of the filmic medium, it explores formal and temporal intersections between film and geology in order to engage with some of the representational challenges posed by the ecological crisis. 'The geological' here acts as a perceptual and cognitive extremity of the human (in)ability to grasp processes unfolding across vast spatio-temporal scales. Through an integrated theory-practice methodology my project takes two specific geological phenomena as prisms through which to explore the greater philosophical problems encountered at the intersections of human and geological timescales. In the process of making two films – one focused on sinkholes, the other on asbestos – the geological has revealed itself to be inextricably tied to socio-economic processes. It has thus become an urgent demand, requiring a response *here and now*. This study is an attempt to offer such a response. By reading film and geology through each other, I have staged an encounter between the moments in which their reciprocity illuminates key issues surrounding the anthropogenic ecological crisis, both in its vastness *and* proximity, its longevity *and* immediacy. I have also taken some steps towards outlining an artistic methodology for engaging with planetary ecological issues via the medium of film.

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Introduction

Fig 1. Still from *Salarium* (2017), Sasha Litvintseva and Daniel Mann

'Nature's cultural hall' reads a solitary sign in an arid desert landscape. A mountain range obscures the horizon and the sky is a cloudless milky haze. My camera is on a tripod capturing this scene, while the rental car idling behind me blasts the air-conditioning. Over the last three days I have calculated that I can keep the camera rolling for exactly ninety seconds before it overheats, shuts down and corrupts the file. The sun blinds me as I remove my sunglasses to set the exposure on the camera. Even within these ninety-second intervals the scorching sun dehydrates my body and burns my skin. To the naked eye this landscape does not betray any visible signs of what we tend to call life; without the slightest movement, the shot that emerges from this moment will be practically indistinguishable from a photograph. By now I've learned to sense when to end the shot without having to rely on the camera's clock. I run back to the car to cool the camera and myself before we can once again take another shot.

We are in the Judean desert just off the Dead Sea shore. It is late July and the temperature is 48 degrees Celsius. In July, it never drops below body temperature. Even in the middle of the night, it stays in the high thirties, and soon after the sun comes up, it is already in the upper forties. The sun here is in such excess that it obliterates its harnessing as a precious tourist commodity. In the extreme heat this tourist area is deserted, and my collaborator and I are able to park and shoot anywhere without obstruction. We have come here to make a film about the sinkholes that have been ravaging the Dead Sea coastline over the last forty years. The sinkholes are caused by anthropogenic interventions into the hydro-geophysics of the area, where over-extraction of minerals and the diversion of water from

River Jordan to irrigate desert orchards has lowered the sea level, leading to the creation of cavities under the surface of the earth. As we film just off the side of the road, there is a latent fear that the ground might collapse and swallow us, the camera, or even the car. When we encounter the sign reading 'Nature's cultural hall', both in English and Hebrew, it comes across as an unauthored pun describing this moment back to us with deadpan precision.

There is a seeming contradiction in this sign that cannot quite be resolved. The sign has a strange way of creating a proximity between nature and culture so that they merge into one, while simultaneously keeping their definitions intact and at a distance. The contradiction that is held in balance by this sign becomes a useful metaphor for the irresolvable contradictions involved in trying to read the ways in which different human and nonhuman processes that occur on incommensurate scales and temporalities are still intertwined. My doctoral project attempts to theorise points of exchange between many such processes, using the geological and the filmic as prisms. The geological here is seen, on the one hand, as a specific material reality, and, on the other, as a measure of time. Film, in turn, is approached as a form of technical media, for which the necessary materials are extracted from the earth, and also as a tool of spatio-temporal construction. Both my own experience in this desert and the resulting images emerge out of the intersection of several human and nonhuman processes, all of which are intertwined and factual, and yet the attempt to link them causally does not describe the full meaning of their entanglement. As I document this ecological devastation, rooted in a multitude of political and economic causes, my presence there is also powered by equally destructive forces: I arrived to the desert by a budget flight and am burning lots of petrol to keep myself and the camera cool. The camera I use is made from minerals, metals, plastics and chemicals, some of which were formed in the crust of the Earth billions of years ago and extracted from it at high

environmental cost. Still, my project is driven by a belief that this aesthetic intervention is a valuable contribution towards a better future where every step forward does not entail two steps back. With this thesis and my film work I therefore attempt to touch precisely the contradictory moments where film and geology intersect, and where, in the interstices of their incommensurability, they illuminate key issues surrounding the anthropogenic ecological crisis. I aim to engage with these intersections in their nuance, without conflating the contradictory moments through a linear causal narrative in a false demand for their resolution.

Returning to the above-mentioned image, we see a ramp to the right of the sign. The ramp appears to provide accessibility to visitors who would not be able to climb the five shallow steps. Having looked at this image for hours, I begin to wonder why the steps were installed in the first place: there is no perceptible incline in the piece of land the steps are on. The ramp is an intervention into the landscape to mitigate a previous unnecessary intervention. My project takes place in the context of the widespread ecological collapse and is in part invested in considering what a 'positive intervention' on my part could mean given that we are living in a world that has seemingly been pushed to the brink through human intervention. It responds to our current moment, which has warranted the postulation of the Anthropocene (a not unproblematic concept as I will discuss later in the thesis): a new geological epoch defined by irreversible changes made to the geophysics of the earth by human influence, including the creation of a geological stratum infused by human habitation, industry and waste, the depletion of natural resources and the modification and erasure of landmass. The ecological consequences of human industrial activity also include an increase in the condensation of carbon dioxide and other greenhouse gases in the atmosphere, due to the burning of fossil fuels and deforestation. This increase in greenhouse gases is one of the symptoms of what has become known as anthropogenic climate change, as evidenced in

the rising temperatures, frequent draughts, cyclones, forest fires, crop failures, the melting of mountain glaciers and polar ice caps in different parts of the globe. Carbon dioxide is also reacting with ocean waters, acidifying them and thus destroying marine ecosystems in a process being described as the Sixth Great Extinction — a mass extinction event that includes the rapid loss of biodiversity on land.

Many readers today would most likely find the account of the ecological situation presented above fairly uncontroversial, yet our knowledge of the facts presented does not itself pave the way forward. Historically, the accumulation of new knowledge gave humans at least the sense of mastery over their own futures, and the absence of this today is perhaps the biggest paradigm shift involved in the ecological crisis. Naomi Oreskes states in her article evaluating the scientific consensus on climate change that 'virtually all professional climate scientists agree on the reality of human-induced climate change' and there are no grounds for doubt (2007: 74). Yet despite the scientific consensus and 'despite being surrounded by warnings of resource depletion, predictions of changing weather patterns, and a growing cinematic imaginary of the world's end' (Neimanis & Loewen Walker 2014: 559) we are not able to transform this information toward a viable image of the future. As Amitav Ghosh (2016) argues, despite there being no lack of factual information about the ecological crisis, our relative passivity with regard to climate change also entails a crisis of the imagination, rooted in our inability to grasp the scope and implications of said crisis.

Our perceptual experience of the ecological crisis is limited by the fact that many of the material factors of said crisis, such as climate change or nuclear radiation, are both invisible to us and occur on a temporal scale that far exceeds human lifespans. This perceptual disjuncture makes the ecological crisis 'difficult to comprehend or connect with in an appreciable way' (Duxbury 2010: 294). As Ghosh argues, the current failure of much of

contemporary cultural production to reckon with the perceptually elusive and unimaginably vast aspects of the ecological crisis 'will have to be counted as an aspect of the broader imaginative and cultural failure that lies at the heart of the climate crisis' (2016: 8). In order to address the urgent question of 'how to live *with* and *through* seemingly inevitable catastrophic environmental change' (Rowan 2015: non-pag.), both the present and the future need to be able to be imagined. This is crucial because 'we cannot make the future […] without also thinking it' (Ingold 2013: 6), and I would further argue — sensing it.

This study proposes the concept and practice of 'geological filmmaking' as a strategy for tackling some of the representational, perceptual and imaginative challenges surrounding the ecological crisis. Throughout the written thesis there will be mention of both the geological and the ecological, with the geological often acting as a prism through which to speak about the ecological more broadly. Geological matter and geological time are one part of the ecological totality of our planet. For my project of confronting some of the challenges of grasping the relational totality of the ecological crisis, the geological presents an extremity of the human ability to understand the nonhuman and the limits of life. Through actively engaging with inorganic geological materiality and geological deep time as the furthest removed from the framework of human perception, I hope to create some tools that could be applicable to engaging with other nonhuman aspects of ecologies, those that may seem closer to us than the geological, but that we nevertheless fail to grasp.

At first glance this presents a significant challenge to moving image, a medium that by design is derived from the physiological parameters of the human body and its perceptual boundaries. Further, if film is an optical medium, which means that it can only capture those objects than can reflect light, and a durational one, limited as it is by the capacities of its transcriptive media, then it should follow that phenomena that are invisible

to us or that unfold in deep time would remain out of its reach. However, from its early days, film has been able to not only convey, but also actively reconfigure our perception of both space and time. As Maya Deren, a filmmaker who made full experimental use of the potentialities of the medium, wrote: 'the special ability of film to manipulate space and time is made possible by the fact that it is both a space art and a time art' (Deren: 1946: 42). The fundamental ability of film to 'reconfigure and thereby shape time' (Lutticken 2013: 25) means that it can be mobilised to stretch the limits of human perception. This is precisely what 'geological filmmaking' aims to do in using geological temporality as an extremity in relation to human temporality.

Since its emergence, film has also allowed for a new way of encountering that which is other than human. In 1923, the era when cinema started to test and define its own boundaries, the critic and filmmaker Jean Epstein commented on its ability to bridge the affective gap between the human and the nonhuman in the following terms: 'if we wish to understand how an animal, a plant or a stone can inspire respect, fear and horror, those three most sacred sentiments, I think we must watch them on the screen, living their mysterious, silent lives, alien to the human sensibility' (1981: 22). My aim in this project is to touch the geological through the medium of film, and to show their potential points of intersection as well as the gaps in our human ability to grasp large-scale and long-term transformation. My hope is thereby to expand our perceptual/imaginative capacities as they relate to the ecological crisis — in its vastness and proximity, its longevity and immediacy.

The concept and practice of 'Geological filmmaking' emerges from the above concerns as a way to see geology through film — and film through geology. Geology is as much a science of matter as it is of process, dealing with mountains and molecules as much as with sedimentation and erosion, and thus with time itself. In this way we can already begin to think

of geology as a film in slow motion, and of land formations as films of their own making: what they are in a given moment also includes the trace of their making. Building on this metaphor, we can perhaps triangulate geology as being constituted simultaneously by land formations as they are in the current moment, the mineralogical materials that they are formed of and the ongoing processes that have formed them and are forming them. A film can itself be triangulated as being constituted by all the images and sounds that it consists of, the material support it is stored upon (be it analogue or digital) and the temporal experience it engenders when screened. Both geology and film are thus defined by the inextricability of form, materiality and temporality. In working to outline 'geological filmmaking' my task takes the form of an attempt to think all three aspects of geology through all three aspects of film. The structure of the written thesis reflects this task, with the chapters on depiction, perception and the future addressing the intersections of filmic and geological form, materiality and temporality.

Methodology

This project is necessarily interdisciplinary. To develop it I have borrowed the diffractive methodology proposed by Donna Haraway and further developed by Karen Barad as a mode of doing interdisciplinary research. In optical physics 'diffraction patterns record the history of interaction, interference, reinforcement, difference' (Haraway 1998: 102). Haraway and Barad mobilise this metaphor methodologically to read a number of disciplines from the humanities and the sciences 'through one another' in order to think 'the cultural and the natural together in illuminating ways' (Barad 2007: 135). In the course of this research, I read work from the disciplines of media studies, environmental humanities, film studies, visual cultures, as well as geology and optical physics through one another. Or, perhaps most accurately, I continuously read film and geology through

each other by mobilising all of these scholarly fields. Diffraction, insofar as it is the record of the traces of interference, allows for new knowledge to be produced at the points of contact and intersection, without the need to resolve or avoid incommensurabilities and contradictions.

In the 1960s the geologist Harry Hess introduced his research in plate tectonics and revolutionized the discipline of geology. Other scientists in his field, however, were not immediately able to grasp the implications of his discoveries. To encourage his peers to engage with his groundbreaking propositions and suspend their disbelief, Hess used speculative 'geopoetry' in his writing: 'he needed his audience, in the absence of much hard data, to speculate imaginatively, as if reading poetry' (McKay 2013: 46). Writing on Hess's work, Don McKay argues that the radically new requires poetry if it is to be imagined at all. He suggests mobilising such a poetic imaginative approach in order to grasp the scale of the geological and the advent of human influence on and in deep time.

Numerous contemporary commentators have argued that the ecological crisis itself both demands and creates opportunities for, as put by McKenzie Wark, generating 'the space within which very different kinds of knowledge and practice might meet', including the transformation of 'ways of organizing knowledge' (2015: 22). Haraway (2015) also champions the use of artistic experiments as part of scientific research and advocates a reconfiguration of the epistemic dichotomy between knowing and doing. She is acutely aware of the need for a new model for the entangled practices of thinking, feeling, theorising and figuring the ecological crisis and everything it entails. 'Geological filmmaking' is a project that emerges out of a methodology that does not subscribe to a rigid division between theory and practice. Drawing inspiration from Haraway, who understands doing as a way of thinking (2015: 261) and Barad, who, conversely, sees theorising itself as a kind of doing (2007: 54), my project combines written argumentation with filmmaking.

In navigating this mixed methodology project, I also take cues from filmmaker-theorist Trinh T. Minh-ha. Minh-ha is an ethnographic filmmaker who has written extensively about the difficulties of theorising through film and practicing film theory. She suggests that film provides something that 'cannot be duplicated or explained verbally' and is a form of theorisation of its own, while 'the verbal forms a parallel track and is another creative dimension' (Minh-ha 2007: 107). As she puts it, 'I theorize *with* my films, not *about* them' (107). She sees 'the relationship between the verbal, the musical and the visual, just like the relationship between theory and practice' as 'not one of illustration, description or explication', but rather 'one of inquiry, displacement and expansive enrichment' (107). Similarly, in my project the written component is not a commentary on the practice work, nor are the films illustrative of the theory. Rather, the overall thesis is comprised of two parallel yet reciprocal investigations in these two mediums of thought: thinking through concepts and linear argument, and thinking through filmmaking.

Both of these modes of research unfolded in stages that initially provided starting points for each other and that eventually contextualised, tested and strengthened each others arguments. The whole project came out of my ongoing filmmaking practice as well as my growing concern about the ecological crisis and investment into the possibilities of visual media to grapple with it. My practice had reached a stage where, in order to approach the representational challenges of the ecological crisis, such as its invisibility and dispersal, with appropriate rigour, I felt the necessity to situate the practice in a thorough grounding in contemporary theory that explores such questions. After the initial formulation of the project, as arising from these ongoing concerns, the first stage of the research was primarily text-based and is broadly represented by the literature review. This initial theoretical grounding had helped to further define and refine the specific research questions to be explored through the

writing/filmmaking methodology in the rest of the project. The key questions to further situate theoretically and test through practical filmmaking emerged to be as follows: how to depict environments in a way that is situated and that allows for a multitude of intra-acting naturecultural agencies to become visible, how to grapple with the invisible and how to grapple with geological time. These questions are at the centre of each of the final three chapters, respectively. They also became the kernels for the choice of subjects in the two films made in the course of this project, which were not predetermined at the start, but evolved in response to these questions and in parallel with the development of the chapters two and three. Chapter four, on perhaps the most defining dimension of moving image — time — reflects on both of the films. In this way, throughout the project writing and filmmaking each drew from insights gained and challenges presented through practicing the other, each contributed a form of thinking that is less readily available to the other, often providing answers to something that could only have become a question within the logic of its counterpart.

A further methodological point specifically with regards to the film work concerns collaboration. As Bill Gilbert writes in his contribution to *Making the Geologic Now* (2013), 'our attempts to address the implications of an Anthropocene Epoch will require a shared multicultural and interdisciplinary perspective that is based in direct engagement with the physical plane', and 'the arts can model a new cooperative/collaborative approach that will supplant the current individualistic paradigm' (56). Individualism will have no place in the creative practices that seek to grapple with the ecological crisis. Gary Hall also argues for collaborative postindividualistic approaches to doing scholarship in his critique of the cognitive dissonance between posthuman theory as 'concerned with the displacement of the unified, self-reflexive, and rational humanist subject from its central place in the world' and the pronouncement of these claims

by non-displaced unified individual human theorists through articles and monographs (2016: 93). Hall is, however, aware of the pressures on academics to perform to certain institutional standards when it comes to publication, and asks only that we 'work strategically in particular contingent contexts and make the best—or least worst—decisions and cuts possible' (120). In my case, I am aware that as a PhD candidate I need to produce a single-authored written thesis with a signed authorial component, which this work is. But in the creation of the two films that make up the other half of the thesis I collaborated with two different artists with whom I shared questions, concerns, approaches and methods, thus having my own questions and methods invaluably challenged.

In the case of *Salarium*, my collaborator Daniel Mann is himself a filmmaker and researcher, and was at the time a PhD colleague in the department of Media, Communications and Cultural Studies at Goldsmiths. Being Israeli, he was aware of the Dead Sea sinkholes from local media, and had brought up the subject with me in response to issues I was concerned with, specifically the ability of geological formations to visually manifest the multiple human and nonhuman agencies acting upon them. As I researched the subject further and had began to consider it as a potential subject for a film, Mann offered initially to act in a producer capacity and help to facilitate things on the ground. As our conversations around the project developed I invited him to participate instead as a co-director. Mann's own research at the time was concerned with the use of habitual media in the Israel-Palestine conflict, and with that the impossibility of drawing solid boundaries between combat and the everyday. To *Salarium* he brought invaluable knowledge of the history and politics of the region, and in the process developed his own understanding of the use of means other than direct combat in fighting that particular war. In terms of conceptual angles, Mann approached it from the perspective of the war being done by environmental means, while I examined it from the

perspective of environmental degradation being inflicted as a consequence of war. In practical filmmaking terms, Mann's own most recent films belonged to the genre of narrative fiction. While I was comfortable in the terrain of experimenting with and pushing documentary and observational techniques, to him this was new and throughout he challenged me to articulate that which felt intuitive to me in my style of filming; and this ongoing articulation was crucial to my own honing and refining of my method. He also was the one to suggest working with actors, who wore their own reserve army uniforms. To Mann, the ever-present figure of the anonymous citizen-soldier alongside every mode of inhabiting the space, from leisure to extraction, was emblematic of the specificity of the human-nonhuman relationship in this particular environment as always mediated by war. To me, working with actors also provided a means for some of the most experimental camera-work in the film, for example such as in the scene where the soldiers throw the camera to each other, destabilising the camera position while visually evoking the sensation of falling. Ultimately, the film's attempts to depict the human and nonhuman agencies coalescing in the sinkholes succeed in precisely the moments where the combination of our two approaches amounted to filmmaking techniques that would not have been thought or attempted by either one of us individually.

Similarly, *Asbestos* involved the coming together of two very different filmmaking approaches. Our shared aim was to do justice to the multiple dimensions and contradictions inherent to the material. Where in *Salarium* each shot and scene were approached collaboratively, *Asbestos* consists in the melding together of two very different sets of moving images, those shot by me and those collected by my collaborator Graeme Arnfield. Arnfield's work generally is concerned with the retelling of marginalised yet pivotal episodes in the histories of technology and labour, and it was the labour aspect of the industrial history of asbestos that he was most interested in. While my initial motivation was the very specific and

ultimately irreconcilable challenge of capturing a submicroscopic material by optical means, which, as I will elaborate in detail in chapter three, visually manifested instead through the material traces of its industrial history. When beginning the process we did not know that we would divide the task of procuring the images, rather it was through deeper engagement with the material and its history that this emerged as the correct approach for the subject matter. Every aspect of asbestos seemed to come with a flip-side: life-saving as a fire-retardant yet lethally toxic when inhaled, a solid and visible mineral when extracted from the earth and invisible and toxic when airborne, mined from the earth for industrial use and mined from walls and roofs to counteract its prior application, found to be toxic and its use in the west rolled back decades ago yet still in production elsewhere in the world. We wanted the film to be able to allow the contradictions that define asbestos to co-exist side-by-side without being resolved. We ultimately found that the most appropriate and, paradoxically, the most collaborative way to approach this would be to divide the tasks of creating and collecting the images and then edit the film together. I went to Asbestos, Quebec to shoot the ever-lingering past of asbestos: the world's biggest asbestos mine, inoperative since 2012, and the town that proudly wears its name. Arnfield, whose own work often has a substantial found footage element, collected found footage of the arduous and ever-ongoing labour of asbestos removal, from around the world and across decades. The final film is an attempt to hold all the multifaceted dimensions of asbestos in balance, while letting its various aspects be visibly different in a way that was only possible through two filmmakers pursuing their own approaches in parallel.

In the case of both films the iterative reconciliation of the diversity of opinion and approach was key to approaching the multi-planar complexity of the subject matter. Writing on using collaborative writing methods as part of academic research, Jane Speedy argues that 'the innovative

contribution' that collaboration 'makes to qualitative research methodologies is its explicit attention to multiplicities and connexions' (Speedy 2012: 353). And this is precisely the point that makes collaborative methodologies so pertinent to the engagement with natureculture and the ecological crisis. The current ecological situation calls for creative and academic inquiry that can account for the multiple human and nonhuman agencies transforming environments through many simultaneous and complex processes that are all interconnected. 'In focussing on multiplicity and simultaneity of stories and selves that are brought to the chosen theme' (353), collaborative work teases out the complex multiplicities and simultaneities in its subject matter.

The films being authored collaboratively also highlighted the collaboration between human and nonhuman actors in their creation: the films are a product of an interaction between the geological subject matter, the moving image medium and cinematic technology and the human filmmakers. The positing of the films as already collaborative invites the definition of this interaction as a collaboration, where the geological, technological and human are all active participants. The definition of collaboration can then be expanded even further. As Nellie Y. McKay and Frances Smith Foster (2001) reflect in their conversation about their collaborative work, attempting to define their collaborative book research project led them to redefine and broaden the understanding of collaboration as involving, for example, the existing scholarship in their field upon which they build, as well as 'the ideas and thoughts and suggestions and encouragements of our teachers, students, colleagues, family, friends […] who respond with questions and comments that push us toward a better articulation of the questions and the answers' (23). They conclude that 'no collaboration is that far removed from what […] we do always in the humanities' (23). And indeed, through the formalised collaborations that make up the filmmaking side of this project, the

collaborative nature of knowledge production more broadly has been brought into relief. In a less immediate and reciprocal, but no less important way, my thinking and making is deeply indebted to the many thinkers and makers working around similar questions, and its the shape of this discourse and field of practice that I detail in the literature review that follows.

Structure of the written thesis

Chapter one functions as a literature review. Its function is to situate the concerns of this thesis among the existing scholarship that addresses thinking, narrating, imaging and meditating the ecological crisis. The chapter begins with a consideration of earlier philosophical attempts to 'think geologically' and of the possibility of applying such approaches to a theorization of geological transformations and their relationship to the social. As theorists writing on the intersection of the geological and the social frequently rely on the concept of the Anthropocene, the following part of the chapter discusses the way this term has been popularised and then problematised. The criticism surrounding the term Anthropocene embodies many of the key theoretical challenges facing the environmental humanities today, such as understanding the place of humanity within the 'natureculture' (Haraway 1998) on which it depends – and over which it supposedly now wields geological agency. In the following part of the chapter I address the way our ability to imagine the ecological crisis is constrained or aided by its visual depictions. From whole earth visualisations to apocalyptic films, visual cultural production is found wanting in its limited ability to grasp the spatial and temporal dimensions of the crisis – if not actively obscuring its causes and implications. In considering alternative models for imaging the environment, I also reflect

on the possibilities of environments themselves engaging in modes of image-making that do not require a human observer and that destabilise what we might understand as images. The final part of the chapter draws together works from the fields of media studies and eco-philosophical film studies that consider the geological materiality of media and their embededdness in ecologies, from addressing the geological materials media are made of to analysing the intersection of the material and perceptual ecologies of cinema.

Chapter two deals with depictions of the environment and the relationship between landscape as a geological form and the formal aspects of film. It begins by tracing the historical development of the Western understanding of landscape as a prospect ready for subjugation through the emergence of landscape painting alongside the rise of colonialism and industrialisation. As an antidote to this art-historical understanding of landscape I consider possibilities of depicting landscapes in ways that do not instrumentalise or objectify them, or, in Barad's (2007) terms, ways to engage in representation without representationalism. I analyse a moving image work that offers an example of such an approach. *Radiant Temperature of Openings* (2015) by Faraz Anoushapour, Parastoo Anoushapour and Ryan Ferko engages with a landscape drowned in the creation of a hydroelectric dam: an eradicated landscape as an absent object of representation. Through this work's focus on the materiality of the display apparatus, I begin to conceptualise ways to account for the geological verticality of the landscape, as opposed to the relationship to surface embedded in the cartographic imagination, by drawing attention to the depth of the image. I develop this idea through a discussion of the formal challenges that arose in the making of my film *Salarium* (2017). The film addresses the emergence of sinkholes on the Dead Sea shore due to anthropogenic changes to the hydro-geological cycles in the area. In the making of the film my collaborator and I encountered the formal challenges

of depicting geological agency, the boundary of life and nonlife (Povinelli 2016) and the play of surface and depth, as we aimed to depict the sinkholes as both symptom and cause, both producer and product of the geosocial transformation of the environment. I show that a focus on the depth and dimensionality of cinematic images, including the material specificity of the cinematic experience, can aid in depicting environments beyond what is visible on their surface, as well as communicating the multiplicity of naturecultural agencies acting upon each other and the environment-in-transformation.

Chapter three engages with issues of perception as they relate to the imperceptible aspects of the ecological crisis. It does so through a focus on the relationality of (in)visibility, the materiality of the moving image and the porosity of the boundary that separates human bodies from their environments (Alaimo 2010). I begin by arguing that the limits of the visible and the ideas of visual objectivity are historically contingent, and that visibility is delineated in the relationality of the object of observation and the perceptual apparatuses, whether biological or technological. As the chapter unfolds I focus on nuclear radiation and asbestos as examples of environmental hazards caused by industrial activity that are invisible to either the naked eye or optical apparatuses, while being able to enter and alter human bodies. By analysing Tomonari Nishikawa's film *sound of a million insects, light of a thousand stars* (2014), created by direct exposure to radiation rather than by optically captured light reflecting off objects, I argue that, as celluloid film is sensitive to the entire range of the electromagnetic spectrum between visible light and radiation, it is able to act as a material witness (Schuppli 2011), beyond an anthropogenic mobilisation toward figuration. However, as most imperceptible aspects of the ecological crisis are not part of the electromagnetic spectrum, in the final part of the chapter I address the challenges of approaching an atmospheric threat that is neither optically nor materially accessible to the

moving image. Through a discussion of the making of my film *Asbestos* (2016), I show that in an attempt to capture a submicroscopic geological material through optical means, what comes into sharp relief instead is the contact zone between the material and its use. By theorising the toxicity and visibility of asbestos from the perspective of haptics, I argue that the mutuality of the type of touch that is immaterial in the way of cinematic images, or imperceptible and penetrating in the way of asbestos, arises not between viewer and film, or body and toxic atmosphere, but rather between responsibility and vulnerability triggered by the encounter.

The final chapter addresses the possibilities for imagining a future via the multiplicity inherent to both ecological and cinematic temporality. The temporalities of the ecological crisis and of the attempts to mitigate it unfold on a spectrum of contradictory and incommensurate scales: that of slow environmental change and swift parliamentary terms, of the vastness of deep time and the urgency of the ever shrinking present moment in which to act to avoid catastrophe (Puig de la Bellacasa 2017). Extending our responsibility towards the future will have to mean also engaging with a time in which we can no longer make a difference. To conceive of such an ethics of duration that is temporally beyond ourselves we must begin by thinking beyond ourselves in the now by engaging with a multiplicity of ecological durations (Yusoff 2013). Through theorising the expansive and nonchronological temporality of the sinkholes as thick ecological time (Neimanis & Loewen Walker 2014) that contains past, present and future, I outline the possibility for geological filmmaking to generate thick cinematic time. I name this 'the deep now': a temporality that contains the breadth and depth of time and makes the future thinkable through a meditation upon the multitude of environmental factors that bring the present moment into being. I then proceed to consider the temporality of asbestos, defined, on the one hand, by the certain future of cancer that follows its encounter with biological cells and, on the other hand, by the uncertainty implicit in

the reversal of its industrial history. I argue that certainty and uncertainty are not contradictory, as with the passage of time the intentional leaves as much of a trace as the unintended. To do so I theorise the (un)certain temporality of asbestos alongside the effects of entropy ravaging cinematic artefacts and thus giving them an ability to communicate beyond the original intent of their human creators (Cubitt 2017). Further, reading the temporality of asbestos from the perspective of debt provides a model for thinking ecological debt more broadly. In conclusion I argue that while, ultimately, no once-and-for-all solution can be written into the future to which unintended consequences would not arise, the future can be made iteratively imaginable in an ever-evolving step by step negotiation alongside geological and ecological agencies.

1. Literature review: Thinking, narrating, imaging and mediating a geophysical crisis

This chapter serves as a literature review, allowing me to situate my research among a number of conversations in the fields of environmental humanities, visual cultures and media studies that are emerging in response to the ecological crisis. I begin by considering what it might mean to think geologically and how such an approach could be applied to the above academic disciplines and their potential engagement with physical geology. Since scholars writing about the interdependence of the geological and the social often rely on the concept of the Anthropocene, I pause to consider its origins and implications. I look at the way the Anthropocene concept has been popularised and then problematised in the sciences and the humanities, as well as at the narratives about the future it allows to be told. In the following part of the chapter I consider the way the ecological crisis has been depicted across a variety of visual media, and argue that art practice, with its methods of experimentation and creative inquiry, can work towards making the relationality and immensity of the ecological crisis imaginable. Finally, I address the geological materiality of digital media upon which visual responses to the ecological crisis rest, and argue for the need to account for the material and the perceptual as inextricably connected.

Thinking geology and thinking geologically

In her interview with Donna Haraway, Thyrza Nichols Goodeve (1998) suggests that what is crucial in Haraway's work is not just discovering entities, but learning to converse with them, that is adapting our own

thinking processes to their needs, rather than applying existing epistemologies to all new discoveries. Haraway is quick to respond that even though that is true, the very word 'converse' 'conjures up speech as we know it' (1998: 67), and therefore anthropomorphises these nonhuman agents we are trying to comprehend. In this part of the chapter I consider what kind of thinking would be appropriate in a project attempting to comprehend the scale and pace of the geological, and what it might mean to think geologically.

Stone, as Jeffrey Jerome Cohen suggests, is 'philosophy's favorite object' in its metaphorical role as the very embodiment of ontology (Cohen 2015: 31). Samuel Johnson refuted George Berkeley's assertion of the material world being '"merely ideal" by forcefully kicking a stone that was not to be moved, declaring "I refute it *thus*"' (Boswell quoted in Cohen 2015: 31). Kant, Goethe and Hegel were all actively involved with the emergent discipline of geology. Shocked by the Lisbon earthquake, 'Kant helped inaugurate the science of seismology; Goethe pitched into geological debates in between managing silver and copper mines', and Hegel collected minerals and followed the development of palaeontology (Clark 2017: 216-7). Philosophers' fascination with the geological together with its treatment as a given continued into the twentieth century. Jean-Paul Sartre writes that stone provides an experience of an 'encounter of pure matter', only accessible in divinity and geology (Sartre 1976: 181-182). Jean-Luc Nancy, in turn, uses stone as a metaphor for the immovable reality 'at the heart of things' (Nancy 1993: 168). Such philosophical uses of geology, however, (mis)understand the geological as being fixed, that is as being merely inorganic matter, rather than accounting for geology's continual (even if often invisible to the human eye) flux. But the geological is not a given. It is not 'firm support for ponderous thinking' (Cohen 2015: 31). In the Anthropocene, as the extractivist over-reliance on geological materials is leading to the destabilisation of geophysical processes, it is imperative not

to think of geology as static or given, a ‘self-evident asset [or] inert commodity’ (41). Geology must be seen as constituted both by matter and process, geological formations and their formation. To think geologically, then, would need to include thinking through both matter and process.

Manuel De Landa mobilises the logic of geological processes as a model for thinking of human history, and specifically the emergence of capitalism, as nonlinear energy flows in *A Thousand Years of Nonlinear History* (2000). Using nonlinear models from natural science, De Landa is able to show that capitalism was not a result of humanity reaching the next logical or inevitable stage of 'progress' (73). He thus criticises what he sees as the common misconception among the Marxist left of seeing the emergence of capitalism from a teleological perspective of '*linear progression* of modes of production' (47). He argues that in fact capitalism 'could have arisen anywhere and long before it did in Europe' or indeed not at all: neither capitalism nor the emergence of Europe as an economic superpower were inevitable (47-48). While De Landa finds furtive ground in using a geological metaphor to theorise the social, he does not provide an account of the way the social materially emerges *through* the geologic. Yet, as Kathryn Yusoff argues, capitalism emerged and developed precisely through the geologic, 'feeding off the fossil stocks and mineral flows', its actions 'material processes, not primarily ideological ones' (2017: 113). As the Anthropocene concept claims the ability of humanity to have an impact on the stratigraphy of the earth, there is an imperative entailed in it to mobilise geological thinking, such as that put to use by De Landa, to refresh ‘existing political repertoires and imaginaries' (Clark & Yusoff 2017: 4) when it comes to thinking the relationship of the social and the geologic and their mutual co-constitution. In other words, there is a need for 'a social thought that might think *through* the geologic' (10), as argued by Nigel Clark and Yusoff in their introductory essay to the edited special issue on ’Geosocial Formations and the Anthropocene’. Their own contributions to

the special issue approach the question through Gilles Deleuze and Felix Guattari's (1987) work on stratification.

In *A Thousand Plateaus: Capitalism and Schizophrenia* (1987) Deleuze and Guattari use the geologic ideas of strata and stratification as a way to speak about the emergence of organised social, as well as geophysical, formations from the chaos of the material world. They write that the earth is 'permeated by unformed, unstable matters' (40); strata, in turn, are acts of capture of the multidirectional flows produced by the earth, which are then stratified into social, political and economic institutions, vocabularies and practices. Deleuze and Guattari draw on the way a geological stratum is physically formed by the dual processes of sedimentation and folding, with sedimentation depositing free-floating geological materials and folding being 'the passage from sediment to sedimentary rock' (41). In other words, in stratification the capture of substances occurs together with their formation into 'a stable functional structure' (41). Deleuze and Guattari point out that the distinction between the two articulations is not to be thought as the distinction between substances and forms, but rather as one 'between content and expression' (47). As applied to the stratification of the social, this double articulation means that, though distinct from each other, content and expression do not exist hierarchically, for example with expression only being able to happen within a given field of content, or the possibility for expressible content being limited by form of expression, but rather occurs in 'a state of reciprocal presupposition' (72). Each stratum is such a reciprocal double articulation, where content is articulated as 'a relative expression within content' and expression is articulated as 'a relative content within expression' (44). With content and expression mutually delimiting each other, strata define the limits of the expressible. Destratification, or deterritorialisation as they alternatively call it, is a movement towards releasing the captured flows in order to expand and reshape the limits of the expressible, the thinkable and the imaginable

within the political, social and economic spheres, and allow for reterritorialisation in new ways.

Yusoff (2017) develops Deleuze and Guattari's work on strata for the political context of the Anthropocene. She argues that the possibility for reterritorialising the world in a less violent way than that of fossil capitalism will need to involve both the social and the geological strata, that is institutions and practices that govern the social and geological spheres. Fossil capitalism couples geological and social strata by destratifying geological materials such as fossil fuels from the ground through the economic process of capitalisation. Yusoff argues that we are therefore to understand the production of power under fossil capitalism as happening 'within geosocial strata' (125), that is strata that are simultaneously both social and geological. In order to contend with power under fossil capitalism, any revolutionary impulse will similarly have to emerge through the connection of the geological and the social. For her, 'an Anthropocene not attached to politics is a hollow concept, and politics not attached to the implications and genealogies of geology is not politics at all' (124). Yusoff argues that it is imperative to destratify from or, in other words, to undo and reconfigure the institutions and practices that define the geosocial stratum of fossil capitalism as 'there is no way to ameliorate the worse effects and causes of anthropogenic change within capitalist modes of production' (119; see also Stengers 2015 and Moore 2015). However, as the geological strata subtend all life, in destratifying from the geosocial strata of fossil capitalism it is crucial to stay stratified with the geological strata, meaning remain embedded in and dependent upon it. Yusoff suggests therefore that it is the destructive relations between capitalism and the geological that need to be examined and undone, including the institutions and practices that shape the modes of the capitalisation of the geological. Also drawing on Deleuze and Guattari, Clark (2017) suggests that the geological did not just gain political

significance in the Anthropocene, but that political formations arise in conversation with specific geologic formations, with the examples of the stratification of class relations in the context of prospecting for coal and later oil. This allows him to argue, in a similar vein to Yusoff, that a strategy for the continuation of political life among geophysical processes is dependent not on abstaining 'from geological agency', but rather on 'how we, collectively and heterogeneously, might negotiate more carefully, more judiciously, more generatively with strata' (Clark 2017: 228). Yusoff and Clark's mobilisations of Deleuze and Guattari's geologically-inspired concept of strata, in other words their mobilisations of geological thinking, allow them to conceptualise the relationship of interdependence between the geological and the social, and to suggest a strategy of less violent ways of a future reterritorialisation of the geological strata.

The anthropogenic impact on the geophysics of the Earth, as described by the concept of the Anthropocene, highlights the entanglement of the geological and the social, as elaborated by Yusoff and Clark. Elizabeth A. Povinelli further argues in *Geontologies: A Requiem to Late Liberalism* (2016) that in order to think of political alternatives to late liberalism in the shadow of the Anthropocene, it is crucial to complicate the definitions of the geological and the social all the way down to the separation of the geological from the biological, or life from nonlife. Povinelli updates Foucault's concept of biopower, defined as the governance of life/death, to *geontopower*: the governance of life/nonlife. She writes that 'the sovereign people of geontopower are those who abide by the fundamental separation of Life and Nonlife' (Povinelli 2016: 56), a separation demanded and reaffirmed by 'extractive capital and its state allies' (44). Povinelli argues that in order to find 'a way to square our current arrangement of life with the continuation of human and planetary life as such' (59), it is crucial to rethink the ways by which the distinction between Life and Nonlife is postulated. She works on complicating this

distinction. Starting from the definition of Life as located in a metabolising organism, she argues that we need merely to shift the scale beyond a single organism in order to perceive the mutual metabolism of the geological and the biological. This metabolism is the planetary carbon cycle that sees Life interact with Nonlife through respiration, digestion and death. In death, Life sediments in the geological layer as fossil fuels, which, in turn, are seen by extractive capitalism as Nonlife, resources to be extracted and burnt into the atmosphere, only to further participate in biological and chemical processes such as ocean acidification. Povinelli suggests that the study of anthropogenic climate change provides impetus and opportunity for such 'a shift in scale', which allows us to think the relationship of 'the smallest unit of life and death to planetary life and death (the planetary carbon cycle)' (56). The Anthropocene is understood in this context not merely as a geological category, but as one involving a blurring of boundaries between Life and Nonlife. The concept of the Anthropocene is also far from a straightforward geological category in a different sense: it is a social construct. In the following part of the chapter I address the construction of 'the Anthropocene', as both a concept and a multilayered narrative.

The Anthropocene narrative(s)

Proposed as a new geological epoch, the term 'Anthropocene' was first coined by marine ecologist Eugene F. Stoermer in the 1980s, and popularised by the Nobel-prize winning atmospheric chemist Paul Crutzen in 2000. This epoch is meant to succeed the Holocene, which began with the end of the last Ice Age, and be defined by the human – *the anthropos* – as the driving force of geophysical, chemical and atmospheric changes on earth, in a way that will be stratigraphically legible in the future. The term did not gain momentum until the Stratigraphy Commission of the Geological Society of London met in 2008 for the first stage of deliberations to consider

adopting the new epoch by the discipline of geology. In summer 2017 the International Geological Congress in Cape Town overwhelmingly voted to proceed with a course of investigation to scientifically confirm the Anthropocene epoch in the coming years. Stoermer's linguistic and conceptual intervention was not, however, the first instance of invoking the anthropos as a geologic force. This idea hails from the nineteenth century and the very beginnings of geology as a discipline, with the Italian geologist Antonio Stoppani naming the 'appearance of human activity in the archive of deep time' the Anthropozoic era (Federighi & Turpin 2013: 34). Over a century before the coinage of the term 'Anthropocene', Stoppani wrote that humanity had already put geology on a new course as 'the ancient earth disappears under the relics of man or of his industry' (Stoppani 1873: 38). The hundred-year gap between Stoppani's and Stoermer's propositions is telling: the concept of a geologic epoch defined by human activity only caught on when the stakes of such human influence on the geophysics of the earth rose dramatically due to the ecological crisis.

Since Crutzen's popularisation of the term 'Anthropocene', it has been widely mobilised beyond the scientific disciplines it originated from. In his influential essay 'The Climate of History' (2009), historian Dipesh Chakrabarty began questioning how this concept informs and challenges the humanities. Chakrabarty argues that in the Anthropocene humanity is to be thought of at the level of species, as it is threatened by climate change and unified by having become 'a geologic force' (206). Yet as soon as the Anthropocene started gaining momentum in the humanities, the term itself and Chakrabarty's reading of it attracted numerous criticisms. On the one hand the Anthropocene is said to perpetuate the nature/culture divide by placing humanity outside of the geophysics of the earth as a force able to act *upon* it, rather than having always been co-emergent with it; while on the other hand it is seen to be erasing the differences among the human population in a totalising sweep of culpability (Moore 2015; Haraway 2016;

Grusin 2017). Further, the Anthropocene is said to aggrandise humanity: as put by Stacy Alaimo, 'the hand-wringing confessions of human culpability appear coated with a veneer of species pride' (Alaimo 2017: 90; see also Cohen, Colebrook & Miller 2016). Alaimo counters Chakrabarty's suggestion that with the advent of the Anthropocene and its global implications it is most appropriate to think of humanity at species-level, as opposed to on the level of political or historical specificity. She argues that the Anthropocene in fact provides us with an opportunity to rethink what species identity could mean for humanity, by recognising that each human subject is at once 'a member of a species that has had a staggering impact on the planet' *and* 'an inhabitant of a particular geographic, social, economic, and political matrix, with attendant and differential environmental vulnerabilities, culpabilities, and responsibilities' (98). In other words, it is important to think the Anthropocene on both macro and micro scales, and to attend to situated and embodied specificities when engaging in planetary thinking.

In *Capitalism in the Web of Life* (2015), Jason W. Moore similarly argues that the name Anthropocene itself presents humanity as 'a homogenous acting unit', thus erasing the ongoing histories of 'inequality, commodification, imperialism, patriarchy, racial formation' (Moore 2015: 170). He suggests that instead of calling this new geological era the Anthropocene, we should be calling it the Capitalocene, 'the historical era shaped by relations privileging the endless accumulation of capital' (173). Moore argues that 'how we conceptualize the origins of a crisis has everything to do with how we choose to respond to that crisis', and that rethinking the origins of what is being called the Anthropocene is therefore not only an intellectual 'problem, but also a political one' (172). One of the most common propositions for the start date of the Anthropocene (Crutzen & Stoermer 2000; Chakrabarty 2009) is the beginning of the nineteenth century, i.e. the arrival of the steam engine and the advent of

industrialisation. Moore argues that such an understanding of the epoch's origins is dangerous because in its focus on industrialisation it overlooks the role of capitalism and imperialism that had had significant impact upon the world's populations and geographies for a number of centuries up to that point. He continues by arguing that locating the origins of the ecological crisis with the steam engine, which implies that the crisis had not already been in the making until the wide adoption of coal and then oil, suggests that it is merely the use of fossil fuels that would need to be eliminated in order to solve the crisis. On the other hand, locating the origins with capitalism and imperialism that took root during the long sixteenth century, 'with its audacious strategies of global conquest, endless commodification, and relentless rationalization, is to prioritise the relations of power, capital, and nature that rendered fossil capitalism so deadly in the first place' (172). Moore's key argument is that capitalism is 'not an economic system; it is not a social system; it is *a way of organizing nature*' (2), and that the only workable solutions to the ecological crisis lie in undoing capitalism: 'shut down a coal plant, and you can slow global warming for a day; shut down the relations that made the coal plant, and you can stop it for good' (172). While Moore's theorisation of humanity, and specifically capitalism, as not acting *upon* but emerging *within* nature is very useful in its nuance, his criticism of the existing ecological thought as insufficient for thinking beyond the nature/culture dualism contains an oversight, as he overlooks the lineage of feminist ecological thought beginning with the work of Donna Haraway.

Haraway's ideas come from her lifelong work of establishing 'fundamental epistemological starting points […] from this enmeshment where the categorical separation of nature and culture is already a kind of violence', a state of events she calls *naturecultures* (Haraway 1998: 106). In *Staying With The Trouble* (2016), Haraway accepts the rhetorical usefulness of the term Anthropocene as a rallying cry, as it provides a common name

for all the elements of the ecological crisis – across locations and times, and across spatial and temporal scales, from deforestation and resource depletion to extinction and ocean acidification. She nevertheless argues against the grand narratives of the Anthropocene, as well as its alternative the Capitalocene, as proposed by Moore. Haraway suggests that these stories are always at risk 'of becoming Too Big' – too totalising, too celebratory, too fatalistic – and that we need to foster instead the 'bravery and capacity to tell big-enough stories without determinism, teleology, and plan' (2016: 50). It is not incidental that she refers to them as stories, as she has long argued that 'understanding the world is about living inside stories' (1998: 107), for it is not 'that the history itself determines [the] narratives, but that the narratives shape the history' (129).

A classic literary theory take on narrative posits that one of the key functions of ordering events by narrative is 'the affirmation and reinforcement, even the creation, of the most basic assumptions of a culture about human existence, about time' (Hillis Miller 1995: 71), and in the case of the Anthropocene, about humanity's place among the geophysics of the earth. Seen through this lens, the geological temporality inherent to the Anthropocene can perhaps only be grasped by us humans if it is narrativised, as 'time becomes human to the extent that it is articulated through a narrative mode' (Ricoeur 1983: 52). From a more contemporary perspective, Caroline Bassett defends narrative in the face of complex non-linear systems we now inhabit, as 'narrative, understood as an extensive arc constituted by a process of emplotment […] can make sense of these experiences through a form of assembly that is not retrospective but in process, not necessarily linear but rather expansive' (2007: 3). And it is narratives that are 'contingent and mutable' (3), open and generative that are needed to account for the multifaceted unfolding of the ecological crisis.

One of the key issues Haraway raises with what she calls 'the dominant drama of the Anthropoce discourse' is that it implies that the

geophysics of the earth are dictated by human beings who are thrust back into the centre of the universe, while in fact and on the contrary, the ecological crisis serves to reconfirm that 'human beings are with and of the earth, and the biotic and abiotic powers of this earth are the main story' (2016: 55). Haraway stresses, however, that the fact that agency does not lie with humanity alone does not mean that the actions of humans, individually or collectively, do not matter. While we need to understand that 'nonhumans are active, not passive, resources or products', it is still 'people who have the emotional, ethical, political, and cognitive responsibility inside these worlds' (1998: 134). Haraway's tactical suggestion is to stay with the trouble: neither optimistically hoping for salvation or investing in more geoengineering, nor hanging our heads in cynical despair thinking all is lost, but rather staying in the present moment while iteratively refiguring it toward a future that is unknown but hopefully made liveable one step at a time.

In her contribution to the volume *Anthropocene Feminism* (Grusin 2017), in large part indebted to Haraway's work, Claire Colebrook proposes an alternative Anthropocene narrative, by imagining a counterfactual scenario where human development had not reached a stage where it would be able to make a geophysical difference. In this scenario the Anthropocene is avoided by way of humanity developing differently by 'remaining more nomadic and with a sense of history more attuned to the broader rhythms of the earth beyond that of the human agricultural year and its seasons' (Colebrook 2017: 13). Colebrook then makes an argument, similar to that of Nigel Clark in *Inhuman Nature* (2011), that 'there is no such thing as a natural stability that anthropogenic climate change disturbs in the first instance', for '"climate" and "geology" are relational and dynamic composites' (Colebrook: 13). The violence that has led to the current ecological crisis consists not so much of destabilising a previously stable nature, but rather of its opposite: 'thinking of nature as an unchanging

standing reserve' and stabilising it to a 'rigid timetable of production based on hyperconsumption' (14). Colebrook then proposes that to imagine that the Anthropocene hadn't happened is to imagine that nature had not been invented. She ends the essay with an urgent critique of what has come to be known as 'the good Anthropocene', initially proposed by Erle Ellis (2009; 2011): a scenario where 'man' wields his newly acquired geological power to 'fix' destabilised nature through geo-engineering. Colebrook shows that such an approach to solving the ecological crisis would merely follow the logic that caused it.

Richard Grusin makes a similar argument in his introduction to *Anthropocene Feminism*, writing that propositions for geo-engineering technofixes of the ecological crisis reveal a propensity in 'scientists and engineers […] to rely on many of the same masculinist and human-centered solutions that have created the problems in the first place' (ix). Rory Rowan (2015) makes a further case against the good Anthropocene by mobilising the critique of Ellis's manifesto by Clive Hamilton (2015), who sees the good Anthropocene as 'a depoliticizing narrative that works to perpetuate the interest of those conservative forces working determinedly to prevent action on climate mitigation and renewable energy' by celebrating the necessity of further industrial advance (Rowan 2015: non-pag.). The good Anthropocene, with its continued pursuit of technological advance and the promise to resolve the ecological crisis, provides a narrative of forward movement and resolution, which have been the defining characteristics of the narrative of industrial modernity itself, as well as the narrative forms that it has engendered. The ubiquity of the narrative forms inherited from modernity, from the bourgeois novel (Ghosh 2016) to the narrative fiction film, makes us crave an Anthropocene narrative with a resolution, be it trust in an impending technological fix, or even resignation to an impending apocalypse. Joanna Zylinska (2014) argues that such 'narrow fatalism' and '"rescuism" of the dominant Anthropocene story' (106) denies

'any possibility of the emergence of an ethical response and ethical responsibility in relation to the predicted events' (109). The narratives of the good Anthropocene and of apocalyptic destruction both preclude political mobilisation as they make the future seem predetermined.

Narrative cinema has been one of the key sources of forming the public imaginary around apocalyptic scenarios and their resolutions. We can mention here the success of the blockbusters *Armageddon* and *Deep Impact* (both 1998), films that depict a threat from outer space that has the power to destroy all life on earth in one spectacular impact, but is thwarted by the heroic protagonists who sacrifice themselves in order to destroy the asteroid and the comet, respectively. In an essay 'What is the Anthropo-Political?' (2016), Colebrook considers the way the Anthropocene narrative informs and is informed by contemporary narrative fiction cinema. She writes that from *Interstellar* (2014) to *Mad Max: Fury Road* (2015), some of the biggest films in recent years have portrayed 'a destructive humanity [that] becomes the catalyst for human triumph, with a proper humanity emerging with sublimity from near death' (Colebrook 2016: 85). The Anthropocene here is understood in terms of the final unification of 'man' as a species by the very threat of annihilation. The 'we' of the 'anthropos' implied by the 'Anthropocene' is the 'we' 'that is constituted precisely by way of a death sentence: I mourn my future non-being and therefore I am, and therefore 'survival is constituted as an imperative' (82). In these films, however, just as the 'human' is united under the threat and guilt of the Anthropocene, it is immediately divided into perpetrator and victim, where a 'bad' humanity of excess has nearly destroyed the earth, and 'good' eco-friendly humanity must survive and inherit it (83). The perpetuity of this depiction of 'man' as triumphant in the plot of the films, and the very necessity of a human protagonist to drive a plot of a feature narrative film, together with the familiarity of the Hollywood style of cinematography and editing, all of which scream business-as-usual, foreclose the possibility of contemplating

the end of man, and thus taking responsibility for the Anthropocene, or indeed taking political action. No action is necessary when the future is guaranteed, at least for the protagonists.

I argue that staying with the trouble, as urged by Haraway, requires rethinking narrative beyond the arc of problem, climax and resolution, as the ecological crisis will have no easy solution or contained finality. Instead, it requires an enduring, sustained, non-spectacular yet imaginative engagement with making the future manifest one bit at a time. Heeding the importance of narrative to envisioning futures, geological filmmaking looks to provide alternatives for thinking futurity beyond catastrophe or triumph. In order to escape the trap of thinking in terms of such technoscientific visions of dominion over a stabilised nature, geological filmmaking engages with the inextricable connection of natureculture, and aims to engage with environments on both micro and macro temporal and spatial scales. It aims to show humans as both members of a species *and* as situated beings part of specific political and environmental arrangements, while showing geophysical phenomena as both planetary and situated. Rather than relegating environments to the background of human narratives, geological filmmaking shows humans as embedded producers and products of planetary processes.

Imagining and imaging the ecological crisis

The ecological crisis, as well as its causes and potential responses to it, take shape in the cultural imagination not only narratively, but in large part visually. Zylinska argues that the ecological crisis 'acquires its meanings and values' through its portrayal in artistic and cultural production, and that images of it can therefore 'be described as world-making rather than just representational' (2014: 106). So what does the ecological crisis look like? Can it be seen in a photograph of a polar bear, a digital render of New

York submerged underwater or a line graph of temperature rises? As Wendy Hui Kyong Chun argues, all such images 'are proxies – stand-ins or representatives – for rising global temperatures', and 'proxies both reduce and introduce uncertainty' (2018: non-pag.). Evidential photography can only ever portray an isolated symptom of the crisis, rather than its relationality and causality. It thus falls short of being able to depict those aspects of the crisis that most challenge our imaginative capacities: its vast scale and the inextricable web of interconnected causes and agencies, both human and nonhuman, that define it. Meanwhile, as argued by Chun, graphs of temperature rises are still subject to misinterpretation and denial, despite being the seemingly most comprehensive and factual visual representations of global warming as a whole. As direct representations of number-based information in visual form, they also ultimately remain as abstract as the numbers themselves and do little for our ability to imagine their implication. In the words of Amitav Ghosh, 'clearly the problem does not arise out of a lack of information' (2016: 8). Timothy Morton (2013) argues that phenomena such as global warming, which he describes as hyperobjects, 'objects that are massively distributed in time and space [and] defy human time and spatial scales' (80), cannot be grasped by images that are merely 'candy coating on top of facts' (182), or 'PR for climate change' (196). Grappling with them requires visual experiences beyond those that 'make you think' or try to change your mind, but rather walk you 'through an inner space that is hard to traverse' (184), such as the contemplation of one's place as producer and product of local and global environmental conditions.

Contemporary visualisations of the human impact on the planet often attempt to make visible the otherwise ungraspable immensity of the crisis by adopting a planetary perspective and scale. Though a seemingly appropriate strategy, these images in fact replicate and entrench some of the most problematic aspects of the Anthropocene concept. Alaimo argues

that 'the Anthropocene should make it clear that what used to be known as nature is never somewhere else' (2017: 90), while such planetary-scale images create an impression of abstract immensity, which 'is safely viewed from a rather transcendent, incorporeal perspective, not from a creaturely immersion in the world' (92). She mobilises Haraway's critique of the God's-eye view, 'a conquering gaze from nowhere' (1988: 581), to argue that such images are thus devoid of politics. By letting the viewer enjoy 'a comfortable position outside the systems depicted' (Alaimo 2017: 92), the 'viewer is not implicated' (99) in them either as participant in the devastation or potential victim of its consequences. As T.J. Demos further argues, such images reinforce 'the techno-utopian position that "we" have indeed mastered nature, just as we have mastered its imaging — and in fact the two, the dual colonization of nature and representation, appear inextricably intertwined' (2017: 28). The disembodied and global perspective of such images replicates the violent objectifying logic that has perpetuated the crisis. With geological filmmaking I aim to conceptualise and make work that instead maintains a feminist commitment to 'an embodied […] way of knowing and being in the world' that necessarily includes 'the co-constitutive role of the embedded observer' (Asberg, Thiele & van der Tuin 2015: 151). There is a further political point to be added to a critique of such vast imagery that embraces 'a view from nowhere'. Demos writes that the planetary scale visualisations rely on a vast network of satellites and are therefore 'embedded in a specific political and economic framework, comprising a visual system delivered and constituted by a […] military-state-corporate apparatus' (2017: 17). Not only do such images depict a universalising and undifferentiated sweep of human activity, 'which enables that military-state-corporate apparatus to disavow responsibility for the differentiated impacts of climate change' (17), they are also produced by technologies enabled by this very apparatus. In other words, the military-state-corporate apparatus that powers the images that

supposedly allow the Anthropocene to be 'seen' and therefore named, is the very actor that is being absolved of responsibility by the totalising aesthetics of such images. This absolving makes the ecological crisis look like the work of humanity as a whole, thus obfuscating the origin of the responsibility.

Nicholas Mirzoeff situates the issue of the visual depiction and obfuscation of the ecological crisis historically. In his essay 'Visualizing the Anthropocene' (2014), he argues that the Anthropocene visuality, where visuality is understood as the a 'visualization of history' by a certain authority (Mirzoeff 2011: 2), can be defined as the dominant visuality of capitalism, imperialism and industrialism over the past two centuries. To demonstrate how this figures throughout the art history of modernity he uses Monet's painting *Impression Sun Rising* (1873). This painting of the smog-covered port of La Havre, by rendering industrial air pollution as beautiful, naturalises and aestheticises it, and thus creates 'an anaesthetic to the actual physical conditions' (Mirzoeff 2014: 223). Anthropocene visuality 'keeps us believing that somehow the war against nature that Western society has been waging for centuries is not only right; it is beautiful and it can be won' (217). In this sense it is one of the very forces, along with capitalism, imperialism and industrialism themselves, that perpetuates the ecological crisis, for it 'allows us to see nothing' (217). Anthropocene visuality thus blinds us to the reality of the ecological crisis and precludes mobilisation toward mitigating it. As a subversion of the dominant and complicit image regime, Mirzoeff proposes a countervisuality, which would provide a 'mental space for action', enabling us to imagine alternatives (226). 'Like all forms of countervisuality', this countervisuality for the Anthropocene 'claims the right to see what there is to be seen and name it as such: a planetary destabilization of the conditions supportive of life' (230). In other words, the countervisuality for the Anthropocene will be built through attempts to image the physical condition described by the

Anthropocene concept that makes it more, rather than less, legible.

While Mirzoeff situates the concealment of Anthropocene visuality historically, Ghosh speculates on the way the failures of the contemporary cultural moment will be viewed from the future, writing that future observers would have to 'conclude that ours was a time when most forms of art and literature were drawn into the modes of concealment that prevented people from recognizing the realities of their plight' (2016: 11). He suggests that the ecological crisis is ultimately 'also a crisis of culture, and thus of the imagination' (9), and argues for the pressing necessity of cultural production that would be able to grapple with the 'forces of unthinkable magnitude that create unbearably intimate connections over vast gaps in time and space' (63). Demos (2016) similarly argues that the ecological crisis is in fact a crisis of political will to imagine and enact alternatives, and suggests that any attempt to mitigate it requires 'an immense project of imaginative thinking and practice' (16). He continues that art practice, conceived as 'experimentation, imaginative invention, and radical thinking', can become a key strategy 'of initiating exactly these kinds of creative perceptional and philosophical shifts' (18-9). The essay collections *Art in the Anthropocene* (Davis & Turpin 2015) and *Making the Geologic Now* (Ellsworth & Kruse 2013) situate numerous art practices that are engaged with the ecological crisis and the geologic. As the editors of *Making the Geologic Now* suggest in their introduction, in the face of such temporal and spatial immensity that nevertheless retreats from view, artists are beginning to create 'works that do not simply take up the geologic as a theme', but that 'activate formats, methods, models, ideas, and aesthetic experience in ways that seek to recalibrate "the human" in relation to "the geologic"' (Ellsworth & Kruse: 9). I see geological filmmaking as situated among such practices. Throughout the chapters to come I engage with a number of moving image works by other artists pursuing such questions, with a view to developing the concept of geological filmmaking through

their work as much as my own film practice. In the making of my two film projects on sinkholes and asbestos I aim to contribute to the creation of the countervisuality described by Mirzoeff, by attempting to develop some modes of depicting and perceiving the current geophysical condition, visually tackling the unthinkably vast yet proximate qualities of the ecological crisis.

Imagining the possibilities for imaging the ecological crisis must include, as Susan Schuppli (2016) argues, the imaging capacities of the environments themselves. In line with John Durham Peter's (2015) proposition of the mediatic capacity of the environment, Schuppli suggests that we might 'have also entered a geo-photo-graphic era in which polluted environments operate as vast photosensitive arrays that register and record the changes brought about by industrialisation and its contaminating processes' (Schuppli 2016: 191). As an example of a landscape that had itself become photographic she uses the Deepwater Horizon oil spill, where the oil molecules released by the spill into the Gulf of Mexico began interacting with the surface molecules of water to produce 'an iridescent image of creeping dread: a horror film, in effect' (191-3). Oil's capacity to behave photographically or cinematically in this way is an inherent feature of its molecular materiality: the relationality of oil molecules is such that their density can vary, making a thicker or thinner film on the surface of the seawater, 'thus modulating the degree to which light wavelengths interact and interfere with one another to produce their rainbow-like effects' (193). A visual event thus occurs 'in which images move beyond their accepted role as representations of events, but are themselves an integral part of the unfolding action' (191). Such an 'understanding of environments as engaged in practices of image-making' (204) destabilises the visuality driven by human-made images that operate symbolically, generating a photographic condition whereupon images that do not require human eyes are created as part of the re-arrangements of molecular matter.

Understanding the behaviour of an oil spill in image-making terms asks that we reconsider what we understand as an image, as well as the way we come to produce knowledge about the world through images. It also demands that we examine what happens to the position of humans as implicit creators of and audience for images, when the nature of what constitutes an image is radically altered. Images such as those created by the oil spill are themselves so vast in time and space that they evade human perception ‘and thus decentre the vantage points of objective human vision' (Schuppli: 197). As Zylinska writes in her essay 'Photography After the Human' (2016), 'liberating vision from the constraints of the embodied human eye, with its established set of visual relations and the limited directionality of its outlook', such as is made available by this rethinking of images, creates an opportunity 'of glimpsing another setup' (184), another bundle of agencies. She argues that this is something that can have 'earth-shattering consequences, because it plants in our human minds a radically different set of images and imaging practices, one that transcends the subjectivism of the human eye', and thus becomes 'a first step in any kind of concrete and responsible reconfiguration of our here and now' (184). In making conscious efforts to create images that generate 'new perceptual realities' (Schuppli: 203) appropriate for the task of depicting the ecological crisis we must remember that environments are doing this already.

The political question of building an alliance of humans and nonhumans, and of avoiding the worst environmental catastrophe, will ultimately be an aesthetic question, as Sean Cubitt argues in *Finite Media: Environmental Implications of Digital Technologies* (2017). Aesthetics is here understood as 'concerning both perception (the root meaning of *aesthesis*) and art, the techniques of mediation and communication in which we construe our relations with one another and the world' (15). Neither economic nor technological fixes would suffice, as both are part of the machinery that perpetuates the crisis, and politics will only be effective 'if

there is a radical change in how we conceive of and pursue politics', a change which in turn could only arise through a remaking of 'aesthetic principles, that is, by remaking communications' (151). Cubitt calls this shift in politics eco-politics, the politics that 'looks toward the unimaginable as an aesthetic category, the unimaginable good life for human, natural, and technological phyla in their once and future interdependence' (188). The aesthetic here becomes a ground upon which to imagine and therefore be able to work towards a future. Cubitt calls this mode an eco-political aesthetics and argues that 'if politics is the art of the possible, eco-political aesthetics is the art of the impossible', for it helps to 'envision for us the unimaginable', to make 'unthinkable futures' thinkable (186). Eco-political aesthetics would need to take into account the existing economic and environmental implications of the media technologies that make perception and communication possible. Indeed, it is precisely by accounting for the matter and energy of which the media consist that the media come to matter: 'only because they are matter can they mediate between fallen nature and fallen humanity' (186). Considering the geological materiality of digital media then becomes a crucial node in making the present and the future imaginable.

Media geologies and moving image ecologies

All technical images of the environment and the environmental crisis are bound to the earth through their reliance on minerals, metals and chemicals extracted from the ground, often at high environmental cost. Jussi Parikka's *A Geology of Media* (2015) introduces geology into media scholarship as both a conceptual tool and an urgent physical reality. Parikka's proposition is to consider the geology of media, that is the mineralogical and metallic materiality of media, all the way down to the fate of the materials after the death of the media themselves, as toxic residue and electronic waste.

Parikka's deep time of media encompasses the mined materials, electronic waste and the energy required to power the production and use of digital media. In this way, he creates a media history of matter where the durations of the materials themselves make up media temporality. He exposes the double bind between the earth that shapes our media, 'provides for [it] and enables it', and the media that in turn shape how we see the earth (13). In other words, for him it is media technologies that allow us to perceive, image and analyse the world in order to understand climate change and thus have the capacity to alter our relationship to the earth, while also, in order to function, media require the natural resources and fossil fuels that interfere in the earth's geophysical order. Riffing on Haraway's concept of naturecultures, Parikka coins the term *medianatures* to describe this double bind of the mutual reliance of our understanding of the earth on the media technologies that are materially subtended by the earth's geology. Just as 'naturecultures' point to the linguistic, conceptual and theoretical impossibility of the nature/culture divide, so too 'medianatures' point to the impossibility of considering media technologies or media content without accounting for their material conditions and ties to natural resources.

The field of eco-critical film studies engages with the double bind that Parikka calls medianatures from the perspective of cinema, thus considering the dual relationship between moving images and the geology that enables them, which they in turn depict. Works such as Adrian J. Ivakhiv's *Ecologies of the Moving Image* (2013) provide an entry point to thinking the material together with the perceptual. He examines the ecologies of film at the stages of production, exhibition and cinematic world-making. Building on Siegfried Kracauer's claim that 'in recording and exploring physical reality', cinema exposes to view our material environment that had laid 'before our eyes', and yet 'remained largely invisible to us' (1960: 299), Ivakhiv stresses the urgency of a cinema that can

redeem 'the material reality of the world' (2013: 23). He argues that to this end the key ethical imperative of ecologically-minded cinema is to advocate 'for greater attention to be paid to the relationship between the worlds produced *by* cinema and the world(s) *from* and *within* which they are produced – worlds that are material and biophysical as well as social and epistemological' (22). Ivakhiv delineates three key cinematic ecologies that span the same continuum of material-to-perceptual with which my project of geological filmmaking is engaged. First he identifies the material ecologies of cinema as dealing with the physical materialities of film production and exhibition: from the minerals, metals, chemicals and plastics necessary to make, run and dispose of cameras, computers, sets and projectors, down to the bodies of actors, sensory organs of spectators and potential damage done to biospheres of shooting locations. These are followed by the social ecologies, which include the socio-political contexts from which the films emerge and which they in turn influence. And finally, there are perceptual ecologies, within which the created images, sounds, durations and experiences are transmitted and received. Together these cinematic ecologies 'entail the material production and consumption of those produced images; the social or intersubjective relations of people whose efforts shape and inform those images; the people and things portrayed or represented by them', as well as on the exhibition end 'those delivering, receiving, interpreting, and being moved by them; and the cognitive, affective, and perceptual relations connecting bodies, sensations, desires, sensory organs, and media formations' (5). For my own project, the key issue about this triangulation of the material, the social and the perceptual, is Ivakhiv's argument that the flows of cause and effect travel in every direction amongst these three poles. This is to say that the perceptual ecologies of cinema carry the ability to influence material and social realities.

In *The Cinematic Footprint: Lights, Camera, Natural Resources* (2012) Nadia Bozak argues that photographic images, whether still or moving, 'directly and indirectly formulate landscape as both an aesthetic category and a physical reality, both representing and contributing to the decay of the environment' (13). She believes in the power of images as 'vital to communicating any kind of political or social awareness about environment in the first place' (95), and proposes that it is therefore crucial to find ways of creating images that cause the least direct material damage to environments. Bozak's discussion, however, while posing important questions, is limited by her focus on industrial cinema production and the (im)possibility of making it carbon-neutral. She cites the 7700 tons of concrete used for a brief scene of an approximated freeway in one of the Matrix sequels as an example of cinematic waste, and as an antidote to such wastefulness proposes what she calls second-hand cinema, 'a cinema of limited resources' (167). She uses the example of Agnes Varda's *The Gleaners and I* (2000) to substantiate this idea. Varda's film was shot handheld on a consumer video camera, using only what was available in terms of technology, natural lighting and location. Bozak advocates for such local and 'low-energy' (167) cinematic practice as a sustainable alternative to industrialised cinema production. Though hers is intuitively and unarguably an apt critique, it overlooks the existing history of low-budget experimental, personal and documentary film, which is as long as the history of industrial cinema, and has been engaged in producing work out of available resources through economic necessity or creative impulse, as well as more recently specifically out of ecological consideration. Bozak's argument for the higher ecological sustainability of personal cinema shot on consumer digital cameras also does not do enough to address the carbon footprint of the production of such cameras, and the increasingly abundant and wasteful production of digital images that results from digital cameras' wide availability and leaves a sizeable carbon footprint in the electricity

required to power data centres alone. Digital cameras, as well as computers required for editing the footage and larger technological networks that power and connect them are part of what Cubitt (2017) calls finite media, i.e. media that are reliant on dwindling supplies of materials and energy. Certainly a less directly environmentally harmful film production is preferable to the alternative, but the key issue here is that there is no innocence to be found in any technical images or filmic practices. Whether making films industrially or personally, on 35mm or consumer digital cameras, there is no escaping the entanglement of image-making technologies and the geophysics of the earth.

Geological filmmaking thus involves developing an awareness of the necessary reliance of the perceptual dimension of cinema on the geological materials that enable it, while looking for embedded ways to engage with and within both naturecultures and medianatures. Their geological materiality ties media, including analogue and digital moving image technologies, to a planetary spatial perspective and the temporal expanse of deep time. Today, some of the most ubiquitous moving image-making tools – smart phones – contain minerals and metals from around the world, from lithium mined in Chile's salt flats to rare earths from Inner Mongolia. As well as being tied to innumerable locations, the temporality of contemporary technical images encompasses the deep past of the formation of the mined materials and fuel required to power and produce the technologies that enable them, as well as the deep future of the material persistence of these technologies. The cinematic intersection with material geology also includes the creation of geological formations on the smaller scale of image capture. As Cubitt writes in *Practice of Light* (2014), both analogue and digital photographic or cinematic capture happen as a chemical exchange on a molecular level, as photosensitive materials enable a 'chemical conversion of light' (244). In the case of celluloid film, light oxidises grains of silver halides, and in the case of digital capture, electrons

are gathered by the crystal lattice of a CCD sensor. Meanwhile the CCD sensor crystal lattice itself is fabricated through a process of geological formation: starting from a seed crystal it is *grown* on the chip, with the molecular structure pre-empting the distribution of the pixels (105). Moving images are thus inherently tied to geology on both planetary and molecular scales. While accounting for how this state of events is actualised in every cinematic image, in this project I aim to develop moving images that will be able to grapple with geological materials and formations, as well as processes operating on imperceptibly vast and imperceptibly small scales. In the following chapters I will examine the ways in which film form, materiality and temporality are able to help depict, perceive and make imaginable the geological transformation of landscape, (in)visible geological materials and the scale and quality of geological time – the defining challenges of geological filmmaking. And in the following and final part of the literature review I will engage with a number of filmmaking practices that tackle such questions.

Seeing geologically: experimental moving image practice and the geological

In this final part of this chapter I am going to situate my work among the field of moving image work that engages with the geological, extraction and the Anthropocene. It is outside the scope and remit of my thesis to produce a thorough survey of artworks dealing with the Anthropocene across a breadth of media. In fact, a number of such book-length anthologies already exist, *Making the Geologic Now* (2013) and *Art in the Anthropocene* (2015) being the most prominent. Here my focus will remain specifically on the intersection of experimental or artists' film and video with the geological: works that in various ways could fall under the umbrella of *geological filmmaking*. By engaging with the growing body of

work of others, I aim to outline how my proposed concept and practice of geological filmmaking is situated in relation to existing practices. The following list is by no means exhaustive, it merely aims to present some exemplary works representative of a wide variety of practices and approaches.

Any account of contemporary work of this nature would be remiss not to build up from the groundwork laid by Michael Snow's *La Region Centrale* (1971). Locating the film in the uninhabited landscape of Northern Quebec, Snow's 'wanted to make a film in which what the camera-eye did in the space would be completely appropriate to what it saw, but at this same time equal to it' (Snow 1994: 57). Snow's goal was to create a means for the camera to record a landscape in a way that was both appropriate and equal to the vast wilderness rich in geological formations, to develop to its full the always already present affinity between the nonhuman apparatus and the nonhuman subject. The film was thus shot by a specially-designed machine that could tilt, pan and rotate the camera 360 degrees along every axis, independently of a human operator. As Irmgard Emmelhainz writes, 'by presenting every possible position of the framing-camera in relationship to itself, *La Région* releases the subject from its human coordinates' (Emmelhainz 2015: 133), enacting a 'displacement of the human agent from the subjective center of operations' (134) in its creation and reception. The gaze of the camera is definitively not human. Indeed, as the film goes on, Snow suggests that 'it more and more sees as a planet does' (Snow 1994: 59), transporting the subjectivity of the gaze from the viewer to the ground of the landscape itself. Snow imagines that the film will preserve that which 'will increasingly become an extreme rarity: wilderness', becoming 'a kind of absolute record of a piece of wilderness' (56). Nearly half a century later the moving image works attempting to access the geological through a focus on the agency and materiality of cinematic technologies no longer reach for wilderness, but focus instead on

the inextricable connection between anthropogenic and geological agencies.

A number of different approaches in contemporary work echo *La Region Centrale*'s heightening of the affinity between the autonomy of the apparatus and the nonhuman subject. These include the use of camera techniques removed from the human hand or human perspectival positions, the use of algorithmic and computational images to create self-sustaining digital environments and using the materiality of celluloid film as an arena upon which to harness traces of non-human agencies. Dinh Q. Le's *The Colony* (2016) continues the work of destabilising a human observer's stable perspectival position by mobilising the machinic view of drone cameras to shoot an isolated landscape that has been put on the map by a history of extraction. The subject of *The Colony*, a video installation commission for Artangel, are the Chincha Islands off the coast of Peru, uniquely abundant in guano due to the colossal colonies of seabirds that nest there. The islands became the locus of the world's attention in the 1850s after the discovery of guano's fertilising properties, which led to numerous military conflicts over the control of the islands, and continues to be mined to this day. The videos are presented on three screens placed in three corners of an equilateral triangle, creating an enveloping and multi-perspectival environment. Viewers are not able to see all three screens at once, needing to change positions in the space in order to watch the different screens in turn, making it impossible to find comfort in a stable viewing position: within the installation there is no 'god's eye view' whence a neutral totality of perspectives would be available. The videos are shot entirely with drones. With the proliferation of birds throughout the images, and the drones at times shooting straight down as they pass overhead, it could be tempting to describe them as presenting a 'birds's eye view' perspective, but it is an unmistakably technological view that equally objectifies the birds, the islands and the humans that labour on them. Unlike the way in which the nonhuman apparatus seeks an affinity with the

nonhuman landscape in *La Region Centrale*, here it is the inhuman in the apparatus that reveals the inhuman of the extraction machine.

John Gerrard's *Western Flag (Spindletop, Texas)* (2017) is a self-sustaining digital simulation of the site of one of the key events in the early history of oil prospecting. The piece and its title reference the events at Spindletop Hill, Texas in 1901, when an unintentional oil eruption, which reached a height of forty feet and took nine days to be brought under control, ushered in an unprecedented rush for the control of the oil reserve, with four hundred rigs and over a thousand oil companies appearing in the town within two years. *Western Flag* creates a digital simulation of the actual site of the eruption as it is today, spent and barren, with a flagpole in the centre of the image that is perpetually emitting black smoke that visually resembles a flag blowing in the wind. The video is of infinite duration, with each successive frame being calculated and produced in real-time. It is also a real-time match to the daylight conditions of the actual site, with sunrise and sunset happening at correct times on every given day of the year. The perpetually renewing stream of black smoke is as much a monument to the once-gushing oil of Spindletop, as a comment on the ever-streaming smoke of contemporary ongoing global emissions. As Lisa FitzGerald writes in her article about the piece, the video simulation 'echoes the original Spindletop but also operates as its own world' (2018: 95). Here too, the autonomy over the iterative creation of the image has been given over to a machine, which is able to create a world that infinitely unfolds according to its own internal logic. The systems-based computational approach to moving image creation communicates the implacable agency of oil that necessarily affects the atmosphere when it is extracted and burned.

Computational images give autonomy to the apparatus as a means to accessing the agency of nonhuman entities, and, in a very different way, so do works that focus on the materiality of celluloid and use environmental elements to expose or develop film. These are works that highlight what

Tess Takahashi describes as 'less film's ability to produce recognizable iconic images of the natural world' and more 'its ability to physically record the influence of the material world on its celluloid body' (Takahashi 2008: 49). For example, Francisca Duran's *It Matters What* (2019) is developed using natural plant extracts. *It Matters What* begins with a child reciting passages from Donna Haraway's essay on the Chthulucene, and includes archival footage alongside phytograms created by overlaying plant matter on the 16mm substrate and exposing that to the sun, a technique developed by the artist Karel Doing whose own work explores similar questions. All of these different methods of image capture and creation are then linked by the contingent nature of the film's uneven reaction to the plant-based developer. As Kim Knowles, a nuanced commentator on the crossover of New Materialism and film materiality, writes, the focus on the process allows for a filmmaker's agency to give 'way to the eventualities of these material encounters' (2017: 263). It is this highlighting of predetermined process over visual results that both connects such work to the legacy of *La Region Centrale* and foregrounds nonhuman agencies. Knowles continues that 'the image is therefore secondary to the gesture, or, rather, it exists primarily as a record – a trace – of a physical encounter that is both durational and, importantly, inaccessible in its complexity to both the filmmaker and the viewer' (266). Sam Nightingale's film and photography practice brings geological materials into such process-based image-making, as it is invested in creating portraits of the invisible material agencies of situated landscapes by using matter from the sites to generate the images. For a project on salt mines in Victoria, Australia he used salt from the mines in the printing of the images, the salt thus becoming both the subject of the images and the means of image-creation, its geo-chemical agency generating its own representation.

Ana Vaz's *A Idade da Pedra* (2013) deliberately brings together 16mm materiality and computational images, as it explores the multiple

temporalities of extraction. Shot in and around a quartz quarry in the savannah in the far west of Brazil, the film centres on the ambiguous construction or unearthing of a monumental geological structure that does not seem to behave according to the laws of physics. *A Idade da Pedra* is shot on 16mm and largely consists of shots of the savannah, the plants, birds, insects and geological outcrops that populate it, as well as the quarry and the men that work there. The central object of the film, either a construction site or an ancient ruin, appears quite late on and is never seen in full. The structure, albeit it appears monumental and mimics the texture of the film and the quarried stone, is a CGI-based speculation. Vaz first collaborated with the sculptor Anne-Charlotte Yver to create a physical version of the structure. Designed to collapse, the original sculpture is a monument to entropy. Vaz then collaborated with a digital artist to animate this unstable monument within the image-world of the film. The meeting of quartz of the physical landscape shot on 16mm and the CGI structure, is a meeting of the deep past and the deep future, suspended in the title's time of stone. Sean Cubitt writes that in the use of CGI animation, instead of a physical engagement with the object of depiction, the focus is solely on 'dimensionality and significance' (Cubitt 2005: 33), the technological image thus 'abstracts itself from the physical world of matter and energy' (35). The entropic monument is abstracted from the rules of both gravity and entropy acting upon the savanna and the quarry. The structure is a visual manifestation of the folly of the utopian fiction of extraction not beholden to the specificity of the finite material environment.

A Idade da Pedra also mobilises essayistic techniques, such as occasional citational voiceover, in the attempt to evoke the time of stone. Indeed, film and video essays form a prominent set among the moving image works engaging with the Anthropocene, ecological crisis and the geological. Reflecting on the popularity and relevance of this tendency Sven Lutticken asks, 'should we not disregard [film and video essays] in favour

of projects that are more properly materialist and intervene directly in the physical world?' (Lutticken 2013: 284). He answers his own question in support of the essay film, however, arguing that 'an essay is always a material hypothesis — and the material in question here is first and foremost the fabric of time' (284). The essay film then, is able to materially engage with the conditions of temporality, 'in a context in which natural time is out of joint', thus 'offering clues for finding one's bearings in this new nature' (226). The Otolith Group's *Medium Earth* (2013) is one of the more prominent examples of essay films engaging with the intersection of geological and human agencies and temporalities. Its focus, unlike some of the works discussed above, is not an anthropogenic extractive intervention into the geological landscape, but rather the reverse: the seismic agency of earthquake-prone landscapes of California and its interventions into anthropogenic infrastructure. The film consists predominantly of static close-up and wide shots of visible traces of seismic activity, such as fractures in roads and buildings. In attentively documenting the still landscape the film reveals its capacity for sudden change, while the sparse voiceover further speculates alongside the power of the tectonic forces hidden below.

The above works have very different, and in some cases seemingly incompatible, approaches to moving image and its possibilities, yet all of them are connected insofar as they all adapt their formal approaches and technological means to reflect their geological subjects. Part of the aim of this project, in proposing the *concept* of geological filmmaking, is to be able to name, understand and theorise all of the above disparate projects as a coherent ecology of practices. The nomenclature 'geological filmmaking' itself is echoed in the names of some recent collaborative moving-image projects such as Geocinema and New Mineral Collective. While their aims and focus somewhat differ from those of this project, with the 'geo' in Geocinema standing for global communications systems and their image-

making capacities and the New Mineral Collective working through speculative performative methods that centre the body and affect as sites of extraction, they too belong to the same ecology of practices as this project. My research is in no way about finding shortcomings with any of the above practices or projects, rather one of its key aims is to create a theoretical framework for this ecology of practices, and to do so specifically through testing theoretical ideas through filmmaking practice. It is from the *practice* of geological filmmaking – which I develop in response to specific research questions and specific geological forms and materials, as will be discussed in the following chapters – that this theoretical framework arises.

2. Depiction: The verticality of landscape and the depth of the image

Visual depictions of the environment have had an impact on how it is understood at given historical moments. A notable example might be the ‘Blue Marble’ photograph of the whole Earth from the Apollo missions, which catalysed the first environmental movements in the 1970s, but has more recently come to be criticised as an inaccurate and apolitical image of terrestrial dwelling (Latour 2018). Jason W. Moore argues that 'ideas of nature are fundamental to earth-moving', wherein 'the "thinking" and the "doing" [...] are two moments of a singular process' (Moore 2015: 79). He proposes that nature, as it is understood, represented and quantified socially and historically, is as much implicated in the processes of environment-making as much as the material processes of depletion, extraction, deforestation and toxification. 'Power, production, and perception entwine' (3), he writes. In other words, what can be seen, heard, imagined and made intelligible about the world is mutually co-constitutive with the power dynamics that compel capitalism and colonialism to treat material environments as a standing reserve. In this chapter I will consider the implications of visual representations of environments on their treatment, and will explore some possibilities for alternative, less objectifying and more situated, approaches to visual depiction through an investigation led by the practice of filmmaking.

The questions guiding this chapter were established in the process of surveying the theoretical fields of study this project engages with, as recounted in the literature review. These key questions include: How can we think and depict the geological as both matter and process, which is to say how can we see and image geological formations — and their formation? How can we depict environments and landscapes in their

ongoing transformation while accounting for the network of human and nonhuman agencies transforming them? How can we account for the blurring of the boundaries of life and nonlife implicit in the concept of the Anthropocene? In opposition to the god's eye view from nowhere, how can we depict environments in a way that is situated and embodied? How can we depict environments beyond what is visible on their surface? The choice of the subject matter for the film that I made in parallel with this chapter emerged directly in response to these questions. The sinkholes decimating the Dead Sea shore initially attracted my attention precisely because of the way they violently intervened in the landscape, revealing its geological depths beneath the surface, as well as they way they embodied the confluence of a geological formation and its active formation: on the one hand a sudden, comparatively to geological timescales of sedimentation and erosion, change in the landscape and, on the other hand, a visible lasting trace of that change. Upon researching the cause of the appearance of the sinkholes further, I found it to be a complex web of interconnected geologic and anthropogenic causes, from the specificity of the formation of the salt deposits underneath the shoreline to the extraction of minerals and diversion of water for agriculture. The use of the extracted minerals in allegedly health-giving cosmetics and of the diverted water in the quest to introduce life into the desert perceived to be barren, the anthropogenic causes of the sinkholes' appearance themselves entwined life and nonlife. The sinkholes thus presented themselves as a prism through which I was able to explore the above research questions.

The above questions guiding this chapter are also approached directly through a practical investigation in the film *Salarium* (2017). The attempt to find a cinematic language that can depict the complexity of the sinkholes filmically is aimed as a contribution to the field of discourse that inspired the questions to which the film seeks to find answers. The research and thinking presented in this chapter developed in parallel with the film.

The earlier sections of the chapter were developed prior to the filming and created a more robust historical and theoretical base for the film, and the final part of the chapter theorised what took place during the making of the film. The earlier parts of the chapter are also a parallel attempt to find some answers to the guiding research questions within existing literature and creative production.

I begin with situating the visual depiction of landscapes historically, by tracing the emergence of the Western understanding of the concept of landscape through the establishment of landscape painting as a distinct genre during the times of industrialisation and colonial expansion. Through the work of Denis E. Cosgrove (1998) and W.J.T. Mitchell (2002), I identify the tropes of linear perspective and frame as implicated in the creation of the Western understanding of the human relationship to nature as one of mastery. I then go on to question whether an alternative, embodied and non-objectifying, mode of depicting landscape is possible, or whether 'landscape' as such cannot be rehabilitated and, further, whether it is actually unfit for the purpose of depicting the complexity and vastness of the ecological crisis, as argued by Timothy Morton (2011). I argue that it is possible, and indeed necessary, in the time of rapid anthropogenic transformation of physical landscapes to find ways of depicting this transformation, without the pitfall of objectifying the landscapes. Drawing on the work of Karen Barad (2007), I thus argue for a need to develop modes of representation without representationalism. Prior to identifying the specific practical challenge through which to explore this proposition filmically, I examine an existing moving image work that I believe successfully deploys one possible strategy of doing so. I look at *Radian Temperature of Openings* (2015) by Faraz Anoushapour, Parastoo Anoushapour and Ryan Ferko, which provides a mode of bypassing representationalism in the depiction of landscape, by focussing on an absent landscape. In foregrounding the materiality of the display

apparatus, this work is able to rediscover depth and verticality both in cinematic images and the landscape drowned by the creation of a hydroelectric dam. In order to add to the existing set of creative strategies, in my own filmmaking investigation I do not go for an absent landscape, but for one that is in the active process of transformation through the appearance of sinkholes.

The final part of the chapter begins with a detailed account of the geological, historical, political, military, industrial and agricultural forces that coalesce in the appearance of the sinkholes. The geological here is understood as the very structure of the ground under one's feet, as the shape of the desert landscape, as the sudden changes to the landscape caused by the appearance of the sinkhole, as the very forces that cause the sinkhole to appear, as the collapsing of the horizontal and vertical planes. Elizabeth A. Povinelli's (2016) work on geontopower provides a useful framework for theorising the continuous breaching and re-establishment of boundaries of life and nonlife by the military occupation of the West Bank and its mobilisation of the environment as a military-colonial tool. The sinkholes, however, reveal the environment to have its own agency, as they intervene in the very possibility of ongoing extraction or cultivation. As the sinkholes become the prism through which to explore the numerous research questions guiding this chapter, these questions synthesise in the following one: as distinct from representational images *of* sinkholes, what could constitute a performative, in the Baradian sense, *sinkhole image*? The sinkhole image is that which reveals the depth of landscape in revealing the depth of the image, the non-perspectival one that destabilises the viewing position or the absent one that draws attention to the materiality of the screening experience. Insofar as the sinkholes themselves collapse surface and depth, as well as the boundaries between inhabitant and environment and life and nonlife, the sinkhole image is a cinematic depiction of that collapse.

Tracing landscape: from object to medium

Moore argues that European 'imperialism of early modernity was impossible without a new way of seeing and ordering reality', for 'one could conquer the globe only if one could see it' (2015: 190). During the Renaissance the advancements in the study of optics included innovations such as telescopes and cartographic techniques, enabling the practical possibilities to 'navigate oceans, map out and colonize new lands, and control and subdivide territories' (Ivakhiv 2013: 80). At the same time, also in the field of optics, the invention of linear perspective further enabled the conceptualisation of space as abstractly geometrical and quantifiable (Panofsky 1991). Perspective, as Denis E. Cosgrove puts it, 'was regarded not merely as a technique, a visual device, but as truth itself, the discovery of an objective property of space rather than solely of vision' (Cosgrove 1998: 22). A painting made by mobilising the rules of linear perspective was thus imbued with a claim to objectivity and realism. This claim, however, was not neutral: it took a pictorial representation of space, the perspectival lines of which converge in the eye of a single ideal viewer, who acted 'as the static centre of the visible world' (22), and then presented 'this view as universally valid by claiming for it the status of reality' (26). Perspective imbued pictorial depictions of the physical world with supposed objectivity, and simultaneously turned them, and by extension the physical world they claimed to represent, into objects placed under the control and ownership of individual human subjects. The invention of linear perspective coincided with the emergence of landscape painting as a distinct genre, which from its very inception has been bound up with the commodification of space.

In the English language the word 'landscape' carries a 'dual ambiguity', wherein it stands for both a 'terrestrial space' *and* its depiction (Cosgrove 1998: 15). The linguistic interchangeability of landscape-as-land

and landscape-as-image deepens the influence the latter wields over the former. The Oxford English Dictionary entry for landscape dated 1725 defines the term in this double way as 'a view or prospect of natural inland scenery, such as that can be taken in at a glance from one point of view' and 'a picture representing natural inland scenery as distinct from a sea picture, a portrait etc.' (quoted in Cosgrove: 16-17). Yet the understanding of land as a 'prospect' is historically bound up with the very practices of its pictorial depiction in landscape painting. The two formal aspects of landscape painting that were the drivers of this conceptual transformation are linear perspective, directing the scene toward the eye of the individual observer, and the frame, parcelling off the physical world into discreet units from which the viewer could choose to turn away. Landscape conceptualised geographically as the physical surface of the earth was simultaneously also monitored, recorded, understood and appropriated 'through the objectivity accorded to the faculty of sight and its related technique of pictorial representation' (Cosgrove 1998: 9). The instrumentalisation of landscape-as-land owed a lot to the emerging understanding of landscape-as-image, serving as evidence of 'the active role of cultural production in the transition to capitalism' (9). Landscape painting first emerged in Europe 'in the most economically advanced, densest settled and most highly urbanised regions of fifteenth century Europe: in Flanders and upper Italy' (20). Through urbanisation a gulf emerged between the cities and the countryside – which, via its depiction in landscape painting, came to stand for 'nature out there', artificially separated from the run of modern life. Later, with the rise of industrialisation in nineteenth-century England, landscape painting flourished into a key artistic genre. Landscape painting developed in tandem with the rise of both individualism and capitalism and had consequences for the understanding of the human relationship with nature as one of mastery.

Beyond the formal elements of landscape painting, the perspective and the frame, the depiction of wilderness in nineteenth-century landscape painting was itself politically charged. In his study of the ideology of landscape titled *Landscape and Power* (2002), W.J.T. Mitchell writes that through landscape painting nature itself was incorporated 'in the legitimation of modernity, the claim that "we moderns" are somehow different from and essentially superior to everything that preceded us […] masters of a unified, natural language epitomized in landscape painting' (13). Mitchell further argues that landscape painting was used by Western imperialism as 'the medium in which it "emancipates," "naturalizes," and "unifies" the world for its own purposes' (13). On colonial territories landscape paintings of idealised wilderness, such as the works by the Hudson River school of painting in upstate New York in the mid-nineteenth century, sought to erase the traces of the presence of the land's indigenous human inhabitants in order to justify its subjugation to the newly arrived European settlers. In England the Romantic landscape was not in fact an innocent refuge from the increasingly industrialised world, or a celebration of wilderness aimed at its appreciation and preservation, but rather a manifestation of the awareness of its coming disappearance. Cosgrove claims that 'the elision of landscape with wilderness or nature untainted by human intervention' was part of modernity's ideological project of 'a rejection of the evidence of human action' (1998: 14). Landscape became a concept that, 'while appearing to criticise industrial capitalism' (234), in fact helped its progress. In this sense, landscape painting in the nineteenth century became what Nicholas Mirzoeff (2011) calls a visuality: a historical trajectory that 'sought to present authority as self-evident' (3) by negotiating the visible and the unseen.

What can landscape mean in the contemporary scenario of ecological crisis? Can it be untangled from its history of being used by Western imperialism and industrialism as a foil for the subjugation of peoples and

environments? Indeed, the understanding of landscape as 'a kind of backcloth to the whole stage of human activity' (Appleton 1975: 2) is, as it is argued in the literature review of this thesis, inconsistent with an ecological way of thinking that defies the supposition that nature is the background to the foreground of human events, or that it could be separated from culture and observed from a distance. The arguments such as that 'the very idea of landscape implies separation and observation' (Williams 1973: 120) are not incorrect. As we have seen above, they are part of a particular historical and art-historical reading of the emergence of the European idea of landscape through landscape painting. But they do not tell the full story. Beyond this historically contingent reading, landscape is in fact far from separate from human activity, and far from a discrete object ready for subjugation. As Jean-Luc Nancy writes, landscape 'is not a view of nature distinguished from culture but is presented together with culture in a given relationship' (2005: 58). Mitchell proposes in turn that 'landscape is a medium of exchange between the human and the natural' (2002: 5). If we understand media as proposed by John Durham Peters in his book on elemental media as 'our infrastructures of being, the habitats and materials through which we act and are' (2015: 15), landscape-as-land is already a medium. Landscape, before it becomes represented in image, be it painted, drawn, photographed or filmed, is already 'a physical and multisensory medium' (Mitchell 2002: 14). How then to rethink landscape-as-image as a medium, which can, as offered by Sean Cubitt, precede 'the separation of the human and the environmental' (Cubitt 2017: 4)?

In his thesis on hyperobjects, objects so dispersed and long-lasting that they evade the perceptual framework of an individual observer, such as climate change and nuclear waste, Timothy Morton argues that the concept of landscape has become insufficient as 'no landscape is big enough or long lasting enough to enclose hyperobjects in its frame' (2011: 83). However, understood as a medium of exchange between the human and

the environmental and as the visible 'consequence of a collective human transformation of nature' (Cosgrove 1998:14), landscape presents itself as one potential visual strategy that seems up to the task of depicting naturecultural environments-in-transformation. In this time of rapid anthropogenic transformation of landscape-as-land, it is crucial to reclaim and critically reimagine landscape-as-image in order to continue depicting environments in ways that problematise the historically specific aspects of landscape painting that objectify and parcel off environments as discreet prospects. Astrida Neimanis (2017) highlights the perils and paradoxes of what she sees as the necessary but impossible work of representing nature. She argues that 'due to a Western mindset that perceives nature as only instrumental, a resource to be used, or a silent backdrop, non-human natures suffer many harms at the hands of such-thinking humans, and thus seem to demand that we speak for them' (139), yet immediately warns of the risks of perpetuating some of these same violences in the process of speaking *for* nature. Applying Gayatri Chakravorty Spivak's (1988) work on the dangers of misrepresenting subaltern subjects to the representation of non-human natures, Neimanis suggests that representational impulses, no matter how well-meaning, risk leaving their object 'rendered passive and mute' (Neimanis 2017: 135). However, if we are truly invested in working off the initial premise of the inseparability of natureculture, there can be no speaking *for* nature, only speaking *from inside* natureculture. Drawing on the work of Karen Barad (2007), Neimanis thus argues for 'a representation without representationalism' (137), a type of representation that 'affords the possibility of *imagining* what we call "nature" and "culture" as truly cosubstantial' (146).

In her critique of representationalism Barad (2007) argues for a more embedded and performative approach to knowing the world. Representationalism assumes that there are two 'distinct and independent kinds of entities – representations and entities to be represented' that are

divided and mediated by another assumed and separate entity – a knowing subject (Barad 2007: 46-47). Barad argues that no such assumptions of a priori existence or separation can be made, and that in fact engaging with the world in order to know it plays a role in the emergence of the world. To account for this inseparability, she proposes agential realism as a performative onto-epistemological framework that aims at knowing the world by *intra-acting* with it from within. In other words, 'unlike representationalism, which', like the traditional understanding of landscape, 'positions us above or outside the world we allegedly merely reflect on, a performative account insists on understanding thinking, observing, and theorizing as practices of engagement with, and as part of, the world in which we have our being' (133). A performative approach 'takes account of the fact that knowing does not come from standing at a distance and representing but rather from *a direct material engagement with the world'* (49). In what follows I will engage with moving image works that aim to reimagine landscape as a way to depict naturecultural environments in their ongoing transformation not from a distance but from within.

The verticality of absent landscapes

The mode of thinking inherited from linear perspective considers something to be real, which it sees as being synonymous with being a representable object, insofar as it occupies a certain space. As Bernhard Siegert elaborates, 'one of the effects of the representational technique known as central perspective is that the identity of objects becomes a function of their being in a particular place' (2015: 102). Could some of the objectifying tendencies of landscape painting and linear perspective be challenged by the portrayal of a landscape that is *not* in its place? In this part of the chapter I will focus on the representational challenges (and their potential) of engaging with absent landscapes, or what Paul Lloyd Sargent

calls 'landscapes of erasure': the 'erasure of material and socio-cultural landscape by human forces operating at the geologic scale' (Sargent 2013: 106). One of the palpable effects of anthropogenic geologic change, along with the creation of a geological stratum influenced by human habitation, industry and waste, is the modification of landscape. Land is drowned in the creation of hydroelectric dams and as a result of rising sea levels; it is dug out in the expansion of mines and canals; it is filled in by toxic lakes on the outskirts of rare earth minerals processing plants and electronic waste grounds where obsolete technology goes to die. Crucially, absent landscapes become a useful tool in searching for a way of depicting environments in a way that goes beyond representationalism, as their absence presents immediate problems to the inherited notions of landscape I am looking to challenge, such as objectification, separation and distancing.

The moving image exhibition *Radiant Temperature of Openings* (2015) by Faraz Anoushapour, Parastoo Anoushapour and Ryan Ferko addresses a set of towns drowned by the creation of the hydroelectric dam on the Saint Lawrence River in Southern Ontario, Canada, in the 1950s. As the artists write in the accompanying publication: 'In anticipation of this unnatural disaster, houses are lifted and moved away from the waterfront. Houses that are not moved are demolished and burned. Trees are cleared. Graves are either moved, or covered in gravel to prevent floating' (Anoushapour, Anoushapour & Ferko 2015: non-pag). This unnatural disaster and logistical feat was amply documented and archived, deemed as it was a key moment in the modernisation of Canada. The artist group focuses on these archives. Alongside the Canadian settler villages accounted for in the archives, the artificial lake created by the hydroelectric dam drowned the territories of the Mohawks of Akwesasne, who, as the artists describe in the publication, were neither properly informed nor aided in this transition. An official apology came only 50 years later, and in

the archives from the 1950s they are conspicuously absent. The exhibition's attempt to portray an absent landscape also becomes an attempt to grapple with this historical representational absence. In their engagement with the archive the artists aim to decipher not merely the event itself — the landscape's drowning — but also the interpretation and mediation of the event by those perpetrating it and some of those affected, seeking out the ambiguities and inconsistencies in the archive.

The exhibition draws from a local archive called 'The Lost Villages Society', which consists of official governmental reports and documents as well as multi-media materials amassed by the inhabitants of the soon to be drowned Canadian towns. The centrepiece of the first room in the exhibition is a three-monitor video triptych that navigates and animates photographs from the archive, including images of the towns as they were, of houses being moved and of the construction of the dam (Figs. 2 and 3). The three screens are arranged vertically and side-by-side to create a single 16:9 screen. They read as the three perspectives from which the archive was conceived and executed: that of Ontario Hydro, the Ontario Government and the towns' residents themselves. The screens oscillate between operating as one and going out of sync, searching for the inconsistencies in the intentions and interpretations of the different angles of the archive. The panning through photographs, as though looking for clues in the minutia of the detail, adds dizzying motion and rhythm. Although formally minimal and based on a collection of still images, the video is at times intensely visceral through the fast motion of the panning, the alternating matching and mis-matching of the three screens and the differentiations in the rhythm of editing. The searching gaze across the small details is constant and unquenchable, as though looking for an opening, a way to pry history open. When the three screens are out of sync, near abstract images and shapes arise from the photographs, these still historical objects, creating new speculative arrangements of spaces, events, shapes, objects

Fig 2. and Fig. 3. Stills from *Radiant Temperature of Openings* (2015), Parastoo Anoushahpour, Faraz Anoushahpour, Ryan Ferko, courtesy of the artists

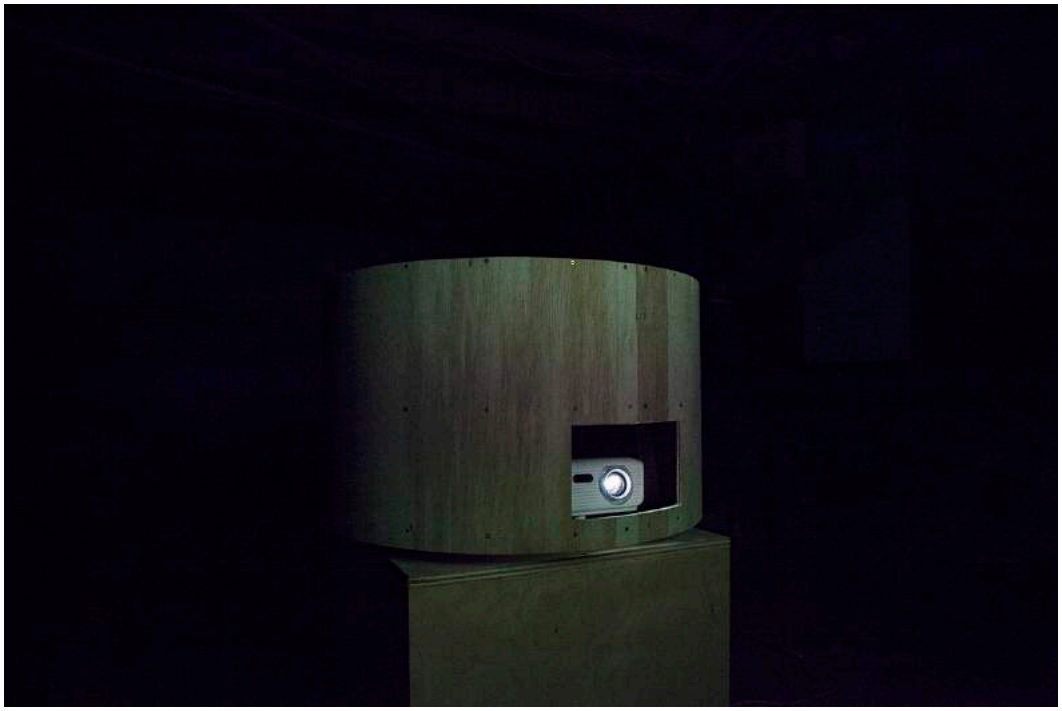
and movements. These abstractions undo the photographs as coherent images of land and thus challenge the definition of landscape as 'both a represented and presented space, both a signifier and a signified, both a frame and what a frame contains' (Mitchell 2002: 5): the space and the signified are absent, the frame is viscerally destabilised. The abstraction disrupts linear perspective and the stable subject position of an ideal viewer, moving toward an enmeshment of multiple yet simultaneous and located perspectives and a plurality of viewers and possibilities.

The verticality of the screens, when operating individually, further dislodges the association between the traditional horizontality of the film frame and the prospecting and cartographic understanding of landscape as surface. It points to the geological understanding of landscape as verticality: a literal material verticality that includes not only the horizontal plane of geography and the surface of the earth, but the vertical plane of geological strata extending toward its core. The material verticality also extends skyward and includes the atmosphere surrounding the earth, on which industrial activity is now able to wield such damaging influence through the continued burning of fossil fuels. In the early twenty-first century all industrial activity on the surface of the earth partakes of the resources that are extracted from its depths and impacts the atmosphere above. Any contemporary portrayal of environments that hopes to account for this vertical inseparability of geology and ecology, and for our embeddedness in their material reality, would have to go beyond any formal inheritances of nineteenth-century landscape painting, beyond notions of horizontality and surfaciality. In formally evoking verticality and breaking down the archival survey photographs, *Radiant Temperature of Openings* begins to undo the historically specific understanding of landscape as a contained and static object.

Works such as *Radiant Temperature of Openings* propose alternatives to the horizontal understanding of landscape by rediscovering depth in

two-dimensional cinematic images. The downstairs room of the exhibition is darkened and hosts a complex projection set-up. A rotating circular wooden structure with a window on one side acts as a shutter mechanism for the projector, plunging the room and the screen into darkness when the beam is hidden (Figs. 4 and 5). The projection surface is painted with glow in the dark paint. It absorbs the light of the passing projected frame and gives off an afterimage, which fades right before the following 'exposure'. The film presented is a total portrait of one of the submerged towns via close-up shots of the faces of every one of its inhabitants. In their focus on the materiality of the display apparatus it is clear that the artists do not mean to equate the white Canadian inhabitants with the submerged location itself: the apparatus obscures and overwhelms the content of the film and points directly to the dimensionality of moving images.

Just like a shadow has invisible three-dimensional volume that is visually actualised upon a two-dimensional surface that cuts across it, so a filmic or photographic image is created when the light reflected off three-dimensional space is registered by the two-dimensional plane of film or digital sensor. The creation of an optically mediated image is a translation of three dimensions into two. In a process continuous with cinematic and photographic capture, cinematic projection takes place when the two-dimensional projection surface cuts through a volume of projected light to actualise its imagistic potentiality. Yet, as argued by Giuliana Bruno in *Surface* (2014), the surface of cinematic projection 'is not superficial but is a substantial plane of relational transformation that has texture and depth', as the phenomenon of projection itself reveals 'the thickness of surface' (108). She writes that by focusing on 'the actual fabric of the screen, outside of figuration' (3), the projection surface 'far from representing any perspectival ideal, is no longer containable within optical framings, and cannot be likened to a window or a mirror' (5). By engaging the material thickness of the projection surface as an active part of the piece, the artists



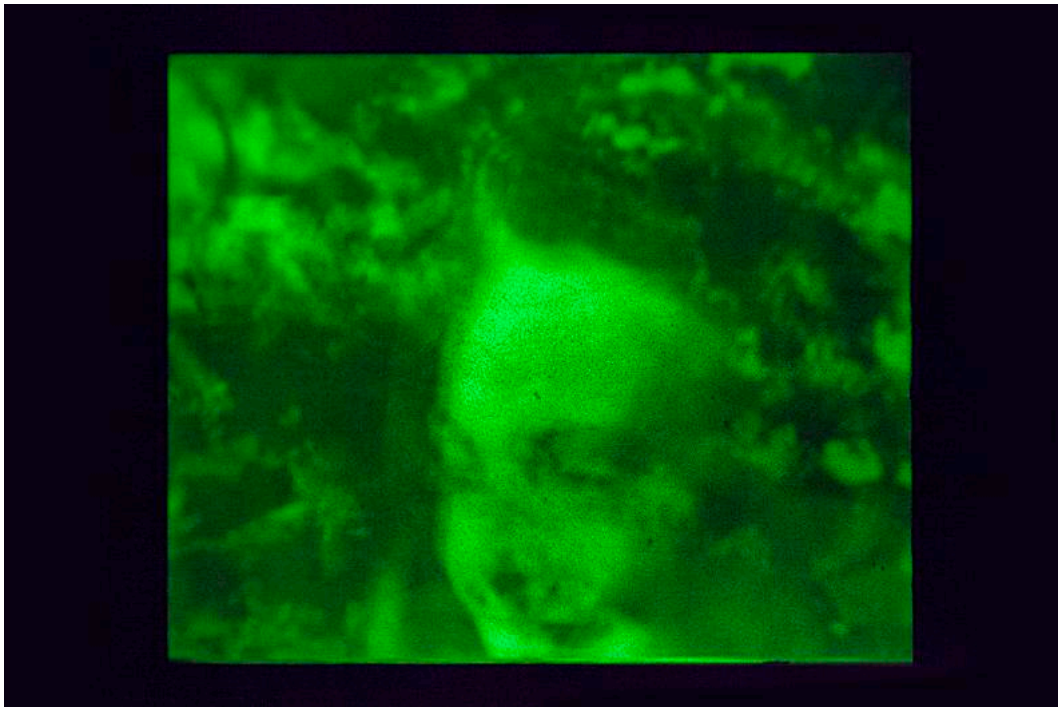


Fig 4. and Fig. 5. Installation shots from *Radiant Temperature of Openings* (2015), Parastoo Anoushahpour, Faraz Anoushahpour, Ryan Ferko, courtesy of the artists

re-animate the depth and dimensionality of cinematic images, and with that the depth and dimensionality of the landscapes they depict. In the following part of the chapter I will build on the idea of landscape as verticality to examine the tension and continuity of surface and depth in the context of moving images, physical landscapes and the encounter between the two, through a focus on the sinkholes decimating the Dead Sea shore and my film project which engages with this environment-in-transformation.

Sinkholes: surface and depth

A horizontal understanding of territory owes much to the history of cartography, which, as Siegert (2015) and Sean Cubitt (2014) argue, shares 'a deep structure' with linear perspective (Cubitt 2014: 214). While both the techniques of cartography and of perspectival landscape painting engage in transmuting a three-dimensional environment into a two-dimensional image, cartography, particularly on a planetary scale, entails necessary sacrifices of accuracy. Projection is required to make two-dimensional maps of a spherical world, either sacrificing the scale of individual countries and continents, as with the Mercator projection, invented by Gerardus Mercator in 1569 and commonly used as the contemporary world map we are familiar with, or preserving the correct area sizes by sacrificing the accuracy of their relationship to each other, as with the Gall-Peters projection map (204-5). The history of maps carries with it the history of imperialism and nation states, and both of the above types of sacrifices of accuracy have bearing on the efforts of state institutions to claim and subdivide territory: accuracy of relation is paramount for navigation and colonial expansion, accuracy in surface area is key in maps at the scale of the nation state and their efforts to delimit the legal bounds of sovereignty. The inaccuracy of cartography's depiction of a three-dimensional body also

includes it being limited to surface: cartography does not account for the volume of the terrain.

The territory of the West Bank has been highly politically contested and is subject to meticulous cartographic quantification, yet these maps account only for the surface of the territory and not the resources underneath. As Eyal Weizman (2002) elaborates, 'two-dimensional maps, fundamental to the understanding of political borders, have been drawn again and again for the West Bank', yet 'each time they have failed to capture its vertical divisions' (2). Though control of the surface territory of the West Bank was given to the Palestinian Authority in 1995, Israel 'retained control over […] the sub-terrain beneath' (1), thus allowing private companies in Israel to develop industry by the Dead Sea. This industrial activity is one of the causes of the dropping of the sea level and resultant decimation of the Dead Sea shore by the appearance of sinkholes. In the figure of the sinkhole the horizontal plane of territorial politics and human habitation and the vertical plane of geological materiality and resource capitalism collapse into each other. The sinkhole appears as the surface collapses into depth, and with that collapses the possibility of thinking territory merely in terms of surface: the volume of the terrain, the resources it holds and its geological agency are yet to be accounted for.

Since the 1980s, close to seven thousand sinkholes have appeared along the Dead Sea shore, rendering the natural shoreline all but inaccessible. The sinkholes have swallowed a number of people and destroyed numerous Kibbutsim, tourist compounds, date orchards and roads. This rapid transformation of the landscape is a direct outcome of anthropogenic intervention into the hydro-geological cycles of the area and the resulting dropping of the level of the Dead Sea over the past half-century. For a sinkhole to appear, a cavity needs to have formed in the sub terrain. As the level of the sea drops, what used to be the seabed becomes exposed as the seashore. This newly exposed shore contains a thick layer of

ancient salt deposits, formed underneath the sea, which is covered with a thin layer of topsoil, formed by the sedimentation of geological debris travelling down the mountains into the sea. When this terrain remained submerged, the salinity of the sea water meant it was not able to melt the salt deposits; but as it becomes exposed, the fresh water that comes with the flash floods in the winter penetrates through the dry topsoil and melts the salt deposits underneath. Over time absences form in the volume of the terrain and the sinkholes appear, exposing its depths and reconfiguring its surface.

The dropping of the sea level is primarily affected by two factors, each related to a mode of instrumentalising of non-human natures as a colonial tool. On the one hand, it is caused by the overextraction of minerals from West Bank shoreline by private Israeli companies; on the other hand – by the rerouting of water from the river Jordan in order to irrigate lands that were confiscated on the basis of claims of their prior non-cultivation. In this sense it becomes an example of a scenario in which, as put by Shela Sheikh, 'the environment itself becomes the medium through which violence is carried out' (Sheikh 2018: 450). In such a scenario, however, 'nature possesses a certain agency' (450), as the appearance of sinkholes, in turn, undermines the possibility of continuing much of the agricultural activity that causes it. The sinkhole collapses two temporal and agential scales: on the one hand, the geological scale of gradual mineral sedimentation and erosion, and on the other, the human historical scale of settler colonialism and resource extraction. More than just a surface interference, a sinkhole is also testament to unstable ground such that the assumption of the existence of nature as a stable baseline to human activity, which has fuelled the environmental destabilisation in the area, can no longer be supported. The sinkhole's appearance, while being directly caused by anthropogenic changes to the geology of the area, itself directly interferes in the possibility of ongoing habitation or extraction. Eating away

the palm groves, crackling beneath abandoned hotels and puncturing deep holes into the desert roads, sinkholes can perhaps be understood as the environment's refusal to be complicit with the slicing, cutting, fragmenting, cultivating, farming and confiscating of land and territory. Making the land uninhabitable in the future, the sinkhole appears as both visible symptom and active cause of this colonial project's failure to instrumentalise the environment. As Moore writes, 'geology is at once subject and object', it both acts and is acted upon (Moore 2015: 179). The sinkhole is not merely a static consequence of human activity upon otherwise stable reserves; rather, it is both producer and product of the ongoing transformation of the naturecultural environment.

It is in this manifestation of the sinkhole as both producer and product, symptom and cause, that my interest in it as a filmic subject is rooted. But how can the depiction of the geological transformation by the Dead Sea be approached filmically? I embarked upon this film project with the hypothesis that representational images of the sinkholes themselves would be insufficient in communicating the assortment of naturecultural agencies acting upon each other in this landscape. In the attempt to go beyond such an approach, I focused on visually interpreting the play of surface and depth, which includes the dynamics of capitalism and natural resources, of colonialism and territorial volume, of horizontal and vertical planes. While shooting *Salarium* my collaborator Daniel Mann and I were guided by a series of questions. We asked, for example, as distinct from an image *of* a sinkhole, what would a *sinkhole image* look like? What kind of camera movement, position, framing or proximity would be best suited to depicting the environment, its transformation and the transformation's causes and effects? How can such formal elements be mobilised to depict the geological agency of the depth of the landscape, other than through what is made visible on its surface?

As the landscape by the Dead Sea shore becomes a nexus of the intersection of politics and materiality, infrastructural violence and environmental violence, horizontal and vertical planes, so in our use of the camera we attempted to visually interact with each element on its own terms. We shot the infrastructural elements of the landscape, such as roads, orchards and electric pylons that permeate the otherwise empty Judean desert, from a tripod with a wide lens, aiming to visually echo the quantifying approach to the space of cartographic imagination (Fig. 6). As described in the introduction, the extreme heat meant that most of the shooting had to happen in ninety-second intervals between air-conditioning breaks. This material constraint meant either adapting my shooting style to committing to a single shot of any given scene, instead of gathering multiple angles, thus creating images that have to contain the wealth and depth of detail simultaneously. Or, alternatively, it meant spending a considerable amount of time in a given location, a time in which things would shift and characters — soldiers and prophets, settlers and tourists — come and go, all of which would make it into the film, adding layers of depth to the hostile landscape through seeing who chooses to, is forced to or is allowed to be there (Fig. 8). When sequenced in the final cut of the film, these static, stable and wide shots gradually weave together a map of the space, generating a sense of coherent horizontal spatiality. In the environment itself, sinkholes appear as interventions in this horizontality and surface stability. Throughout the film, we aimed to make perceptual and visceral interventions into the stability of the landscape shots to open them up to questions of verticality and destabilised depths. Though images of sinkholes do appear towards the end of the film (Fig. 9), we primarily worked on creating destabilising stylistic interruptions through camera work. All the images shot on the shores perforated by sinkholes are handheld. As I follow the geologist around the rim of the sinkholes, guiding the camera across the landscape

Fig 6. and Fig. 7. Stills from *Salarium* (2017), Sasha Litvintseva and Daniel Mann

Fig 8. and Fig. 9. Stills from *Salarium* (2017), Sasha Litvintseva and Daniel Mann

through the motion of my body, the (in)stability of the shots is mediated through the (in)stability of my arms and my steps. When the ground itself stops being dependable, the formal language of the film becomes demonstrably probing of the environment. Fear mixed with heat-stricken dizziness generates increasingly abstract, visceral and vertiginous shots of the surface of the ground (Fig. 7).

The two causes of the dropping of sea level can be examined from the perspective of what Elizabeth A. Povinelli (2016) calls geontopower, the governance of the separation of life and nonlife demanded and reaffirmed by 'extractive capital and its state allies' (44). She argues that the desert is seen by geontopower to reaffirm the distinction of life and nonlife and to stand 'for all things perceived and conceived as denuded of life—and, by implication, all things that could, with the correct deployment of technological expertise or proper stewardship, be (re)made hospitable to life' (16). In the Judean desert the question of life and nonlife has been particularly highly charged historically, as the posited absence of life in the area was used as a pretext by settler colonialism to justify the confiscation of Palestinian lands. In the Zionist imagination the desert could be transformed into flourishing arable lands, and Jewish settlements and Kibbutsim used agricultural development as a colonial strategy of claiming territory. The rapid development of settlements meant that the scarce water sources available in the extreme desert terrain were circumvented to facilitate the irrigation of palm groves within Jewish settlements, leading to the dropping of the sea level and consequently the creation of sinkholes.

While the anthropogenic transformation of the Judean desert depended on the maintenance of the life/nonlife distinction, the extraction of minerals from the Dead Sea implies a slippage in this distinction. The Dead Sea, with the salinity of 40% and rising, does not support any life other than bacterial: the mineral content of the sea acts to preclude the possibility of animal life. Meanwhile, the mineral mud being extracted and

processed by Israeli companies along the shoreline has been mythologised as having rare healing capacities. The dark subsoil being dug up by a booming cosmetics industry is today a commodity sold around the world with the promise of rejuvenation and good health. As Povinelli writes, the definition of life as self-directed biochemical activity only stands 'from the standpoint of the organism's so-called final membrane, […] a membrane that links and separates it from its environment. The final membrane of an individual human is usually thought of and experienced as skin' (2016: 52). She argues that life and nonlife are only differentiated 'if the scale of our perception is confined to the skin' (56), and that we need only to shift the scale beyond the membrane of a single organism in order to perceive the mutual metabolism of the biological and the geological. While the Dead Sea mud is subsumed into the pores on the skin of people worldwide, its extraction facilitates the formation of pores in the surface of the Dead Sea landscape, which subsumes occasional individual human inhabitants as well as the possibility of continued human habitation. The extractive practices on the Dead Sea shore and the consequent appearance of sinkholes continuously breach the membrane between life and nonlife, organism and environment, across scales that are both local and global.

We shoot some scenes with actors dressed as soldiers, who had also once been soldiers themselves, applying the mineral mud on their bodies and faces. They perform as agents of the state violence responsible for the confiscation and instrumentalisation of the land, as they wear the material soil on their skin as a token of the militarised territory. Some shots are close-ups of the mud absorbing into their skin, as their skin becomes a porous threshold between life and nonlife in defiance of their role as agents of geontopower, as well as classic biopower (Fig. 10). As they submerge in the Dead Sea, I follow them into the hot and salty water with the camera. I guide the camera around their floating bodies, their weight supported by the salinity of the water, in extreme proximity. For these shots I use an

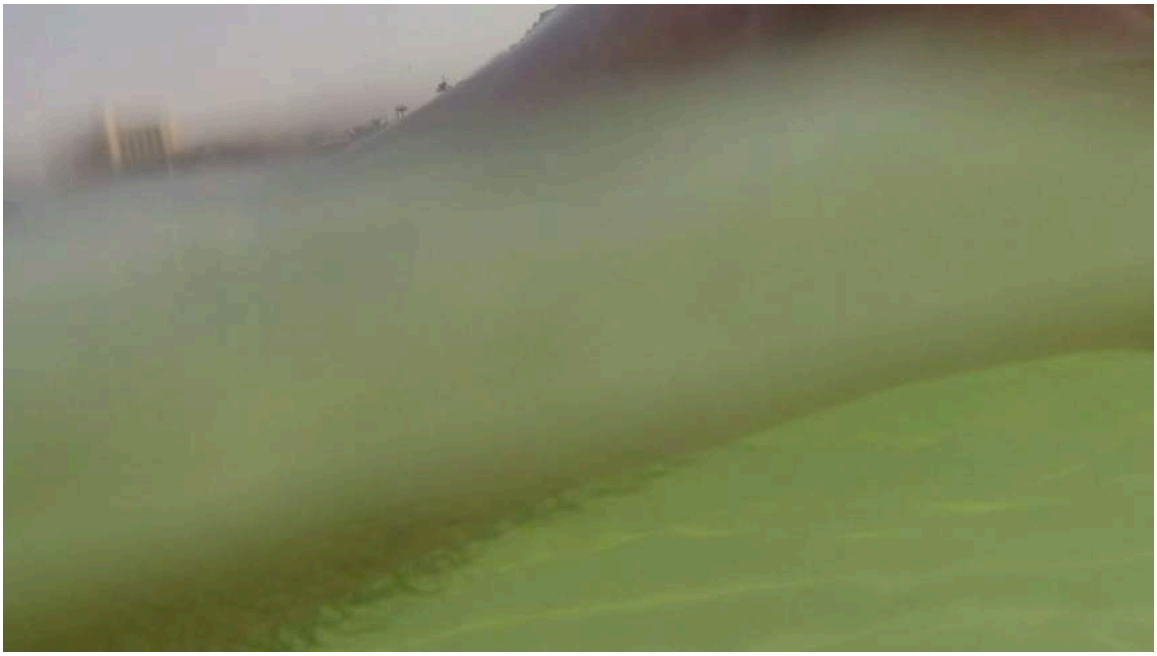


Fig 10. and Fig. 11. Stills from *Salarium* (2017), Sasha Litvintseva and Daniel Mann

underwater camera in order to be able to continuously break the surface of the water. Emerging and submerging the camera I aim to generate a sense of the vertical dimension of the landscape, the above and the below, and the permeable nature of the surface that separates them. Where perspectival images optically represent three-dimensional space as though by providing an immaterial window onto it, the camera movement in this scene positions the lens, and by extension the screen, as a material surface that cuts across the three-dimensional environment. In cutting the landscape vertically, this camera movement aims to render the surface of the water as perpendicular to the surface of the image, as is particularly evident in the moments where both the above and the below are visible at once (Fig. 11). Understanding the image as being on a perpendicular axis to the surface of the landscape creates depth and dimensionality in a way very different to that of perspectival images. In thus positioning the image as the outer surface of the landscape, this scene generates a membrane that the sinkhole image seeks to breach.

A sinkhole, like any hole, is an interruption in the surface of its material host. Surface is understood here, following Roberto Casati and Achille C. Varzi's (1994) study of the ontology of holes, as 'the first part of a material object to come into contact with the object's environment' and thus 'defines the inside and the outside of the object' (11), rather like the skin that separates and links an organism to its environment. A hole presupposes the existence of a surface, and is neither a location nor a presence. Indeed, 'it is uncertain whether the hole really *occupies* the place where it is localized' (9). Instead, 'it seems that there is a hole there just *insofar* as nothing occupies that place' (9). A hole, then, is an active *presence of an absence*. A sinkhole, in turn, is an active presence of an absence of a portion of the membrane that delineates inhabitant from environment, a refusal of the surface that separates life and nonlife. Almost exactly halfway, *Salarium* is punctuated by a narrated story of the experience of

being swallowed by a sinkhole. In considering the most appropriate visual component for this part of the film, we came to the realisation that perhaps the sinkhole image that punctuates the visual landscape of the film is no image at all — an active presence of an absence. For these few minutes of the film the screen remains black. Yet when projected for an audience, the black of the screen did not read as absence, as nothing, but rather as the presence of the projection surface as a material and spatial phenomenon onto itself. In this moment of being confronted with the affective dimension of being consumed by a sinkhole, we are left with the specificities of the materiality and spatiality of the circumstances of our watching: these too constitute the depth of the image. A consideration of the material specificity of the film experience thus becomes an integral part of the work of depicting environments beyond what is visible on their surface. In the following chapter I will focus on the materiality of the moving image apparatus further as I discuss perceiving and depicting (in)visible geological materials and atmospheric phenomena. I will also develop further the ideas surrounding the (im)possibility of drawing solid boundaries between the environment and its inhabitants.

3. Perception: Sensing the (in)visible in ecological crisis

One of the key aesthetic challenges posed by the ecological crisis is that it encapsulates numerous aspects, such as climate change, species extinction or resource depletion, that are either (in)visible or otherwise defy the human perceptual experience due to their dispersed spatial and temporal scale. While in the previous chapter I addressed some of the issues surrounding the *depiction* of the naturecultural world-in-transformation, here I will investigate the *perception* of such imperceptible aspects of said crisis. The key question guiding this chapter is: how might it be possible to visually engage with an (in)visible atmospheric threat, and what would such an attempt make intelligible? In response to the challenges identified in the literature review, I will also investigate how to engage with environments and materials on both micro and macro scales, showing geophysical phenomena as both planetary and situated, unthinkably vast yet proximate.

My goal has been to identify a subject that would encompass being unavailable to the naked eye or to optical microscopes, the result of the fallout of industrial activity, dispersed around the world and persistent over vast geological timescales. But, as thinking the geological and the perceptual together, as is the aim of this research project and this specific chapter, necessarily involves thinking the geological and the embodied together, I have also been interested in finding an imperceptible nonhuman agent that is able to enter and alter organic bodies, thus highlighting, as suggested by Jason W. Moore, 'the intimacy, porosity, and permeability of humans and human organizations within the web of life' (2015: 7). The mineral asbestos encompasses all of these qualities. Once broadly used in industrial and architectural applications for its inflammable and durable

qualities, submicroscopic airborne asbestos was found to be fatally toxic when inhaled. The turning point in its industrial history hinged on the invention of non-optical microscopes, prior to which airborne asbestos was undetectable. Where in the previous chapter the geological was understood from the perspective of the form of geological formations, such as sinkholes, here it is understood from the perspective of the materiality of a specific mineral. The dynamic nature of the geological is considered through the trajectory of the mineral from the mine, to its dispersal to interior architectures around the world, to toxic waste sites. Asbestos, its promise and its downfall also present a prism through which to study the non-linear, complex and contradictory industrial history of the past century, as I continue to explore in the final chapter.

This chapter follows the same methodological path as the one that precedes it. The above guiding research questions are addressed through a direct practical filmmaking experiment, which has resulted in the making of my film *Asbestos* (2016), while the written chapter is developed in parallel to the film. As both centre on the discussion of materials and phenomena that are invisible to the naked eye as well as to optical microscopes, the first part of the chapter is concerned with defining visibility, and situating it relationally and historically. The following part of the chapter explores some possible strategies for addressing the research questions through a number of existing creative filmmaking practices. Specifically, I look at a film that attempts to visually capture nuclear radiation, another invisible yet toxic result of contemporary industrial activity: Tomonari Nishikawa's *sound of a million insects, light of a thousand stars* (2014). Unlike asbestos, however, nuclear radiation is able to visibly affect celluloid film, which Nishikawa mobilises as the means of making his film, thus foregrounding the agency of radiation and the discrepancy between cinematic capture and the operation of the human eye. The challenge remaining for the cinematic engagement with asbestos is how to approach the material and foreground

its agency in the absence of it having an impact on film substrate. The film and the final part of the chapter thus expand on this challenge.

The key theoretical touchstones for the final part of the chapter are Stacy Alaimo's (2010) concept of trans-corporeality, which she defines as a theoretical site that is constituted by a dual recognition that '"the environment" is not located somewhere out there, but is always the very substance of ourselves' (4) and that 'humans are the very stuff of the material, emergent world' (20), as well as Kathryn Yusoff's (2017) work on geosocial strata and the inextricable connections between the social strata of extractive capital and the physical geological strata. Building on their work, the key arguments in this chapter and, ultimately, the key claims of the project as a whole are the entangled and reciprocal co-emergence of the socio-economic and the geologic and of our mortal bodies and environments, and that this is the case all the way down every scale: from the molecular to the planetary, from the immediate to the stretches of deep time. In the course of the chapter and the film *Asbestos*, connections are revealed and boundaries broached across a breadth of scales, from the boundedness of a single atom to a single cell, to a single organism encased in skin, to a body enclosed in a hazmat suit, to houses and walls, the city and the toxic waste site, a local mine and the global use of the material mined in it, and, finally, the viewer and the film.

The project as a whole uses the geologic and the filmic as prisms through which to theorise points of exchange between human and nonhuman processes that occur on incommensurate scales and temporalities yet are still intertwined. In this part of the project the framework of the investigation is set up at the seemingly incommensurate encounter of optical media and the imperceptible. It is precisely this that allowed for moving away from considering geological and human spatio-temporal scales as incommensurate, and toward accounting for their intimate connections in the here and now. The practical attempt to access

the submicroscopic airborne asbestos through moving image, had foregrounded instead the highly material practices and infrastructures of asbestos extraction and removal. It thus made it possible for me to argue that the aesthetic challenge posed by the imperceptible aspects of the ecological crisis is not so much about making the invisible visible, but rather about engaging with and accounting for the existing points of connections between human bodies and systems and the seemingly imperceptible objects of study. This is a crucial point as, I argue further on, it is those existing anthropogenic relations with the geological that are in need of renegotiating toward a more sustainable future.

A final crucial insight from the practical filmmaking investigation, which I reflect on in detail in the conclusion to the thesis, pertains to an appreciation of the physical limits to the scope of one's intended actions. A major part of the methodology of geological *filmmaking* itself is that formal approaches cannot be premeditated, but emerge through the unfolding process of engagement with the specificity of both the nonhuman subject of the film and the moving image medium. The practical filmmaking work thus provides an avenue for actively exploring being an engaged participant in perpetually unfolding processes instead of imposing one's premeditated plan on them. These are valuable tools for the broader issues of living in and through the ecological crisis.

On the relationality of (in)visibility

The limits of the visible world are delineated by perceptual apparatuses, biological and technological. As such, they are bound up with the history of scientific visualisation and optical technologies, and the relationship between instruments, witnessing and knowing. As Joseph Vogl (2007) shows in his essay on Galileo and the telescope, the visibilities produced by the newly invented instruments don't bring us closer to being able to see the world exhaustively, but rather make us aware of the newly invisible,

engendering an infinity of further invisibilities. By making some things that were previously invisible, such as distant stars, visible, the telescope introduced 'an alterable horizon of the visible' (Vogl 2007: 21), whence better telescopes could provide access to more distant stars yet. Every form of visibility thus bears 'a stigma of provisionality', surrounded as it is 'by an ocean of invisibility' (22). Such an awareness of the growing wealth of the as-yet invisible shows that 'with every deepening of clarity comes a new depth of the unclarifiable' (22). Every attempt to produce knowledge about the world through making things visible produces knowledge about what is as yet unknowable. More numerous and better technologies don't therefore mean a better, and progressively more exhaustive, understanding of the world – or of our place within it. Technological advances push back the limits of visibility while producing constituent invisibility. Vogl also situates the first instance of the denaturing of vision in the telescope. He argues that 'the telescope does not enlarge any more than the eye makes smaller, and the telescopic view is no less natural than the eye's vision is artificial' (Vogl 2007: 17), demonstrating that the telescope and the eye are but two in a sea of infinite potential optical systems and perceptual positions. It is thus with extending the capabilities of the natural eye that the limits of its capabilities are revealed.

Jonathan Crary (1999) describes a further destabilisation of the human observer as the centre of the visible universe that took place in the early-to-mid nineteenth century through the split of the study of optics into physics-based study of the nature of light and the physiological study of vision. The advancements in the study of physical optics showed light to be a wave, which 'made obsolete the notion of a rectilinear propagation of light rays', thus removing the scientific legitimation from the theories of linear perspective and 'all the modes of representation derived from Renaissance' (Crary 1999: 86). Optics dissolved as a sub-discipline of physics, as light began being studied alongside other electromagnetic

phenomena such as electricity and magnetism. The more 'light began to be conceived as an electromagnetic phenomenon', the more it was dissociated from 'the description of human vision' (88). Simultaneously breakthroughs in the physiological study of human vision began to erase the difference between internal and external stimuli. Johannes Muller's experiments showed that 'the observer's experience of light has no necessary connection with any actual light' (90), and could be caused by stimuli including electricity, physical impact and chemical changes to the bloodstream. The difference between inside and outside is blurred, as 'all sensory experience occurs on a single immanent plane' (92). In this schema of perception 'the perceiver […] becomes a neutral conduit, one kind of relay among others', further decentering the human observer (94). Crary suggests that such a perceiving subject 'is homologous with the contemporary phenomenon of photography: an essential property of both is the action of physical and chemical agents of a sensitized surface' (92). Such an understanding of the photographic image as an inscription surface for an array of stimuli, only some of which come from the light bouncing off objects, will be developed in the following part of the chapter.

During the nineteenth century scientific representations and visualisations were also undergoing a revolution, as the quest for scientific objectivity underwent a shift toward the photographic. As Lorraine Daston and Peter Galison write in their study of objectivity, 'as oracles speaking nature's own language, the inscription instruments […] could actually *become* the ideal observers science had always sought' (1992: 116). In a quest for objectivity that was as moral as it was scientific, photographs promised to succeed where the 'all-too-human scientist' failed: to 'restrain themselves from imposing their hopes, expectations, generalizations, aesthetics, even ordinary language on the image of nature' (81). However, photographs, 'burdened with detail not found in the reader's own specimens, produced in black and white, often blurred to boot', frequently faltered when it came

to accuracy (117). The objectivity they were thought to have provided was rooted not in precision and resemblance, but in automation and authenticity: the elimination of the human hand. Yet, as Donna Haraway argues, neither the human nor the machine gaze can ever be considered fully neutral or objective. Vision is always a question of power, 'a question of the power to see' (Haraway 1988: 585). In her 'Situated Knowledges' essay (1988) Haraway argues that any thinking around vision has to account for one's position as the one seeing, be it with or without the aid of technical apparatuses. She argues against 'the god trick of seeing everything from nowhere' (581), the objectifying and supposedly distant and neutral gaze that I argued against in the previous chapter, a gaze that claims 'the power to see and not be seen, to represent while escaping representation' (581). As a way to defy the 'violence implicit in our visualizing practices' (585), Haraway proposes situated objectivity and partial perspective. She points to the necessary perspectival position of any view, and the necessary bio-technological apparatus that embodies and mediates it, and also the necessity of providing an account of these.

In outlining her onto-epistemology Karen Barad writes that 'one must inquire into the material specificities of the apparatuses that help constitute objects and subjects' (2007: 27). She draws on Niehls Bohr's experiments on the wave/particle behaviour of electrons, where the electrons consistently exhibited one type of behaviour – either that of a wave or a particle – with the use of one experimental apparatus, and another type of behaviour with the use of a mutually exclusive apparatus. The ability of the apparatus to influence the nature of the observed phenomena challenges the ontology of classical physics and the epistemological assumption 'that experiments reveal the preexisting determinate nature of the entity being measured' (106), showing instead that 'observation-independent objects […] do not preexist as such' (114). 'Apparatuses are not passive observing instruments' (142), and the world

that is available to knowledge is only the world in which we had intervened. Barad thus argues that 'we make knowledge not from the outside but as part of the world' (91). When it comes to seeing at molecular or atomic scales, using transmission electron or scanning tunnelling microscopes, respectively, Barad suggests that 'seeing' becomes a physical intervention onto itself. Such microscopes, as will be discussed in the last part of the chapter, do not merely zoom in further than optical microscopes, but operate according to an entirely different set of physical principles that redefine what can be thought of as vision.

The view created by the eye, the telescope or the transmission electron microscope 'implies its own construction', for in all cases the object seen, be it a landscape, a previously unseen distant star or the molecular structure of asbestos, 'implies the technical operation that makes it visible' (Vogl 2007: 18). Or, as Haraway puts it, 'the "eyes" made available in modern technological sciences shatter any idea of passive vision; these prosthetic devices show us that all eyes, including our own organic ones, are active perceptual systems, building on translations and specific ways of seeing, that is, ways of life' (Haraway 1988: 583). Optical and visualising technologies are not merely sense-prostheses for human vision, 'not just an extension of the senses nor an auxiliary device to improve or correct the senses' (Vogl 2007: 17), but devices with their own agencies and positions that expand the very definitions of the sense of sight. The camera is one such technology.

Seeing and being seen by nuclear radiation

The cinematic image is constituted not only by the impression of the light reflected off objects positioned in front of the camera, but also by all material forces affecting the recording surface during and after shooting. Susan Schuppli (2011) proposes the concept of the material witness to

account for the ability of images to testify not through the content of what is recorded, but through the visible impact to the material support of the images, damaged by the violent historical forces or events to which they thus bear witness. A material witness is an image that not 'merely records history' but 'one that is itself an object of historical forces, capable of testifying on behalf of its own history' (Schuppli 2011: 28). As an example she uses the roll of film shot by a film crew that flew over Chernobyl three days after the catastrophe in order to document the fallout, physical damage and decontamination efforts following the explosion and meltdown of the nuclear reactor. After the footage was processed and screened it appeared to be distorted: a snowfall of sparkling incandescent markings plagued the surface of the image. Thinking at first that the film stock was defective from the start, the filmmaker Vladimir Shevchenko realised that 'what he had captured on film was the image and sound of radioactivity itself, as decaying particles moved through the exterior casing of the movie camera to remolecularise his film' (28-29). The substrate of the film was transformed beyond human intentionality. More than the documentary images of the destroyed power plant that the film crew had set out to capture, these abstract traces evidenced the presence of radiation during their creation.

Photosensitive substrate's sensitivity to nuclear radiation is in fact responsible for the discovery of radioactivity. In 1886 the physicist Henri Becquerel serendipitously placed a piece of uranium on a photographic plate in a dark drawer, later finding the plate fogged evidencing radioactive exposure (Schuppli 2015). Artist Tomonari Nishikawa had set out to explore precisely this property of the relationality of photosensitive film and nuclear radiation in his work *sound of a million insects, light of a thousand stars* (2014). Nishikawa's film is one of a number of artistic projects made in response to the 2011 Fukushima Daichii nuclear disaster triggered by the Tohoku earthquake and tsunami. A naturecultural disaster, it had once

again foregrounded, as the subject of political debate and artistic production, the continuous presence of the nuclear in contemporary industrial culture, and thus the continuous spectre of catastrophe. Other artists' films that have attempted to grapple with the implications and consequences of the Fukushima disaster include The Otolith Group's *The Radiant* (2012), a self-reflexive attempt to visually capture the (in)visible through observational footage of the region following the disaster, or Pierre Huyghe's *(Untitled) Human Mask* (2014). Huyghe, in turn, uses the real environment of a destroyed village in the exclusion zone as a stage set for a science-fictional narrative, which sees a monkey wearing a human mask as its only inhabitant, proposing an alternative or future scenario emptied of humans. For the Otholith Group and Huyghe, the event of the Fukushima disaster and the location of the exclusion zone become stand-ins for the unrepresentable elements of the nuclear: the invisibility of radiation and its unimaginably vast timelines. Nishikawa's project takes a different approach. Instead of mobilising representational proxies, he sets out to make images directly via the medium of radiation.

To do this, Nishikawa buried a 100-foot roll of 35mm colour negative film about 25 kilometres away from the power station, for the period between sunset and sunrise, on a summer night in 2014 (Fig. 12). Unlike Shevchenko's film of Chernobyl, Nishikawa is interested in interference itself: there is no 'documentary' footage to interfere with. The resulting film, printed as a positive from the original negative, is abstract and silent. The image mostly has a turquoise-blue background and is a blizzard of white, black, and incandescent blue. The film bears material witness to the presence of radiation, it is created by physical impact with radiation, and as such reveals radiation to be neither invisible nor immaterial. These are images made by radiation, rather than of it, impressed directly into the celluloid by material impact rather than by exposure to light reflected off objects. Light is of course itself a kind of

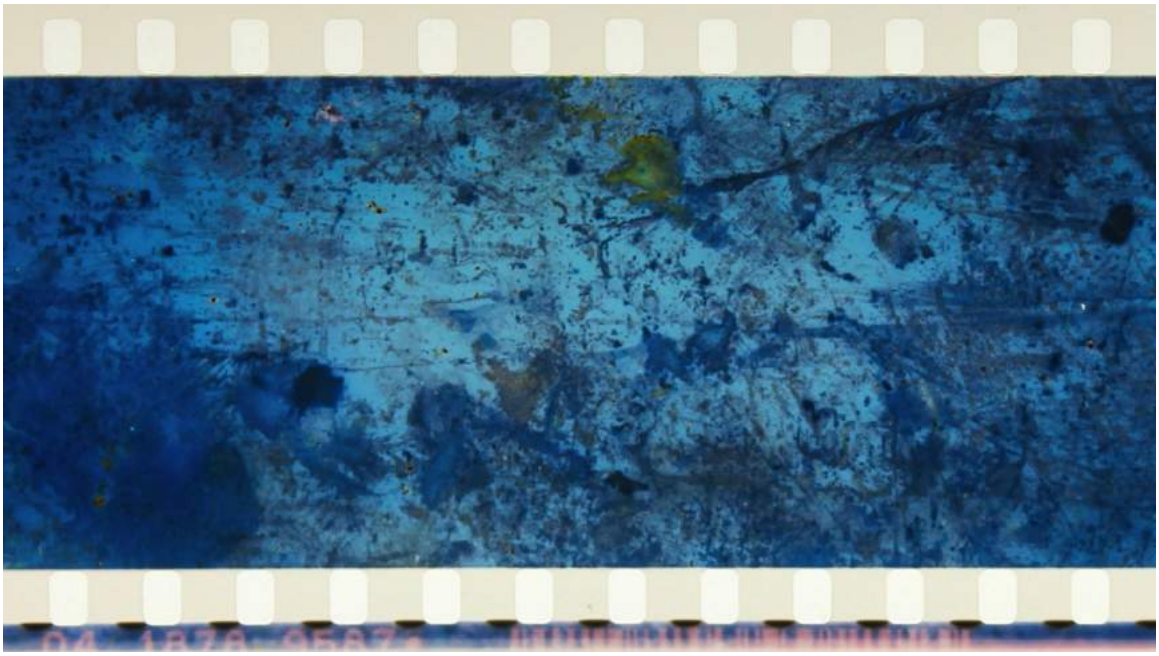


Fig 12. Still from *sound of a million insects, light of a thousand stars* (2014), Tomonari Nishikawa, courtesy of the artist

radiation: a solar radiation. The difference between nuclear radiation and light is one of degree, not kind. Gamma rays, the most dangerous and penetrating of ionising rays that together form nuclear radiation, are part of the same electro-magnetic spectrum as visible light. At one end of the spectrum, with the lowest frequency, longest wave, and least energy, are radio waves, microwaves and infrared. The colour red is the first to appear in the visible spectrum, its waves being shorter and frequency higher than those of infrared. The difference in frequency between all the visible colours is minuscule as compared to the entire spectrum, and yet those differences account for the entirety of our experience of the visible world. As the frequency and energy rise and the waves shorten, visible violet gives way to ultraviolet, then to x-ray radiation, and finally, with the highest energy and frequency of any wave in the spectrum, gamma rays.

The question of radiation's (in)visibility is not a question of a set external physical property, but rather of the relationship between the abilities internal to our perceptual apparatus, biological and technological, and the properties of the object or wave in question. Jean-François Lyotard addresses the discrepancies between the physical properties of matter and human perceptual apparatus in *The Inhuman* (1991). Drawing on Bergson, he uses the example of the colour red to show that the reason we perceive it as a static property of an object rather than a vibration is due to the discrepancy in speed between its frequency, 400 trillion vibrations per second, and the time the human eye needs 'to make a temporal dissociation between two pieces of information', two thousandths of a second (Lyotard 1991: 42). If the eye were somehow able to synchronise 'itself to that rhythm, it would no longer perceive red at all' (42), but rather the individual waves, 'instant by instant, each of those shocks itself' (43). Our eyes, optic nerves, and brains' processing power constitute the visible world as much as the physical properties of the observable phenomena. In other

words, the visible world is constituted by the relationship between what there is to see and the means by which the seeing is done.

We cannot see the gamma rays with our naked eye or with optical apparatuses, but they can 'see' us. As Timothy Morton quips about gamma rays and x-rays: 'they see you. They see you so intensely that in sufficient quantities they kill you' (Morton 2016: 170). Gamma rays are a product of the radioactive decay of atomic nuclei and are highly penetrating. They are unreachable by optics, but are able to penetrate through walls, protective clothing and biological matter, while ionising particles in it, which can lead to cancer and the mutation or even death of cells. Visible light, by contrast, is not able to penetrate the body, apart from the lens of the eye: visible light bounces off the external boundaries of objects, rather than penetrating their insides. It is this quality of visible light that has historically painted vision as a form of perception that does not intervene, that is able to happen at a distance, and that is able to be one-sided and objective, as argued against by Haraway, Barad and Vogl. Above all, the success of Nishikawa's film lies arguably less in making radiation visible to human eyes, and more in highlighting the materiality and relationality of vision. Analogue celluloid substrate, though designed to replicate the world as seen by the human eye, is receptive to the entire upper range of the electro-magnetic spectrum, from visible light to ultraviolet, x-ray (as evidenced by the advice to not let undeveloped film go through the x-ray machines at the airport) and high-energy particles, or gamma rays. Nishikawa's film is thus also a reminder of the fact that cinematic and photographic images are, as argued by Sean Cubitt, 'interventions in the physical processes of the world' that are 'evidence only of a photon, not of the existence of whatever surface it bounced off last' (Cubitt 2014: 246). A photosensitive surface, be it analogue or digital, produces 'a record of light, not things' (244). Whether created by solar or nuclear radiation, it is a nonhuman witness to a chemical reaction, over and above its anthropogenic mobilisation toward figuration.

Asbestos: optics and haptics, inside and outside

Asbestos shares many similarities with radiation when it comes to its invisibility and toxicity, yet its reconfiguring of visibility and materiality nevertheless take a different form. Asbestos is a fibrous mineral whose submicroscopic molecular structure enables it to become airborne and, when inhaled, to pierce a biological cell like a needle, triggering the cancer-causing process. Airborne asbestos, similarly to nuclear radiation, is invisible to the naked eye and has delayed toxic effects upon organic matter. As we have seen, nuclear radiation is separated from visible light merely by an order of degree, rather than kind, and is able to not only make itself visible but also to create images by impacting the film surface on a subatomic level. Asbestos, on the other hand, like most other imperceptible aspects of the ecological crisis, is neither a current that can impact the film surface directly, nor a contained object that can reflect light, and is thus both materially and optically unavailable to the film image. Approaching asbestos cinematically, and specifically through a practical investigation, becomes a challenge when it comes to the possibility of imaging an invisible and latent atmospheric threat: a challenge that is actually emblematic of the visual culture of the Anthropocene.

The history of the use and disuse of asbestos is tied up with the history of the advance of scientific visualising technologies. Mined since the time of the ancient Greeks, its industrial use expanded dramatically in the first half of the twentieth century. Its applications ranged from filters in early gas masks and fireproof fireman suits to the more broadly known uses as a heat and electric insulator, in brake linings and in construction, as a fire-retardant in roofing, walls and floors. Some early-envisaged uses were more eccentric. For example, in a letter published in the *New York Times* in 1866, an entrepreneur writes: asbestos is as 'pliant as any silk' and due to its 'incombustible nature' it would be able to 'set aside the vexatious

expense and use of soap and water, for all a lady will have to do when she unrobes herself, will be to pitch her articles of apparel into a glowing fire, and when they have become as white as a snowflake she may resume them at her pleasure' (Anonymous 1866: 5). This application of asbestos never caught on, but in the space of merely a decade asbestos extraction on an industrial scale was already underway. Writing in 1888, Robert H. Jones called it 'one of Nature's most marvellous productions' (Jones 1888: 5), and a 1909 *New York Times* article suggested that 'of all the queer materials which nature seems to have provided for no other purpose than that man may show his ingenuity in their use, nothing compares to that mineralogical vegetable, asbestos' (Anonymous 1909: 6). Such flamboyant excitement feels chillingly foreboding with the benefit of hindsight.

The history of asbestos-related illnesses is as long as the history of its use: 'since the first century A.D. it was suspected that asbestos might be the cause of illness among those who mined and processed the material' (Skinner, Ross, Frondel 1988: 3). The first cases of asbestos-related deaths in asbestos-processing factories were documented in the nineteenth century. In the 1920s the 'number of deaths at T&N's Rochdale plant, near Manchester, led to the first medical descriptions of asbestosis, a fibrosis of the lungs caused by the inhalation of asbestos fibre' (McCulloch 2005: 258). And yet asbestos extraction and use continued to grow until the mid-twentieth century. It was not until 1972 that restrictions on the amount of airborne asbestos allowed in the workplace began to be put in place, becoming progressively stricter over the following decades, before asbestos was officially banned in EU member states in 1999.

Sight and visibility were crucial for the turning point in the history of asbestos, as it was with the invention of the transmission electron microscope (TEM) that airborne asbestos began to be able to be detected and seen. This resulted in the placement and subsequent enforcement of restrictions on asbestos use. It was also thanks to progress in imaging

technologies, from TEM and spectroscopy to electron diffraction, that the physical properties of both asbestos molecules and human cells, as well as the relationship between the two, began to be understood better. Asbestos is not a specific mineral, but rather an umbrella term for a group of silicate minerals with a fibrous structure: chrysotile, amosite and crocidolite being the most frequently mined and used varieties. Although the formulae for the asbestos minerals show them to contain a number of ubiquitous elements, it is their physical attributes on a molecular level that dictate both their industrial usage and their health hazards. The microscopic shards of asbestos are the shape and size that, when coming into contact with a human cell, are able to physically pierce it like a needle. They trigger the cancer-causing process by becoming '"foreign bodies" in the biological environment' (Skinner 2003: 3). The advances in imaging technology have revealed that asbestos is 'formed through polymerization, the repetition of a chemical unit in a linear array' (Skinner, Ross, Frondel 1988: 11). This means that 'a fiber visible to the naked eye is formed by the aggregation of thousands of elongate submicroscopic linear arrays' (11) and can be pulverised indefinitely, breaking down into ever smaller forms, until we are left with a chain that is one molecule thick. As such, it is invisible not only to the naked eye, but also to optical microscopes.

While optical microscopes use glass lenses to focus light upon the object of study, which then reflects back, transmission electron microscopes use electromagnetic lenses to focus a beam of electrons that travels *through* the object of study, sensing its structure on a molecular level. As Barad writes, TEM 'works on a different set of physical principles than optical microscopes, it undermines any illusion that the image represents the mere magnification of what we see with our eyes' (Barad 2007: 51). As the image created through electron microscopy is achieved through physical contact of the object of observation and the tool of observation, Barad suggests that it can be 'more aptly likened to an encounter that engages the sense of touch

rather than sight' (52). The transmission electron microscopes have challenged the conception of vision as an immaterial perceptual sense that remains on the outside of the objects of observation: on the molecular level visibility is haptic. Further, just as asbestos itself materially traverses the boundaries of inside and outside, the technology that makes it visible penetrates through the object of observation, rather than observing it from the outside. Both the toxicity and visibility of asbestos are manifest in the physical contact of two material entities: the fibre and the cell in the case of toxicity, and the fibre and the beam of electrons that passes through it in the case of visibility. Ordinarily the event of touch occurs on the surface of the body, when an outer boundary of one body comes into contact with an outer boundary of another body. Asbestos, however, is able to breach the boundaries of bodies and interfere with them on a cellular level, destabilising the integrity of what appears to be singular and bounded, and showing that our physical insides are not separate from our outward environments. The visibility and toxicity of asbestos are thus manifested through touch and in both cases they demand a reconsideration of hapticity that goes beyond ideas of surface.

The toxicity and visibility of asbestos are both defined by material entanglement and the breaching and renegotiating of the boundaries of inside and outside. Herein lies one potential approach for a filmic engagement with asbestos: not attempt to make that which is unavailable to optics visible, but attempt to follow the traces of its material entanglements and to traverse the boundaries it has traversed. In facing the filmmaking challenge of using an optical medium to approach an object of inquiry that specifically evades optical apparatuses, the focus has to shift away from the invisible material and toward the possibility of depicting its effects, its production, its material legacy: asbestos has to be depicted in its relationality. This necessary shift of focus to the environments, bodies and practices that have been touched by asbestos ultimately points to the

necessity of their inclusion in any discussion of toxic materials. Following the visibility-driven revelations of asbestos' toxicity, the asbestos industry has far from ceased: some of it has merely relocated out of the developed countries, and much of it has shape-shifted into an asbestos removal industry, where extraction from the earth has been replaced with equally industrialised extraction from the walls. In the making of the film *Asbestos* (2016), made collaboratively with Graeme Arnfield, we aimed to follow the logics of these two kinds of extraction – extraction from the earth and equally industrialised extraction from the walls – and the impact they have had and continue to have on bodies and spaces.

The film attempts to articulate the oscillating poles of asbestos, at once local and global, situated and dispersed, static and mobile, latent and current, imperceptible and material. Large-scale asbestos mining only took place in a handful of locations, including Canada, Russia and South Africa, and the material was then distributed all around the world, and in some cases continues to be used to this day. As a result, asbestos removal is an ongoing global practice. The film oscillates between observational footage I shot in Asbestos, Quebec, of the marks made upon the town by a history of asbestos mining, and the found footage of the practice of asbestos removal, across locations and across decades. The two types of footage are not edited into a linear causal narrative, but exist side by side, as there is no linearity to the history of the industrial use of asbestos. Beginning to remove asbestos from existing architecture in order to counteract the history of its extraction did not mean that the extraction and use had themselves stopped – the two contradictory processes have been going on side by side for decades.

Asbestos, Quebec, is home to the Jeffrey Mine, the largest asbestos mine in the world. The mine only stopped extraction in 2012, although domestic use of asbestos in Canada had ceased in the 1980s, sending most of the ore to Asia: the history of the use and disuse of asbestos is

geographically uneven. The name of the town, itself a reminder of the misguided pride and hope that is characteristic of the history of this 'magic mineral', is prominently displayed on flowerbeds, lamppost flags and signage (Fig. 13). The laundromat, the hospital and the bowling alley all sport the word 'asbestos' in their names (Fig. 14), and the supermarket parking lot wall is covered by a mural celebrating the mining history of the town. The town itself exists as a consequence of the presence of asbestos in the ground beneath it. Even though these material impressions made by asbestos upon the surface of the town are specific to it, they speak to the marks left by asbestos upon innumerable towns and cities around the world. Asbestos, Quebec, is the *here* of the *everywhere* of asbestos. In order to engage with the town as an immovable dot on the map compared to the journey of its mineral product, I opt to shoot only from a tripod. I frame the images as wide as possible in order to allow for the widest possible array of incidental detail to make it into each shot, providing context for the more recognisable marks of asbestos. Though the shots are spacious and slow, I make no effort to avoid getting people into the frame – this happens naturally as the town is practically deserted, as after the shutting down of the mine most residents have to commute to work elsewhere. As a result, the shots I make of the town are static, quiet and unpopulated.

In contrast, the found footage of removal is dynamic, embodied and full of bodies. Meanwhile, the archival quality of the images testifies to the dispersed and durational nature of the practice of removal, and the ongoing global persistence of asbestos: in the array of film and video formats, from 16mm to magnetic tape to HD, it is evident that this process has been unfolding for many decades, from the early days of asbestos regulation in the 1970s to present day (Figs. 15 and 16). The plethora of different media formats brings together a swath of historical time. In shot after shot the workers are seen laboriously putting on layers of protective gear, with

Fig 13. and Fig. 14. Stills from *Asbestos* (2016), Sasha Litvintseva and Graeme Arnfield

Fig 15. and Fig. 16. Stills from *Asbestos* (2016), Sasha Litvintseva and Graeme Arnfield

asbestos being removed from walls, floors and ceilings, entire houses being wrapped in plastic, and that plastic being violently torn down. Some of the footage is amateur and some professional. A number of the shots are made by the workers wearing GoPro cameras on their heads, adding a vertiginous embodied dimension to these images. The bodies of the workers, however, are visually accessible only as mediated by the hazmat suits that cover them, just as they are physically mediated to the toxic atmospheres they occupy. During the practice of removal the potential for submicroscopic asbestos fibres to pass from stable to airborne warrants the mobilisation of a highly-material infrastructure – from hazmat suits and breathing apparatuses to plastic that is wrapped around objects and walls – in order to maintain the separation of inside and outside by counteracting the boundary-crossing toxicity of asbestos. In the footage of removal this material infrastructure of protective layers of plastic becomes a visual manifestation of airborne asbestos fibres, of an atmosphere that is imperceptible but nevertheless visibly toxic.

What is made visible in the optically captured images that make up the film is not asbestos itself, but the practices and infrastructures it necessitates and leaves in its wake, the chain reaction that is triggered beginning with its extraction from the ground. In an attempt to tackle an imperceptible material through a visual medium, what comes into sharp relief instead is the contact zone between the material and its use. And this realisation is key, as it is precisely that contact zone that needs examining and renegotiating. As Kathryn Yusoff (2017) argues, drawing on Deleuze and Guattari's work on stratification: because geological strata subtends all life, it is necessary to remain embedded in and dependent upon it, while simultaneously examining and undoing the most destructive relations between capitalism and the geological, including the institutions and practices that shape the modes of capitalising on the geological. Nigel Clark elaborates in the similar vein that the continuation of life among

geophysical processes is dependent on 'how we, collectively and heterogeneously, might negotiate more carefully, more judiciously, more generatively with strata' (2017: 228). Asbestos the mineral and *Asbestos* the film demonstrate that the human does not just touch the nonhuman, culture does not just touch nature, but rather that the boundaries between the two become porous, interpenetrating and dissolving in an act of what Alaimo (2010) calls trans-corporeality. Asbestos the mineral and *Asbestos* the film are both able to traverse the boundaries of inside and outside, which shift in scale from individual cells to the skin that forms the outer boundary of our bodies, from skin to the outer skin of the protective hazmat suits, from bodies to walls, from interiors to exteriors of domestic spaces, from the local to the global, from the screen to the optical nerve.

But can the image really be said to touch or penetrate the eye, or the eye to touch the image? The idea of haptic cinematic images was developed by Laura U. Marks, who has proposed that 'in haptic *visuality* the eyes themselves function like organs of touch' (Marks 1998: 332). As Thomas Elsaesser and Malte Hagener elaborate, theories of cinematic haptic perception 'could be seen as a reaction or backlash against the "scopic regime" of previous theories (based on distance)' (Elsaesser & Hagener 2000: 10), highlighting instead 'the interplay, continuity, and transition between […] the film and the viewer' (130). While such proximity, mutuality and continuity between viewer and film are in principle an apt avenue for a cinematic exploration of a haptic encounter with a boundary-breaching material, I would argue that it is in fact the very *gap* between the *metaphorical* touch of the cinematic image and *physical* touch that lends itself as a tool for a discussion of the hapticity of asbestos. The touch of the image does not involve physical contact and the touch of asbestos is imperceptible, and it is in this sense that a cinematic experience could be a useful instrument for thinking through a haptic encounter with a toxic atmospheric threat, which is not mutual in the way that physical touch

between two solid bodies of comparable size is. As Barad writes in her essay 'On Touching', which complicates the way touch is understood in classical physics, 'what would it mean to acknowledge that responsibility extends to the insensible as well as the sensible, and that we are always already opened up to the other from the "inside" as well as the "outside"?' (Barad 2012: 218) In considering touch from the perspective both of outside boundaries and their breaching, both the perceptible and the imperceptible, what Barad highlights is the responsibility that comes with vulnerability: 'the sense of exposure to the other is crucial and so is the binding obligation that is our vulnerability' (218). The mutuality of the type of touch that is immaterial in the way of cinematic images, or imperceptible and penetrating in the way of asbestos, arises not between viewer and film, or body and toxic atmosphere, but rather between responsibility and vulnerability triggered by the encounter.

The negotiation of the boundary of inside and outside triggered by the toxic hapticity of asbestos extends from the breaching of the boundary of a single cell by a submicroscopic shard of asbestos to the spatial and temporal qualities of asbestos as it disperses around the world and projects itself into the future. Once removed from buildings, asbestos and asbestos-infused materials are most commonly buried in hazardous-waste landfill sites. However, this practice does not take away from the potential toxicity of the material and remains safe only as long as the deposits remain undisturbed. Indeed, there is no outside in which to deposit toxic materials. There is no transcending our material environment, so when it comes to cohabiting alongside existing toxic materials and imagining a future among environmental degradation already underway, a livable future will not be imposed on the environment from the outside or be built despite it – it could only emerge from within it. In the following chapter I will examine the multiplicity of interdependent environmental and human temporalities that have the potential to make and unmake the future. From sinkholes to

asbestos, geological temporalities are themselves multiple and contradictory, and the inherent multiplicity of cinematic duration offers some possible tools for accounting for the complexity of geological time.

4. The future: Material debt and ‘the deep now’

The temporalities of the ecological crisis and the attempts to mitigate it unfold on a spectrum of often incommensurate scales and contradictory directions. As Maria Puig de la Bellacasa writes in her work on care time, the future 'appears to be pulled forward by an accelerated timeline toward a gloomy environmental future, while the time left for action in the present is compressed by urgency' (2017: 173). At the same time this condition of emergency is at odds with the slowness required in ecological care, 'running against the accelerated linear rhythm of intervention characteristic of technoscientific futuristic response, traditionally straddled to a productionist pace' (173). Ecological and geological phenomena themselves contain and enact a host of nonhuman durations that destabilise 'unilinear, anthropocentric, temporalities in order to make time for a multiplicity of others' (214). In this chapter I will look at the complexities, contradictions and multiplicities inherent in the temporality of geological materials and formations, and the way these can be explored through the multifaceted temporalities of film. The key question guiding this chapter is how can film address the scale and quality of geological time, or that of the ecological crisis? More specifically, how can it grapple with the deep time of geological durations? How can it account for the multiplicity of ecological durations? How can it engage with non-unilinear and non-uniform temporal flows? How can it imagine modes of futurity that involve both certainly and uncertainty? This chapter seeks to answer these questions through an engagement with both of the case studies presented in the previous chapters.

Any question of temporality in the ecological crisis, or indeed any call for environmental justice, as is argued by Kathryn Yusoff (2013), has at its core the question of the future. In this chapter I explore two different

modes of relating to the future within ecological crisis, through the specific prisms of sinkholes and asbestos. My argument builds on Yusoff's proposition that durability depends on the future being non-predetermined, nonsingular, nonunilinear and emergent through a complex multiplicity of interacting and interdependent temporalities. She writes that despite our best efforts to secure a future in the changing environment — the future is unpredictable, as any activist efforts or legal victories that are localisable cannot guarantee longevity as there is 'no one decision that is made once and for all' (213). Extending our responsibility toward the future means also engaging with a time in which we can no longer make a difference. Yusoff argues that in order to conceive of an ethics and politics that goes beyond ourselves temporally, we must begin with thinking beyond localisable objects of our concern in the now. What she calls 'ethical duration is not to be conceived as one duration, [...] but rather as modalities of duration for the more than one, which have differing durations' (211). In other words, durability within the crisis hinges on our ability to take 'a diversity of timescales into account' (Puig de la Bellacasa 2017: 191-2). To begin to consider how film could engage with and account for such an ecology of durations, the first part of the chapter unpacks the rich multiplicity already inherent to cinematic duration, from the duration of the screening experience to the production and decomposition of the celluloid strip, magnetic tape and digital file. I argue that, simultaneously vast and minute, continuous and discontinuous, technological and physiological, the multifaceted temporality of film carries potential to account for a multiplicity of ecological temporalities.

In the second part of the chapter I discuss the specific multiple and non-linear durations inherent to the temporality of sinkholes, and how these provide a model for thinking of media history sedimentation and the role of cinematic technology therein. I further go on to define the temporality of the Dead Sea landscape through Astrida Neimanis and

Rachel Loewen Walker's concept of thick ecological time: the time woven together by multiple human and nonhuman actors and processes. The thick time that coalesces in the sinkhole contains not only past, present and future, but also a multiplicity of parallel and interacting human and nonhuman durations. From here, I work on conceptualising a model of cinematic thick time that could contain this multiplicity of ecological temporalities. Using Vilém Flusser's writing on the dimensionality of moving image, I propose thinking of film as a three dimensional temporal solid, made up of the sedimentation of two-dimensional images. This thick temporal solid presents time non-linearly, as it can be traversed in every direction: forwards and backwards into the past and future, and up and down, thus deepening and complexifying individual moments. As a counterpart to the geological deep past and future of *deep time,* I propose the concept of the *deep now*. The deep now is the cinematic equivalent of thick ecological time as it engages with the multitudes of human and nonhuman agencies and durations that bring the present moment into being. While deep time may remain out grasp of individual human lifespans or film durations, it is in this thick present moment, accounting for this bundle of agencies, that the potential to transform the future lies.

In considering the continuity between the present and the future it is necessary to address the relationship between the intentional and the unintended and certainty and uncertainty, which are the focus of the final part of the chapter. Certainty and uncertainty are crucial to consider critically, as they play a key role in the way that capitalism incorporates and sells the future for present profits, by locking the future into a symmetrical relationship with the past or present. Nowhere is this demand for the predictability of the future more present than in the capitalisation of natural resources through the futures markets. As Sean Cubitt writes, futures trading transactions are 'the most powerful accounts we have of the immediate future of planetary geology' (2017b: non-pag.). The abstraction

of today's cash values of the future values of natural resources, from oil to gold, has significant bearing on material realities, present and future. Futures markets 'change the valuations of stockpiled resources and raw minerals, change plans for constructing large communication, logistical and urban projects, and directly influence decisions on building energy infrastructure to power extraction and transport' (non-pag.). Today's futures markets' decisions shape the future in the past's image. Predictably, this closing off of the future has exponentially devastating effects on those material realities that capitalism sees as externalities: ecologies and ecological crises, and the quickly deteriorating living conditions for humans and nonhumans. The final part of the chapter seeks to present an alternative mode of relating to the future that accounts for the material agency of natural resources.

My argument takes a damaged videotape as a starting point to theorise the relationship of certainly and uncertainty and the intentional and the unintended in industrial progress and its toxic fallout. I argue that the degraded footage is able to communicate the two sides of asbestos temporality: the reversal of its industrial history due to the unintended consequences of its toxicity on the one hand, and the certainty of the effects of its toxicity implicit in its materiality on the other. I further argue that the damaged footage, insofar as it is still able to relay the content of the images as intended by its creators while also visibly manifesting the effects of entropy on its material substrate, actively attests to the fact that certainty and uncertainty are in fact not contradictory, as with the passage of time the intentional leaves as much of a trace as the unintended. In other words, no certain future can be imposed on geological materials or ecological systems from the outside, the only certainty is that which is embedded in their material specificity. Indeed, what to us may appear as undesirable unintended consequences of advances in techno science, are in fact the certain unfolding of processes set in motion upon the initial unearthing and

mobilisation of particular natural resources. In order to theorise the mode of relating to the future implicit in this certainty I update the already ubiquitous concept of 'climate debt' to mean not a debt between two sets of humans, but the very temporal condition of the ecological crisis, where debt implies an obligation to the past and a responsibility for the future.

The multiplicity and relationality of cinematic duration

Simultaneously vast and minute, continuous and discontinuous, technological and physiological, the multifaceted temporality of film carries potential to account for a multiplicity of ecological temporalities. The question of co-existing and contradictory timeframes has been at the core of cinematic time from its very beginnings. Cinema emerged at the end of the nineteenth century into a cultural landscape that saw not only the earth being reimagined as a resource by colonial and industrial projects, but also time itself, as the latter became increasingly uniform, homogenised, standardised and rationalised. As Mary Ann Doane (2002) writes, the emergence of cinematic time took place amid a 'cultural imperative' for 'the structuring of time and contingency' (3). Alongside the discoveries around the irreversibility of time through the Second Law of Thermodynamics, and the establishment of universalised world clock time, much of time's standardisation was linked to its becoming, after Marx, a measure of value. During this period 'the time of the world thus becomes the time of capitalist calculation' (Markley 2012: 55). For the capitalist to buy a quantity of the labourer's time, it had to be 'measurable and therefore divisible' (Doane 2002: 8), which clashed with the longstanding philosophical understanding of time, as conceptualised by Bergson during the same historical period, an understanding that posited time as 'uninterrupted transition, multiplicity without divisibility and succession without separation' (Bergson 2002: 205).

This dilemma around the (dis)continuous nature of time became the locus of the theoretical discussion surrounding the possibility of its representability. It was then that film emerged and appeared to embody this dilemma: on the one hand it was made up of individual frames, the dreaded instants of time, on the other it was seen as able to emulate the perception of continuous time. Deleuze later used the geological metaphor of a crystal to theorise further the ability of the cinematic image to make the dual nature of time in Bergsonian philosophy visible: the split of 'the present into two heterogeneous directions' of the present that passes on and the past that is preserved (Deleuze 2005: 79). With televisual transmission and recording on magnetic tape or via CCD sensor, the ability of the moving image to create the illusion of continuous motion was no longer tied to separable frames, yet its ability to carry a multiplicity of co-existing temporalities has not diminished.

Cinematic duration can be understood across a variety of scales, from a single frame to deep time, and perspectives, from material to perceptual. The smallest unit of cinematic duration that perhaps first comes to mind is the time between the frames, which, by definition and by design, occurs beyond the limits of perception. The very possibility of the illusion of motion created by cinema requires this time interval to effectively disappear. Early cinema emerged hand in hand with physiological experiments into the precise interval that was needed for image retention to be achieved. As Ute Holl (2017) argues, 'looking to the prehistory of cinema in the psycho-physiological laboratories we can see that models developed in the laboratory of how the mind and the psychology of the senses works exactly corresponded to the structure of cinematic perception' (35). She writes that the first cinematic apparatuses relied on the research in image retention and the perception of motion, pointing to an alliance between 'the functions of the apparatuses assume […] with the functions of the nervous system' (42). The first unit of cinematic duration is thus determined by the

human neurological system. In the silent era this interval fluctuated between sixteen and twenty-four frames per second, but with the introduction of sound this number had to be standardised, and was settled on twenty-four. With the introduction of digital moving image, new technological possibilities arose for both the capture and display of cinematic images, and the notion of a cohesive gap between frames disappeared. As Sean Cubitt writes, 'whereas analog cinema dissects time into discrete but whole moments, through the clock function and scanning, digital images ensure that there is never a whole, complete, coherent image' (2014: 251). 'Pixels act in the same way as film frames but much smaller and in much swifter succession', each frame appearing one pixel at a time and thus having a duration of its own (251). Thus in digital moving image 'the frame itself is a temporal phenomenon' (251), becoming the smallest measure of cinematic duration. By doing away with the discreet succession of analog frames, the smallest measure of cinematic duration is in fact defined by constant, continuous and imperceptible change.

Cinematic duration can be reconsidered further from the perspective of the light it takes to expose each individual frame. If exposed by sunlight, the duration of each frame can be thought to contain the eight minutes and twenty seconds that it takes the light to travel from the sun to the earth. If exposed by artificial lighting, the frame can be thought to contain the temporality of the electricity that powered the light, be it derived from fossil fuels, nuclear fission, water, wind or sun. Nadia Bozak (2012) writes that in either case every cinematic image can be thought of as 'fossilized light' (13), in the sense that it is captured light. She continues to argue that fossil fuels, as compressed organic matter fossilised by millions of years of sunlight, and thus 'compressed energy derived from fossilized sunlight' (18), can equally be thought of as fossilised light. In thinking through light and the equivalence of fossil fuel and 'the fossil image' (34), the duration of the *minutely* imperceptible process of the registration of light upon celluloid

or CCD sensor *becomes commensurate* with the *vastly* imperceptible millions of years it took for the formation of fossil fuels.

Expanding outwards from the frame, cinematic duration includes the duration of each individual shot of the film, the duration of the film as a whole and the future of the film. The duration of the film itself has a multiplicity of dimensions that include the material (for example the physical length of the film reel, which exists independently of being screened or seen) and the perceptual (the length of the cinematic experience when the film is screened), the perceptual dimension of course itself having a material dimension that spans the hardware on which the film is played to the audience members' eyes and ears. From the perceptual perspective the future of the cinematic experience expands into the time in which the film 'reverberates across the space between the film world and the real world, seeping into conversations and dreams, tinting the world and making it vibrate in particular ways, injecting thought-images, sensations, motivations, heightened attunements to one thing or another, into the larger social and ecological fields within which the film's signs, meanings, and affects resound' (Ivakhiv 2013: 12-13). Beyond the length of the film reel, or any other material support of the film, there is the material history of the hardware that went into the production, storage and exhibition of the film. This material history expands into the future upon a geologic scale that far outstrips the lives of the film's viewers, creators or the civilisation to which cinema owes its invention, a time that Jussi Parikka (2015) refers to as the deep future of media technological fossils. From a single frame and beyond, cinematic duration is able to contain a multiplicity of temporal scales, which are determined relationally by the physiological capabilities of the human eye to see motion and the capabilities of the cinematic apparatus to register light, all the way to the future deep time in which the minerals, metals and chemicals that make up the cinematic hardware will decompose. In the following parts of the chapter I will further consider the

potential of cinematic temporality in its relationality to the geological subjects of *Salarium* and *Asbestos*, from both perceptual and material perspectives.

Thick time and 'the deep now'

What can the temporality of a sinkhole and the temporality of film tell us about each other? Sinkholes are the result of both the millions-of-years-long history of the underground salt deposits on the Dead Sea shore as much as of the decades-long history of colonial settlement, mineral extraction and desert irrigation. Sinkholes do not merely combine these two temporal scales: they intervene. In appearing they disrupt the possibility of a linear progression of either topsoil sedimenting on salt deposits, or continued capitalisation of the land through extraction and cultivation. In this sense, more than operating on multiple scales, sinkholes embody multiple modes of relating to the past and future. On the one hand, time as it is experienced when traversing the perforated landscape is of an intense anticipation of the sudden forming of a new sinkhole: the now of this anticipation already contains the potential future collapse. When a sinkhole does appear, the pressure valve of the present is released and the preceding breadth of time flows in: the entirety of the past that has made the sinkhole possible is made present in it. In both cases the temporality of the sinkhole is not the chronological or teleological time of one-thing-after-another, but of an expansive present opening up toward the future, and of the expanse of the deep past made manifest at once. The time of the sinkhole unfolds according to what Barad calls the 'sedimenting process of becoming', a material temporality where 'the past matters and so does the future, but the past is never left behind, never finished once and for all, and the future is not what will come to be in an unfolding of the present moment; rather the past and the future are enfolded participants in matter's iterative becoming'

(Barad 2007: 181). Sinkholes simultaneously contain the ongoing geological and anthropogenic processes that have resulted in the contemporary devastation of the landscape, its current conditions, as well as the anticipation of future change that has already been set in motion.

As discussed above, the duration of every film contains the past time of the process of its making and the deep past of the formation of the geological materials that make up cinematic technologies, as well as the future tense of all its potential screenings and the deep future of the materiality of the hardware. From a media archaeological perspective, the duration of every cinematic artefact also includes the duration of media history's sedimentation. As Parikka writes in *What is Media Archaeology?* (2012), 'the media-technological artifact as a monument is a reminder from a past media culture, and as such carries with itself pastness', with each machine itself being 'a concrete form of the principles, diagrams, examples of past media in action' (132). Media history is here seen not as a teleological progression of one-thing-after-another, but as akin to a geological time, where each formation carries the trace of its emergence. *Salarium,* as a cinematic artefact, is by definition subject to all the types of cinematic duration discussed above, and in the making of the film we aimed to further interpret the expansive temporality of the sinkhole through the formal decisions.

Through the oscillation between the static durational shots and visceral shots that replicate the sensation of falling, it was our intention to generate a temporality that contains both anticipation and collapse. As discussed in chapter two, we strived to destabilise the perspectival logic of the cartographic imagination in order to access the dimensionality of the material volume of the landscape. In her essay 'Imagining the Geologic' Janike Kampevold Larsen writes that 'to the extent that we are wrapped up in a notion of landscapes as visual and perspectivized scenarios, we are missing a sense of the world as an abundance of material without meaning'

(2013: 84). In *Salarium,* the parts of the film where the landscape is imaged not as perspecitivised but as a continuous tactile encounter, the shots revel in the materially abundant world and aim to make infinite depth of every moment palpable in the level of the seemingly inexhaustible material detail of the landscape. As Jason W. Moore argues, the Western conceptions of 'nature as external, space as flat and geometrical, and time as linear' are all mutually reinforcing and share their historical and political origins (Moore 2015: 191). Alongside the engagement with the spatial depth of the landscape that seeks to undo the understanding of landscape as flat, the formal approaches in the film were also aimed at destabilising the understanding of time as linear by considering the depth and dimensionality of the landscape's temporality.

The temporality of the Dead Sea landscape itself, as it is transforming through the influence of both anthropogenic and geologic forces, can be read through what Neimanis and Loewen Walker call the thick time of trans-corporeality (2014: 570). Drawing on Stacy Alaimo's concept of trans-corporeality that sees human bodies as components of material environments and the environments as components of human bodies, thick time refers to a temporality that is woven together by both human and nonhuman actors, actions and durations. Neimanis and Loewen Walker use thick time to describe the temporalities of climate and weather, and argue that these 'are not something we pass through (in a linear progression of time) or sustain (in an impossible denial of time), but are rather a time that we weather together' (570). Thick time in this sense is a 'stretching between present, future, and past, that foregrounds a nonchronological durationality' (561) and 'understands that matter has a memory of the past, and this memory swells as it creates and unmakes possible futures' (570). The thickness of time simultaneously and nonchronologically contains not only past, present and future, but also a multiplicity of parallel and interacting human and nonhuman durations. In the case of the landscape

surrounding the Dead Sea these durations range from the time it took salt deposits to form in the sub terrain and the time it takes the salt to melt to the length of the Israeli occupation of the West Bank and the time it takes an artificially irrigated date grove to bloom — all of these durations coalescing in the thick time of the sinkhole.

Vilém Flusser's (2002) work on the dimensionality of writing, image and moving image offers a useful tool with which to consider the thickness of time from a moving image perspective. In his essay 'Line and Surface' (2002) Flusser discusses the temporal differences in the encounter between writing/line and image/surface. He argues that the successive and linear nature of writing supports and engenders a successive and linear understanding of time. An image, on the other hand, presents its message to us immediately, but it acquires detail and depth with time: it offers a non-linear encounter, compared to the linear time of the text. Moving images, comprising as they do of a convergence of linear and surface thinking, have the potential to 'enable us to think about facts that are presently unthinkable', thus 'permitting us to rediscover a sense of "reality"' (31) and providing imaginative and perceptual tools to grapple with the present and the future. For Flusser the potential of film to achieve the non-linear line-surface fusion was an object of anticipation, and geological filmmaking begins to offer one possibility for holding linear and surface thought processes together through a sustained formal engagement with the ecological thick time.

Through the models of the ecological thick time and the geological time of the sedimentation of strata, it is possible to begin to conceive of the dimensionality of linear-surface fusion in moving image. Flusser refers to writing/line as one-dimensional and image/surface as two-dimensional. As the combination of the linearity of writing and the surfaces of images, the dimensionality of moving image can be imagined as a sedimentation of two-dimensional surfaces upon one another to form the depth of a three-

dimensional solid. This thick temporal solid then 'stands in that sort of time wherein processes are seen as forms' (Flusser 2002: 33): like the expanse of geological time visible in the current lines of the landscape. The 'material duration' of this temporal solid is 'both broad and deep' (Neimanis & Loewen Walker 2014: 570) and can be traversed in every direction: forward and backward into the breadth of past and future on the horizontal plane, and up and down the vertical plane of deepening individual moments. The verticality of cinematic time is here understood in Maya Deren's (1953) sense as a probing of 'the ramifications of the moment', as 'concerned with its qualities and its depth' (non-pag.). The depth of time here refers not to the time most distant to the present moment, which is ordinarily called 'deep time', but rather to the depth and thickness of temporal and material relations of the present moment itself, which I call *the deep now*. At a time when the temporality of both technoscientific progress and ecological emergency 'suspends and compresses the present', the deep now makes time for care time, which 'distends the present, thickening it with myriad multilateral demands' (Puig de la Bellacasa 2017: 207). The deep now makes futurity thinkable through asking to consider all environmental, political, social and material factors that bring the current moment into being, and to see the present moment from the perspective of the potential for agency it holds. In the deep now agency does not have to confront the incommensurable scale of deep time, but rather to engage with the ecological dimensionality of the present.

Material debt and the entropy of unintended consequences

The future material history of cinematic time includes not only the longevity of the geological materiality of media technological apparatuses, but also the impermanence of media artefacts through the degradation of

their material supports. In the case of cinematic artefacts these range from celluloid strips to magnetic tape and digital files, the latter no less material than the former two. Early cinematic nitrate stock was made using camphor and nitrocellulose, which are extremely flammable: 'even without fire, the stock gradually outgasses, leaving a sticky and unworkable gel', which mutates beyond the ability to retain the images it carries given enough time (Cubitt 2017: 2). Cubitt writes of the decomposition of the celluloid strip carrying a fragment of the 1906 film *The Story of the Kelly Gang*: 'the filmstrip is a slowly percolating soup, a patch of molecular combination and mutation' (2). For Cubitt however this process is not to be understood merely as destruction, but as an 'evolution of a new artefact from the old' (2). In their materiality all moving images are subject to entropy, but the resultant change is not simply an erasure of a past communication, which would be privileging the content over the materiality or a complex understanding of cinematic temporality, but rather carries the potential to communicate across time beyond the original intent of the human creators.

One of the archival segments we included in *Asbestos* is an excerpt from a 1980s amateur documentary on the molecular structure, potential health hazards, detection and removal of asbestos. Shot on magnetic tape, and perhaps stored incorrectly, the tape has disintegrated in the intervening decades and the images it carries have become corrupted (Fig. 17). These aged and decayed images of once cutting-edge laboratory optical technology stand in contrast to the crisp HD images we shot of the ageing and decaying industrial machinery at the mine. The optical technology from the 1980s depicted in the corrupted images is now out of date, reminding us that the contemporary HD images may themselves become entirely unreadable due to a future switch in file formats. Through their distorted coloration the corrupted images perform as what Susan Schuppli (2011) calls a material witness. The compromised images are still able to communicate their content, but their damaged material support

communicates the complexities of asbestos temporality with added nuance and accuracy. The temporality of asbestos embodies a contradiction surrounding (un)certainty. On the one hand, it is defined by unintended consequences: asbestos's fall from grace followed millennia of being considered a magic mineral, being but one example of the unplanned toxic consequences of extractive capitalism, alongside rising CO2 in the atmosphere as a result of the burning of fossil fuels. On the other hand, when considered from the point of view of the encounter of asbestos with biological matter, it is defined by a certain future: in the piercing of a cell a process is triggered that makes some aspects of the future guaranteed.

In the distorted images of the corrupted magnetic tape that appear in *Asbestos* the damage to the surface of the physical carrier of the moving images is made visible in their distorted colours: flesh colour is blue, much else is grey scale with occasional bursts of bright yellow, turquoise and purple. In one of the scenes the presenter speaks directly to camera about the insidiousness of the delayed deadly effects of asbestos. His skin colour bright blue, he says: 'I sometimes wish that when we humans were exposed to asbestos, that somehow or another we would turn green or blue immediately, so that we'd know we'd had the asbestos exposure and possibly could do something about it' (Fig. 18). What he wishes could be possible in order for asbestos exposure to be detectable before its certain yet deferred effects appear with the passage of time, has with retroactive irony in fact happened through the effect of entropy on the footage. In other words, the degradation of the materiality of the tape that carries the image manifests upon the body of the presenter the deferred effects that asbestos exposure would upon the lungs of which he speaks. These compromised images are able to communicate the two sides of asbestos temporality: in preserving the ability to relay their content the images attest to the original intentions of their creators, a temporality imposed on them from the outside just like the extraction and industrial use was imposed on asbestos,

Fig 17. and Fig. 18. Stills from *Asbestos* (2016), Sasha Litvintseva and Graeme Arnfield

and in their degradation they attest to the temporality that emanates from inside the nature of their materiality, and thus communicates the latent temporality inherent to asbestos. What the damaged images from the documentary reveal is that these two modes of relating to the future *are not contradictory*, but rather that human agency or intention, as invested into the content of the images or the extraction of asbestos, is but one factor among a host of material agencies, such as those manifest in the entropy that ravishes cinematic images over time and in the specificities of the molecular structure of asbestos.

The dual temporal model of thinking through the non-contradiction of the unintended consequences of technoscience and the certain future of the unfolding of the specificities of matter can be applied to thinking the ecological crisis more broadly. On the one hand, the force of the material agency of asbestos demonstrates that, as Yusoff suggests, durability within ecological crisis will precisely need to include 'understanding duration as a form of responsibility to the ongoing material and immaterial recombinations of matter that exceed social action' (2013: 211). And on the other hand, it also provides a culturally resonant reference point for the fallibility of technoscientific progress. In a 2017 article in *The Guardian* entitled 'The death of diesel: has the one-time wonder fuel become the new asbestos?' (Forrest 2017) asbestos is used as an analogue for a newly failed promise. The logic of infinite growth implicit in capitalism and industrial progress craves magical and wondrous materials, which it requires as resources and leaves behind as waste. Yet the unintended consequences of materials such as asbestos, which causes deadly illness, and diesel, which was marketed and subsidised as a green alternative to petrol but turned out to be more toxic than regular fuel, have a markedly different relationship to futurity than that implied by the capitalist logic of infinite growth.

Despite initially seeming like unintended consequences, once the asbestos particles have entered the cells of the body or diesel exhaust –

along with other greenhouse gases – have entered the atmosphere, some aspects of the future become guaranteed. Deferred yet certain, their temporality could be considered from the perspective of what Donna Haraway calls 'an already-written future': the future of a debt repayment obligation (Haraway: 1998: 99). The reason debt provides a useful framework for thinking the certainty embedded in the temporality of materials and nonhuman processes, is because it brings obligation and responsibility into the centre of the discussion. This includes an obligation to the past and a responsibility for the future. Framing environmental degradation through the concept of debt allows for a description of the temporality of such aspects of the ecological crisis as the finitude of natural resources, the fate of the already emitted CO2 and the long-term storage of nuclear waste. Indeed, 'climate debt' is being widely used in official climate change discourse to differentiate between the responsibilities of developing and industrialised nations. T.J. Demos defines the concept of 'climate debt' as 'the notion that countries burning fossil fuels since the Industrial Revolution have used up their pollution allowance and owe a liability to the others' (Demos 2016: 9). Nicholas Mirzoeff continues that the 'developed world therefore "owes" emissions' to less developed nations, and that 'this climate debt requires a cut in developed world emissions sufficiently far as to leave "room" under the overall limit for currently underdeveloped nations to expand their economies and mitigate the everyday emergency of their living standards' (Mirzoeff 2013: 832-3). Here 'climate debt' is understood as a technically repayable debt owed by one set of humans to another. I would go further to suggest that the very temporal condition of the ecological crisis can be thought of from the perspective of debt. Perhaps it can be thought of as a material debt: a debt taken out with the extraction and application, dissemination or burning of natural resources; its record stored in the molecular structure of toxic chemicals and greenhouse gases.

The temporal scale upon which this material debt unfolds can be at odds with contemporary political timeframes: the effects of CO2 are measured in hundreds of years and half-lives of nuclear waste in hundreds of millennia, which makes the urgency of the crises seem deferred on the temporal scale of the parliamentary terms of party politics – becoming in effect a debt for/to future generations. As Rob Nixon argues in his thesis on environmental slow violence, politicians are unwilling to take actions that may be economically unpopular in the short term, and only pay off environmentally 'on someone else's watch decades, even centuries, from now' (Nixon 2011: 9). Asbestos, with its relatively smaller time scale of effects upon the body measurable in decades and the success of the worker movements to get it banned in an increasing number of countries, becomes a valuable tool for thinking through this temporal disjuncture. Through its toxicity asbestos brings embodied time into proximity with geological time; it also gives us a glimpse into the workings of the temporality of ecological debt and with it a glimpse into our deep future. That is to say, unless we begin to take account of and engage with the multiplicity of ecological temporalities now, the centuries that lie ahead will spell ecological catastrophe – the uncertain future of ecological collapse will certainly take place.

Yet the future is never written wholesale. Asbestos is but one example of a non-linear episode in the history of industrial progress. As such it is a lesson in the potentially catastrophic unintended consequences of over-eager investments in particular resources or their uses. It also serves as further warning about the potential unintended consequences of the often hubristic attempts at hopeful techno-fixes to the ecological crisis currently proliferating under the moniker of 'Good Anthropocene': the Anthropocene where humanity aims to wield its power over the geosphere to undo catastrophe. No once-and-for-all solution to the ecological crisis could be arrived at to which other unintended consequences would not

arise: as we have seen in the deteriorated images from an out-of-date documentary on asbestos – certainty and uncertainty are not contradictory, and with the passage of time the intentional leaves as much of a trace as the unintended. A wholesale solution cannot be written into the future, but neither does it have to promise wholesale catastrophe: certain processes causing ecological devastation having already been set in motion do not mean that all hope is lost. It merely means that human agency will have to act in concert with the agency and material specificities of resources, landscapes and ecosystems, working with, not against, them, through an informed, continuous and ever-shifting step-by-step negotiation of the future.

Conclusion

At the very beginning of this research process I expected that imagining geological deep time would become the key temporal challenge facing this study. Yet as the project developed to be about paying attention to all the points where the human and the nonhuman touch and interpenetrate, rather than about reaching for the geological as some kind of 'other', I realised that it was much more pertinent not merely to attempt the impossible task of imagining the deep future, but to engage with the existing current intersections with geological time. Similarly, where I initially set out to inquire into whether film could provide access to the otherwise imperceptible geological materials or environmental phenomena, I ultimately found and was able to argue that it is not the materials or phenomena themselves but our interactions with them that are most urgently in need of examining and renegotiating. In reading geology through film and film through geology a reciprocity of insights was established that brought to light many such points of connection. Reading cinematic form through the geological form of the sinkhole helped develop formal cinematic approaches that can account for the volume of the terrain and the confluence of geological and human forces. While reading cinematic time through sinkhole time, understood as an intervention into linear time that simultaneously and non-chronologically contains not only past, present and future, but also a multiplicity of parallel and interacting human and nonhuman durations, became a model for theorising the cinematic 'deep now'. In turn, a consideration of cinematic time from the perspective of the entropy acting on the technical carriers enabled me to theorise the non-contradictory nature of the many modes of relating to the future inherent to asbestos, and the ecological crisis more broadly. Indeed, it is precisely by setting up the framework of the project at the seemingly

incommensurate encounter of geological and cinematic durations, and of optical media and the imperceptible, that allowed for moving from considering geological and human spatio-temporal scales as incommensurate, to accounting for their intimate connections in the here and now.

Just as a reciprocity of insights emerged from the intersections of film and geology, a similarly reciprocal relationship was formed around the insights from the parallel and ongoing investigations in the medium of film and the medium of words. This project as a whole came out of my ongoing filmmaking practice and the questions that were arising through it and demanding a deeper theoretical underpinning. The literature review is in many ways a response to and a grounding of these ongoing concerns, while also being the springboard for the subsequent entangled theoretical and practical investigations. I worked on the chapters on depiction and perception, as well as *Salarium* and *Asbestos*, simultaneously over a continuous time period, each of the four influencing the others and providing further questions that were addressed in the others. As time is perhaps the most striking aspect of moving image as a medium, and is differentially applicable to both depiction and perception, I knew I wanted to save the discussion of temporality for the final chapter, where I could develop theoretical claims about the intersection of geological and filmic temporalities in response to all the practical work already completed. While the chapters of the written thesis drew on the films, and vice versa, they did not attempt to fully interpret each other's findings. This is why I would like to use this conclusion to synthesise further the insights I have arrived at through both theoretical argumentation and filmmaking. As many aspects of the more processual side of the practice work did not fit into the flow of the written argument, it is through the *filmmaking* part of geological filmmaking that I would now like to present some of the project's key claims, its development and its future.

The process of geological filmmaking begins from a sense of awe in the face of a particular nonhuman entity. In the case of this project such entities were a land formation and a geological material, but they need not only be geological. I first encountered the sinkholes in photographic form. It was the power of those images of the craters ravaging the coastline that motivated me to parse out the details of their causes and effects and to imagine what type of images could account for their relationality. Asbestos, on the contrary, intrigued me precisely in its invisibility — the invisibility that makes it inaccessible to images and that also makes its toxicity so insidious. I wondered what could be deduced about the history of its toxicity from attempting to make images of it. In practicing the methodology of this project the filmmaking did not follow outcomes of researching the films' subject matter in order to illustrate what had been found out, but rather new knowledge was produced through the challenge of depicting it visually. Indeed, in order to use filmmaking to discover something new, it is crucial to be open to discovering something new about filmmaking. Producing new knowledge through filmmaking does not mean applying a static notion of filmmaking to a new film subject, but rather allowing for filmmaking to be fluid and to push at its boundaries in the effort to grasp the subject. The starting point for geological filmmaking is thus a dual motivation to learn more both about the nonhuman entity through film as well as about the medium of film itself. The very first instance of a reciprocity between film and geology lies in this dual openness of the wonder elicited by the subject of the film and of the ongoing curiosity towards the possibilities of the film medium. Cinematic formal constraints as well as cinematic technologies, already in such an intimate relationship with the geological, thus become equally as worthy of investigation as the subject of the film, and can be equally as determining of the film's outcome as any intentions of its human author.

Alongside the initial encounters with the nonhuman subject of the

film and its technological means, the starting point of geological filmmaking involved considering my own role as author. In the first instance it entailed understanding myself as a member of the species that exists in a precarious and perhaps unsustainable relationship with its environment, as broad yet inescapable as this statement is. Perhaps more important was understanding myself as a specifically situated human subject, embedded in particular political, geographic and ecological microcosms, which differentially affect and are affected by the subjects of my films as well as the worst of the current symptoms of the ecological crisis. For example, studying the history of asbestos highlighted the pivotal role that Russia, where I am originally from, and Canada have played in its continued extraction and marketisation long after the revelations of its toxicity — with the difference that in Canada they had stopped using it domestically. I have then had to wonder whether the schools I went to as a child were insulated with asbestos and if it was safely contained. And with that, I also had to consider myself as a material entity, a body made from mostly organic matter, constantly cycling environmental matter through my system, tied to the earth and to technology through 'the iron in our blood, the salt in our tears' (Cubitt 2017: 188), in the words of Sean Cubitt that once shook me deeply. Part of the awe in the encounter with sinkholes and asbestos was triggered precisely by understanding the intimacy of their relation to my material body, highlighting the body's porousness and vulnerability, which became one of the driving themes for the formal choices in the films. The initial consideration of *my*self as both a socio-economic subject and a fleshy sponge was the foundation for what the films later brought into sharp relief: the entangled and reciprocal co-emergence of the socio-economic and the geologic and of our mortal bodies and environments.

The formal decisions that went into shooting, and later editing and exhibiting the films, and thus the experience of space and time generated by

them, emerged out of the above considerations of all the actors involved in the making of the films: the nonhuman subjects of the films, the moving image medium and filmmaking equipment, and the author as a situated human subject and a material body. If such consideration can perhaps be described as an initial *conceptual* encounter with and between these actors, then the process of making the films is the *material* encounter between them. In the extreme heat of shooting *Salarium* the encounter of the environment with both the equipment and my body meant that almost the entire film was produced in the ninety-second intervals between air-conditioning breaks. The way this material necessity circumscribed the process necessarily informed every individual decision, while the strain on the body as well as the camera inspired every formal experiment. Throughout the making of both films there were constant reminders that there is only so much that is physically possible, but that precisely in touching that boundary there is a lot to learn. The very foundation of *Asbestos* was defined by this fact, as the film engaged in the impossible task of tackling a submicroscopic material through optical means. While making *Asbestos,* concern for the safety of my body became an obstacle in gaining access to the spaces of asbestos removal and thus a deciding factor in turning to found footage. This formal choice in response to a material reality ended up being one of the richest aspects of the film, and not something I would have thought to, or even known how to, execute on my own, which is one of the many reasons collaboration has been so fruitful throughout this project and will continue to play a big role in my future practice. My collaborator Graeme Arnfield works primarily with found footage in his own practice, and while I went to shoot in Asbestos, Quebec alone, he gathered the material about asbestos' removal. Using the different moving image formats as pointers to different times, a key part of the film, was triggered by encountering the plethora of historical and contemporary material — not the other way round. A key aspect of the methodology of

geological filmmaking is that formal choices cannot be premeditated, but emerge through the real-time unfolding of the encounter between the specificities of all the actors — human, nonhuman and technological — involved in the making of the film at each particular moment. It is through this open methodology that geological filmmaking fosters modes of non-linear and non-teleological cinematic temporality in the films themselves. An appreciation of the physical limits to the scope of one's intended actions, and a surrender to being an engaged participant in perpetually unfolding processes instead of imposing one's premeditated plan on them are valuable lessons for the broader issues of living in and through the ecological crisis.

In the fabric of the unfolding of the making of the films, the formal choices that emerged often aimed to mimic cinematically the more representationally or perceptually challenging qualities of the subjects of the films. In *Salarium*, asking what a sinkhole image might look like resulted in framing and camera movement decisions that created contrasts between stability and instability, and that generated and punctured surfaces, thus implying depth and dimensionality to the image. While shooting *Asbestos*, in the absence of the possibility of generating images of its mineral namesake, I opted for creating wide and static shots of the town of Asbestos, Quebec, to contrast the dynamic footage of removal, in an attempt to articulate the co-existence of contradictory aspects of asbestos: at once local and global, situated and dispersed, static and mobile, latent and current. Contrasting the extraction from the earth from extraction from the walls, all the shots from Asbestos, Quebec are exteriors, and all the shots of removal are interiors, creating a tension between inside and outside. This is, however, not to claim that the films were thus able to provide some privileged access to sinkholes and asbestos or channel them directly. Film, documentary or otherwise, is never a window onto some pre-existing reality. The reality that a film creates is always specific to film. As Pasi

Valiaho puts it, insofar as film is 'a mode of disclosing and bringing forth' of the world, 'a way of letting appear and thus generating being', film 'discloses and brings forth the world in a manner specific to itself' (Valiaho 2010: 10). This is not film's limitation — but rather its strength. As Maya Deren writes, in shooting and splicing together a film, 'the reality which emerges is a new one — one which only film can achieve and which could not be accomplished by the exercise of any other instrument' (Deren 1946: 39-40). It is arguably film's special privilege that, by exploring and bending its possibilities as a temporal and optical medium, it is capable of creating a new reality. This process takes place as much in shooting as in editing. Indeed, in editing the films my collaborators and I were not guided by an attempt to replicate already existent spatial relations or linear causal narratives, but rather by trying to find resonant points of cinematic connection and juxtaposition in the footage and its formal qualities, and thus create new spatio-temporal arrangements. In this sense, reaching for the elusive nonhuman subjects of the films was really a reaching toward the core of film itself, and there at the core of the formal possibilities and limits of the medium some insights about the films' subjects came to light. Filmmaking, thus understood as a shaping of spatio-temporal reality, can therefore be said to already be a shaping of the future.

While the process of making the films was illuminating in itself, it was also important for me to consider the future of the finished films, including their audiences and dissemination. The films were screened widely, and with *Asbestos* there was also an opportunity to exhibit it in a gallery setting. Just as with geological film*making*, *exhibiting* geological film presents an opportunity to confront the potentialities of the exhibition medium in relation to the film's subject. By a serendipitous, if initially worrying, coincidence, when *Asbestos* was exhibited the show had to be delayed by a week in order to check the space — for asbestos. The exhibition was organised by an itinerant curatorial project, Roaming, which

takes over non-residential spaces between commercial uses and turns them into temporary galleries. It took place in March 2017, in a disused ground floor shop in London. No actual asbestos was found, yet visiting the space we could immediately see how such suspicions arose. The space was divided into four consecutive rooms, and the ceilings of each of the rooms were in quite varied visible states of disrepair, including ceiling tiles, insulation, paint and cables hanging loose. The state of the ceilings was evocative of the asbestos-harbouring ceilings in the film, and instead of fixing them up to make the space feel more like a white cube, we decided to work with the space and incorporate all of the rooms as sculptural elements of the immersive installation. The final shot of the film travels through a labyrinthine interior where the walls, floors and fixtures of every room and corridor are wrapped in red plastic, in preparation for asbestos removal from the ceilings. In the exhibition we physically recreated this pictorial space by wrapping the walls and floors of the first three rooms of the gallery in red plastic, which one would have to travel through to arrive at the final darkened room where the film was projected (Fig. 19). As visitors traversed the space of the exhibition they experienced the plastic crunching under their feet, felt it cling to the walls through static electricity, breathed the heavy still air. We wanted the experience to be bodily and visceral, and to add to it every visitor was given a red hazmat suit to wear for the duration of their visit (Figs. 20 and 21). During the opening event the space was filled with forty people at a time, all brushing past each other in identical red hazmat suits, asking us if the space was in fact contaminated. Not only did every viewer's embodied presence in a hazmat suit serve to heighten the sensorial dimensions of their own experience, but crucially the viewers became part of the visual experience of other visitors. In this sense, the viewers were not merely observers of the surface of the exhibition: they were internalised by it as part of its content. In the ecological crisis there is no outside viewing position just as there is no outside to either

Fig. 19. Documentation of *Asbestos* exhibition, Sasha Litvintseva and Graeme Arnfield, Roaming project, London, UK, 2017

Fig. 20 and Fig. 21. Documentation of *Asbestos* exhibition, Sasha Litvintseva and Graeme Arnfield, Roaming project, London, UK, 2017

responsibility or vulnerability. The aim of geological filmmaking with regards to its viewers is to situate them as both producers and products of environmental phenomena, and beyond the formal qualities of a given film, the conditions of its exhibiting present an opportunity to literalise viewers as embedded and embodied elements of the depicted environments.

Considering the future of geological film perhaps warrants a speculation on what it might mean on a geological timescale. Would these (or indeed any) films still exist in one hundred, one thousand or one hundred thousand years? What would their audiences be? Is there any point in imagining the audiences as not yet born, or already deceased, as nonhuman or indeed inorganic? I had a sense during the very early stages of this project that geological filmmaking would aim to destabilise anthropocentric image-making to a degree where it was no longer addressing a human viewer. And this question was one of many to which the reciprocal theory-practice methodology brought nuance: while it would have been possible to argue for the existence of a cinema that was entirely independent of human eyes, actually engaging in filmmaking constantly put into question the possibility of such a thing as well as what the value of such an ultimately abstract exercise would be. While I was invested in making work where human subjectivity and agency was not centre stage, it is still 'people who have the emotional, ethical, political, and cognitive responsibility inside these worlds' (Haraway 1998: 134) that we share with myriad nonhuman agencies. What has emerged, I hope, is cinema that aims to recalibrate human viewers' perception toward accounting for this multitude of nonhuman agencies alongside which we shape the world. A piece of footage that particularly struck me in this regard, as I reveal in chapter four, was the moment where the narrator of the colour-degraded footage inadvertently predicted its entropic transformation. Projecting the films I made into the future also begs the question of how their technical carriers, from hard-drives and servers to file formats and playback

software, are going to fare with the passage of time. And whether in being subject to entropy they will end up revealing, with a dramatic irony, something that is happening to us now or that awaits us in the future without our knowing. Whatever happens to them, for as long as they persist these films will be a document of *this* moment, a moment in which we will perhaps be seen to have begun to come to grips with our place in the material world, just as they were made *for* this moment. Geological filmmaking is therefore of and for the 'deep now' of *right now*, as it has developed to become about intersecting with geological time in the now, without trying to project ourselves into deep time. Ultimately, while not too long from now the files may become unreadable and the films disappear altogether, my hope is that the future of this project will lie in its conceptual and methodological reverberation.

The future of geological filmmaking that I am perhaps most immediately invested in is the way in which other artists and thinkers can mobilise the methods and concerns described here. The methodological insights arrived at in this project can hopefully also go beyond the thematic concerns and inform a broad range of work: from theoretical work that reads different disciplines or disparate entities through each other, to research that unfolds through a reciprocity of writing and filmmaking, and to filmmaking that thrives at the limits of the medium and emerges out of the unfolding of the encounter of the agencies of the subject matter, the technologies involved and the author. The above account of the process of geological filmmaking as it took place during the period of my doctoral research can also serve as a soft methodological guide for such filmmaking more broadly. In this thesis I have taken the first steps towards outlining what I came to call geological filmmaking, but it far surpasses this project or my own filmmaking practice. While the practical challenges encountered in the making of the films helped me flesh out the conceptualisation of geological filmmaking, the term in no way excludes existing or future work

of other artists, many of whom tackle similar questions and some of whose works I draw on throughout my argument. Not only in this study's combination of theory and practice but also in this sense of openness — geological filmmaking is a concept *and* a practice. It is a concept that can be mobilised toward further theorising of the rich variety of the ongoing film practice that shares similar concerns and a practice that can be taken up by other artists, to be developed and transformed in ways that only future will tell.

Links to *Salarium* and *Asbestos*

Salarium

42 minutes, 2017, by Sasha Litvintseva and Daniel Mann

Full film: https://vimeo.com/234010072

Password: salarium

Asbestos

20 minutes, 2016, by Sasha Litvintseva and Graeme Arnfield

Full film: https://vimeo.com/178594759

Password: asbestos

***Asbestos* exhibition installation documentation**

Solo exhibition at Roaming Projects, London, March 2017

Video walkthrough: https://vimeo.com/208969201

Files of the films are also provided on USB in the back of the thesis.

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Filmography

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