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Radiological Deep Time Aesthetics

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Submission for PhD

Declaration of Authorship I …A WEIR……. (please insert name) 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.

Signed: _____ _____ Date: 25/9/19

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Abstract

Nuclear energy production worldwide has created the problem of what to do with its legacy of high-level radioactive waste. This waste, increasing at a rate of around 12,000 tonnes a year, is dangerous to humans and the environment, and so must be contained for durations up to hundreds of thousands of years, or longer.[1] Alongside technical questions of nuclear waste storage, such 'deep' timescales also open up questions such as how the hazardous toxicity of these materials could be communicated to future generations of people, or even how such long-term futures could be imagined from a present perspective. To address these concerns, the Nuclear Energy Association launched an interdisciplinary initiative in 2011 named the Preservation of Records, Knowledge and Memory across Generations (or RK&M) project. Taking this project as its starting point, this thesis argues that the imaginary of nuclear futures is based on a problematic assumption, that of a universalised image of a future human, separated from 'nature' and made safe against fear of nuclear apocalypse. The thesis challenges this basic premise, proposing a more critical perspective on transformations of 'the human' in relation to deep times of nuclear waste. It does this through practice-based methods and a written dissertation.

The art encounter is rethought as a speculative ethical call from an unknown entangled future, alienating experience in the present. Through practice, artwork is developed as a buried distributed 'marker' of nuclear toxicity. Against current proposals to mark waste storage sites, this highlights the materiality of the waste itself as part of an ongoing ecology of toxicity its viewers are implicated within. Through developing 3D-printed

[1] 'High-level' waste is defined by its decay heat. It contains components that must be cooled and stored for various durations depending on decay rates of particular radionuclides, https://www.oecd-nea.org/brief/brief-03.html. Uranium-238, the most prevalent isotope in uranium ore has a half-life of 4.5 billion years, https://ieer.org/resource/factsheets/uranium-its-uses-and-hazards/ Onkalo, a deep geological repository facility in process in Finland, is being designed for 100,000 years of storage, http://smudgestudio.org/smudge/with/uncertainty/uncertain.html.

demons, it uses mythic fiction as method to connect local sites with histories and deep time futures of radioactive waste. This informs the dissertation, which goes on to propose a new aesthetic structure that escapes traditions of the sublime and the 'already made' of contemporary art through imagining radioactive waste as future relic.

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Introduction

1. Nuclear Waste as Deep Time Today

"This is not about the future, this is about today," argues Mami Mizutori, UN secretary-general special representative on disaster risk reduction, discussing the UN Global Assessment Report on Risk Reduction. (Harvey 2019: para 2) The report (GAR 2019) emphasises the practical importance of thinking environmental crisis now instead of deferring it to an indefinite and distant future. It makes connections between climate emergencies in the Global South, deregulation, waste and consumerism in the Global North. The report shows the inadequacy of analysis at the scale of 'the human' in understanding this complex more-than-human network, where environmental risk emerges from factors such as a hyper-connected financial system, income inequality, resource extraction and conflict. 'Deep times' of materials, such as billions of year half-lives of radioactive waste, necessitate thinking at geological scales beyond human existence. At the same time, however, as the report suggests, such inhuman scales become entangled with displacement of communities and human-induced natural disasters in the present.

The challenge of thinking at scales of deep time, while approached in very different ways, has been a common thread across much recent theoretical writing. This includes critical discussions around the geological Anthropocene, where humankind's mark on the Earth is acknowledged as part of, rather than transcendent to, its environment (Davis & Turpin 2015; Haraway 2015; Zylinska 2014; Yusoff 2018); philosophies that challenge the post-Kantian tradition by arguing for novel ways of expanding thought beyond human finitude into the 'non-correlational' world of the real (Meillassoux 2008; Brassier 2010), or as part of material networks including and exceeding humanity (Barad 2007; De la Cadena & Blaser 2018). Such theoretical questioning of 'the human' and its relation to planetary timescales has been taken up broadly by artists and curators, including work operating at longer scales than human experience or species existence (Huyghe 2012; Paglen 2010), and claims to make non-anthropocentric exhibitions (Christov-Bakargiev 2012).

There is a politics of temporality here, however. Positing deep time as magnificently and seductively elsewhere is problematic as it defers problems of the present, a temporal analogue of philosopher Elizabeth Povinelli's description of spatially deferred toxicity in the dumping of waste materials around the world, "at some point there would be no further, no behind, no over there" (2019: part 1 para 8). At the same time, claiming to represent a universal scale or humanity misses both the asymmetrically varied vulnerabilities and economically differentiated causes of harm outlined in the UN report. The concept of deep time must itself be contested then. It must be understood not as a time other to human politics, nor an empty temporal container for human action, but instead as complex overlapping scales with performative effect, including transformed human experience as it becomes bound up with materiality beyond it. It must include consideration of how deep futures of materials are impacting on crisis today.

This is especially the case in a nuclear context. The specific materiality of what I define in this study as 'radiological deep time' is premised on durations of half-lives, extending not only before the formation of the planet, but also into futures beyond planetary exhaustion. The overawing magnitude of these scales leads to many problems. It opens up an imaginary of cosmic immensity, separated from its embedding in political realities of the present. Confronting timescales of extinction can serve to reaffirm the drama of human finitude, while the apocalyptic spectacle of imagined future disaster overshadows the everyday toxicity of the nuclear that many around the world are exposed to. As flipside to this imaginary of apocalypse is its construction as 'saved'. By deferring destruction, imagined futures are invoked as ways to stage the fantasy of heroic action, based on an idealised return to 'nature'. Against this narrative of apocalypse and salvation, my project advocates something similar to what theorist Donna Haraway has called 'staying with the trouble' of nuclear toxicity, in all its unfinished configurations of places, times, human and non-human things. I do this through defining a concept of radiological deep time against the 'made-safe futures' of the nuclear waste storage imaginary.

2. Challenging the Marker Subject

To expand on these arguments, I focus in this study on deep geological repositories for long-term storage of radioactive waste, and in particular in how these sites are proposed to be 'marked' in the future through the interdisciplinary Records, Knowledge and Memory (RK&M) project. Rather than focusing in detail on a specific repository project or site, my aim is to address a more general imaginary of nuclear waste storage, disseminated and contested through culture as well as Nuclear Industry material. At the same time, I have also focused practice and research on the HADES underground laboratory in Belgium as a test site for these concerns. The RK&M context is premised, I argue, on the narrative of heroic salvation, communication with and mastery of the future I have outlined so far. I go on to argue in the dissertation that it is figured through the production of a specific subject, unchanged over time and separated from the contained toxicity of nuclear waste and its planetary entanglements. Drawing on the RK&M language, I call this *the marker-subject*. It is problematic as by creating this image of the secure subject separate from nature, as radically other to thought, responsibilities and differences in the present, it resists entanglements and implications within broader ecological networks of toxicity. As the figure most amenable to the extractive logic of capitalism, the marker subject serves to occlude ways that knowledge and subjectivity relate, within radiological deep time, to more expanded notions of care and harm. This includes, for example, ways that waste 'marked' as contained at the HADES underground laboratory in Belgium, has ongoing colonial toxic legacies in uranium mines in the Congo. At the same time, the problem of what to do with continually growing masses of radioactive waste remains. The UK alone, for example, is likely to have produced 4.9 million tonnes of nuclear waste by 2125.

Fundamental to the imaginary of the deep geological repository, the marker-subject is produced aesthetically. I draw on the RK&M project here as a key site not only for production of the marker subject, but also for its contestation. By intervening in and analyzing this project, I argue that it can be re-thought to explore questions of knowledge, subjectivity and ethics immanent to radiological deep time in the present. This includes not only a universalised concept of 'the human', but also global realities of

unevenly distributed harm. For art to challenge this representation of subject separate from deep time, then, it is not enough to make images that seduce through immensity of scale. I describe in the dissertation how these serve to emphasise deep time as sublimely unknowable, emphasising pleasurable dwelling in the derangement of scale of the Anthropocene, against knowledge or action. At the same time, contemporary art's conditions of meaning more generally can work to reduce deep time to existing processes of subjectification. In this case, the non-human world collapses into the frame of the artwork, always 'about' deep time rather than from within it. I analyse these aesthetic structures as, firstly, the 'Anthropogenic deep time sublime' and, secondly, 'the already made', arguing that, in different ways, they create a limit between subject and deep time. Chapter One of the dissertation focuses on radiological deep time, the repository context and the marker-subject. Chapter Two moves to focus on art practices that take radioactive half-lives as their materials, including work by Thompson & Craighead, Erika Kobayashi and Shimpei Takeda, considering how they draw upon and suggest moving beyond the Anthropogenic deep time sublime aesthetic. Chapter Three focuses on the artwork *El Chaco* by Guillermo Faivovich and Nicolas Goldberg, at the Documenta 13 exhibition in Kassel, Germany, to develop the concept of the already made. The final Chapter Four is informed by my practice-based research, which I will go on to outline next.

3. Aesthetics of Radiological Deep Time

What I aim to develop, against the structures of the sublime and the already made, is an 'aesthetics of radiological deep time'. In my dissertation, I draw on writing on scale, alongside philosopher Karen Barad's ontology of phenomena in dynamic intra-active relation,[2] to propose a definition of radiological deep time as universal continuum enfolding within, affecting and affected by its relations to other materials, scales and sites. Counter to its formulation as radically other to human experience, deep time is seen as emerging from these relations and having performative effect. Considering

[2] Rather than 'interaction' where entities pre-exist and then relate to one another, Barad argues for 'intra-action' where phenomena are shaped through the process of interaction itself. See Barad 2007: p.179.

philosopher Timothy Morton's description of the 'hyperobject' as a very large finitude that it is impossible to stand outside of and make sense of as a whole, I then move to the question of how such an entity could be known. Against what I analyse as 'the planetary image' which claims to represent deep time from a transcendent position, I propose aesthetics as a connector between a subject within deep time and its universal scale.

This informs my practice-based research, which becomes an experiment in drawing connections between multiple scales, in order to attune to radiological deep time as complex hyperobject. In this work, I intervene directly within the specific context of the RK&M project, developing and burying 3D-printed demons as distributed markers of deep geological repository sites. Taking as starting point philosopher Reza Negarestani's description of Babylonian-Assyrian demon of dust and contagion Pazuzu through 'double flight', scavenging the dust of the Earth to uplift it to alien currents of the universe, I create a demonic figure that mutates through contact with local myths and sites. This morphing *Pazugoo* figure is proposed as navigational device for mythic flight to universal deep time horizons and back to thought in the present, connecting sites of toxicity through a topography of pestilence. Practically, this involves a process of prototyping including group workshops and the production of SLS-plastic prints; bronze and resin casts designed for different levels of burial, and Index figures which occupy museum collections, referencing the buried objects. [3]

As well as these sculptural objects, videos, drawing and diagrams play the role of speculative imagining of deep time futures, and the artwork enters into more interdisciplinary discussions and projects of nuclear waste storage, marking and memory.[4] The research involves work with the Belgian Nuclear Waste Agency to design a demon figure for HADES. Here I am working with materials scientists to trace histories of the stored waste and proposing three figures – one buried as underground marker of the waste repository site, one buried at a site representing an earlier stage of the waste life-cycle, and one exhibited in a museum being built at the site. This aims to

[3] See Documentation of Practice: Sections 1-4; 9, showing the process of production and exhibition of 3D-printed demon markers.
[4] For example, the Stakeholder's Roundtable at Modern 2020, Documentation of Practice: Section 10.

represent past, present and long-term futures of radiological deep time, embedding objects as part of long-term decay, while bringing debates into the present.[5]

Through this work, sites of nuclear waste are addressed not as isolated problems, but as networks at planetary scale, including the exhibition, the viewer and artist as part of a deep time ecology of toxicity, rethinking the exhibition and the art encounter in this context. By shifting focus from marking the contained site to tracing and personifying the materiality of the waste itself, and using this to develop a mythology through burial in contaminated earth, I propose that the narrative of apocalypse and salvation and the marker-subject imaginary can be challenged.

This practice then informs the final chapter of the dissertation. Here I draw firstly on semiotician Thomas Sebeok's (1984) original proposals for inter-generational fictions for deep geological repository sites. While critical of these, I propose rethinking them through a process of 'geo-fictionalisation', replacing his transcendent priest figures with a focus on grounding and ungrounding in the earth. Elaborating on this, I unearth and cut into barrels of nuclear waste for long-term storage, considering them in terms of what theorist of nuclearity Gabrielle Hecht (2018b) has called the 'interscalar vehicle'. From this I propose more general directions for artistic strategy, firstly through the theory of sampling as method. Against the alreadymade structure, sampling assumes an elsewhere that its encounter opens toward, foregrounding the artwork as partial model, remaining not fully determined by its viewer. Taking this further I argue for an understanding of nuclear waste as a kind of future relic, or 'radioglomerate'. A relic is a sample from another time. It twists the past into the present, connecting now to deep time and investing death with life, crossing ontological boundaries. Buried nuclear waste, however, inverts this temporality. As future-relic, its viewer becomes relic for-it. Against an idea of communication with people like us in deep time futures, this burial and mythic double flight suggests a critical process of alienation in the present, the ethical call of more-than-human futures in the now.

[5] Documentation of Practice: 14.

Chapter One – Nuclear Waste Futures: Scale, The Marker Subject and The Deep Geological Repository

1 1 Introduction: A Call from the Ungrounding Ground

1 1 1 Into Eternity

1 2 2 The Marker Subject

1 2 Radiological Deep Time as Irreversible Cut into the Present

1 2 1 Deep Time of the Future

1 2 2 Arche-times and Extinction

1 3 Navigating the Multiple Timescales of Radiological Deep Time

1 3 1 Scale as Emergent, Relational and Performative

1 3 2 Speculating on Deep Futures: Models, Predictions and Hypotheses

1 4 Conclusion: Rethinking RK&M Markers

1.1. Introduction: A Call from the Ungrounding Ground

1.1.1 Into Eternity

It begins with a framing of formlessness. Mist or fog drifts in front of and around the camera. Surrounding forest sound is intensified, becoming part of the hum of the plant. The camera tracks slowly from road through penetrated granite or argillaceous limestone, while a disembodied voice invokes an uncanny addressee, a 'you' of the future, called into being from an imagined 'we' of now. "This place should not be disturbed", it cautions through a whisper, "this place is not a place for you". Ignoring this, the camera moves on, sweeping across incised rock with mechanical crackle, sketching a landscape both invested with desire and radically indifferent to your gaze.

This describes the opening of the 2010 documentary film *Into Eternity*, directed by Michael Madsen. The film documents research at the Onkalo deep geological repository site in Finland, one of a number of sites currently being tested around the world for the long-term isolation and containment of radioactive materials considered damaging to human health. Excavations take place in response to the geological make-up of specific sites - granite, ignimbrite or plastic clay, for example – aiming to safely deposit the growing mass of radioactive waste generated from, among other sources, spent nuclear fuel. Experiments test the absorptive capacities of material combinations, aiming to slow the leaky afterlife of nuclides as particles drift over hundreds, thousands or millions of years.

Through slow close movement across the pocked granite interior surface walls, the camera moves further into the darkness of a tunnel. The frame is then illuminated by a human figure, the film's director, striking a match to attach the opening voice to a visible body. He stares into the camera, his hushed warning to "keep out" evoking a desire to move in further to this mysterious and forbidden underground world.

This short pre-credit sequence is already complex in its representation. The repository site is figured, on one hand, as a space indefinitely 'away' from human culture, a barrier separating human bodies from the damaging effects of excess radiation, and human

thought from its contemplation - out of sight, out of mind. At the same time, it is a site that viewers are invited into, as imagined future intruders. Through the camera's penetration, the site is made porous, leaking into perception as a problem for thought as radionuclides slowly diffuse through bentonite. Then, 'not a place for you' - who is the addressee of the director's call? Who is the 'you' of the future and who does it exclude? Who or what will continue to remain vulnerable to radioactive damage in the wake of its ongoing industrial production? Temporally, to imagine this from the perspective of the present makes no sense – the repository is not yet built so 'this place' is a projection into an uncertain future. The imperative to 'stay away' puts viewers into the position, perhaps, of future explorers encountering Onkalo, but then, as archaeologists discussing repository designs have argued, why should we imagine such future people as simply the same as us here now? (Holtorf & Hogberg 2018) Gliding from inside to out of the container, while investing the tracked granite walls with close-up interest, the camera suggests a visual affective 'grounding' in the materiality of the Earth. Managing contagion through geological formations suggests an image of control and mastery over the environment. At the same time, however, as the camera probes into the underground laboratory and around the edges of long-term decay, it opens up current thought towards the reality of its own future extinction. These same close-ups emphasise the alien indifference of rock that will outlast the viewer's life and its own technological recording capacity. By de-prioritising the presence of human experience as a grounding centre, it also simultaneously incites a rational and vertiginous ungrounding of thought. This 'ungrounding ground' acts as point of departure for this chapter, informing the chapters to follow.

1.1.2. The Marker-Subject

What I propose here is that this call to the 'you' of the future in *Into Eternity* acts as a specific production of subjectivity. It addresses a subject secure and separate from the toxic materiality of the repository site, 'not for you'. It imagines an individual human subject, transcendent to and unchanged by its environment, 'not to be disturbed'. This is deferred to an indeterminate future while imagined no different to now, claimed as universal while unacknowledged in its privilege and cultural specificity. What I will go

on to argue is that this subject is configured not only through the film, but is fundamental to the imaginary of the deep geological repository as a whole. It is focalised through the concept of the 'marker' central to waste management discourse on Records, Knowledge and Memory (RK&M) of nuclear storage sites. Borrowing from this project and the implied question of who or what such a marker is for, I call this 'you' the *marker-subject*. It is problematic as by creating this imaginary of the secure subject separate from nature, as radically other to thought, responsibilities and differences in the present, it resists entanglements and implications within broader ecological networks of toxicity.

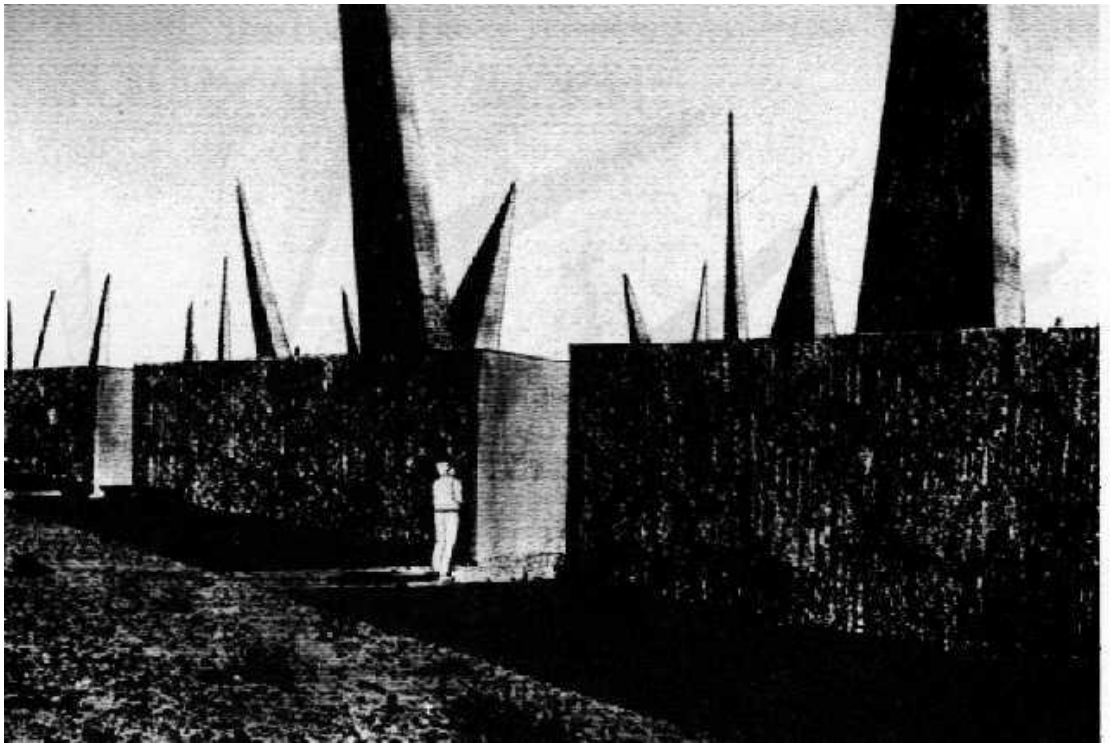

Figure 1.1: *Spikes Bursting Through Grid*, design by Michael Brill, illustration by Safdar Abidi, from Sandia National Laboratories Report, *Expert Judgement on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant*, 1991, image: https://urbigenous.net/library/WIPP/

Like the architectural 'scalie' figure in this early nuclear industry design for repository markers, the marker-subject is figured as both individual bounded human and representative of generic humanity. It can be understood as a particular 'genre of the human' (Wynter 2015) claimed as universal. Following analyses of the Anthropocene such as that of Kathryn Yusoff (2018), I understand nuclear waste production and storage as an enterprise that entwines geology, subjectivity, formations of the human

and inhuman, colonial geographies of extraction and export of harm. The marker-subject in this context can be understood as the formation most amenable to the extractive logic of the capitalocene.[6] By being universalised and separated from planetary toxic trajectories, in other words, it reinstates a transcendent anthropocentric perspective. It replaces violence specific to historical forms of capitalism and to environmental destruction in specific communities primarily of the Global South with a 'neutral' human figure. In proposing the marker-subject as that saved by the repository project (our children, our future), it adopts a primitivist logic towards the future, where unchanged futures are mastered and controlled by the nuclear industry, against the constant threat of nuclear apocalypse. As my analysis of the *Into Eternity* film sequence suggests, the marker-subject is produced, reinforced and contested through aesthetic practices. In this study I propose, through this written thesis and through art practice, to rethink the RK&M project as not only a site for production of this reactionary subject, but also potential site for its challenging, rethinking art, knowledge and ethics within a specific more-than-human temporality.[7]

Developing the concept of such a temporality, then, is key to a critical rethinking of the marker-subject. In this chapter, I focus on the concept of *radiological deep time* and aim to define it in two key ways – firstly, through its inhuman ungrounding force, and, secondly, its emergence through a multiplicity of scales, giving it agency in the world. Radiological deep time undoes the marker-subject in two ways. Firstly, through forcing

[6] See Sassen (2014), defining post-1980s capitalism through its ability to extract value from human labour through a complex network of 'predatory formations'. I use extraction here also more literally to refer to mining of resources, as Sassen focuses on in part of her more wide-ranging argument (pp.173-179). Following my discussion in the Literature Review, I use the term 'capitalocene' (Moore 2016) to capture the unequal nature of environmental destruction against the universalised 'Anthropocene'.

[7] I use the term 'more-than-human' throughout this thesis to capture the sense of a temporality that includes timescales of human lives and species existence, *as well as* times indifferent to humanity - the time of ancestrality described by Meillassoux, and times of future planetary extinction. Maria Puig de la Bellacassa discusses how the term, while widely adopted, has been criticised for "its abstract unspecificity, and for the moral undertones that invite us to 'transcend' the human for something 'more than," as well as the way it "starts from a human centre, then to reach 'beyond'." At the same time, in choosing to use it, she embraces its possibility to "speak in one breath of nonhumans and other than humans such as things, objects, other animals, living beings, organisms, physical forces, spiritual entities and humans." (2017: pp.1-2)

a confrontation with extinction, the subject is rendered contingent and immanent to its environment. Secondly, through a rethinking of scale, it is enfolded into dynamic relation with the more-than-human material network it is implicated within.

As continuum including and extending beyond human experience, radiological deep time challenges the outside position occupied by the marker-subject. I draw on my research at the HADES underground laboratory for testing long-term radioactive storage in Belgium to show that the magnitude of geological repository timescales stretches beyond 'future generations' to billions of year futures. This leads to an initial definition of radiological deep time, beyond a focus on the past, as extending into long-term futures beyond planetary exhaustion. Against the spectacular apocalypse of the popular Hollywood imaginary, I argue that nuclear waste futures evoke the material reality of slow damaging decay over immense periods of time, happening now rather than in an indeterminate future. Analysing this in relation to realist philosophical claims of Ray Brassier and Quentin Meillassoux opens up the potential for thinking deep time to expand thought now beyond the limits of human finitude. I propose understanding radiological deep time in this context as an incision into existing co-relations between subject and thought. While this has impact within philosophy for Meillassoux, I argue that these problems of thinking 'non-correlational' time have become more of a political urgency in the context of environmental crisis.

Following this, I argue that Meillassoux's focus on the *arche-,* as a realm separate to the phenomenal, is insufficient to conceptualise radiological deep time in its entanglements with sense, experience, physical decay, agency and cognition. Drawing on writing on *scale*, referencing the 'agential realism' of Karen Barad, I take a more relational approach, proposing to understand the emergence of radiological deep time through a multiplicity of overlapping scales*.* Its universality, in other words, is known through contact with other localities and positions, through scaling methods. Challenging an understanding of scale as either human (the marker-subject) or external to humans (the planetary image), it is understood instead as in dynamic relation with other material phenomena. Humans are transformed and affected by deep time rather than only restaging their transcendence through its mastery. I develop this through examples of future-projection methods from my research at HADES and nuclear waste management

more generally. Through devices such as simulation and staging interruption, deep time is understood as emerging from a network of human and non-human phenomena including isotope half-lives and abductive hypothetical fictions.

This analysis leads me back to a focus on the RK&M project. Following my discussion of radiological deep time, I propose that this interdisciplinary project can be rethought, against production of the marker-subject. Through its potential focus on connecting local sites to beyond-planetary scale, focused on concept of the 'marker', it can instead be understood as a test site for exploring questions of knowledge, subjectivity and ethics immanent to radiological deep time in the present. This includes not only a universalised concept of 'the human', but also global realities of unevenly distributed harm. By focusing on art as site for challenging and rethinking the marker in this specific context, I aim, as the study develops, to make more general claims for art practice as attuning to and developing an aesthetics from within radiological deep time, including its own self-questioning.

1.2. Radiological Deep Time as Irreversible Cut into the Present

Philosopher Eugene Thacker, outlining a context of global climate change, natural disasters, energy crisis and progressive extinction of species argues that "one of the greatest challenges that philosophy faces today lies in comprehending the world in which we live as both a human and non-human world" (2011: p.2). This leads to contradiction, he argues, as "we cannot help but think of the world as a human world, by virtue of the fact that is we human beings that think it" (p.2). Confronted by growing stockpiles of radioactive waste as reminder of ongoing environmental crisis, further contradictions arise in conceptualising such crisis as both indifferent to humanity in its agency, yet also caused by and affecting specific humans, or indeed in thinking what is meant by 'human' or 'nature' in this context. These seeming contradictions of thinking the more-than-human world through the lens of human thought and agency, have been central to recent discussions relating to both realist philosophy and to critical discourse on the geological Anthropocene. The deep geological repository becomes inevitably bound up with such questions and contradictions through the magnitude of its human and non-human design timescales.

As would be expected due to the damaging effect of radiation as cellular mutation in animal bodies, the 'you' of the *Into Eternity* call "this is not a place for you", is imagined primarily as an individual human body. At all stages of the life cycle of radioactive materials, some bodies are affected by radiation more than others. A villager in the Gaebon province of South Africa where lack of regulation and containment has led to winds of uranium residue dust, for example, will be more physically affected by damaging radiation than the scientists in *Into Eternity* working under different conditions and governmental regulations. The question of who exactly is affected by radiation is a complex geopolitical one.[8] The 'you' of the film, however, is also proposed

[8] See Gabrielle Hecht's discussion of 'nuclearity', "radiation is a physical phenomenon that exists independently of how it is detected or politicised. *Nuclearity* is a *technopolitical* phenomenon that emerges from political and cultural configurations of technical and scientific things, from the social relations where knowledge is produced" (2012: p.15); and her discussion of the unequal impact of the 'African Anthropocene' (2018a) where

as a more general call. In claiming to refer to the human species more generally, it opens up a thinking of the relation of humanity to the environment it is embedded within. Thinking radiological deep time, I will argue in this section, drawing on philosophical work by Ray Brassier and Quentin Meillassoux, is to undo the exceptionality of the category 'human' as transcendent to its surrounding environment. The 'truth of extinction' for Brassier, or the 'arche fossil' for Meillassoux, both concepts dependent on extremely long timescales, are radical in challenging the finitude of philosophical tradition. I draw on them here to challenge the imaginary of the marker-subject through arche-scale radiological deep time. Rather than the deferred temporality of the marker-subject, radioactive decay loops thought to its own extinction and returns to unground its foundations in the present.

1.2.1. Deep Time of the Future

The EURIDICE project works with a range of future timescales, based on the half-lives of specific isotopes.[9] This includes a range from isotopes such as I-123 and Cs-137 from nuclear medicines with half-lives of less than thirty years, through to isotopes from nuclear fuel production such as Pu-239 with a half-life of 24,065 years and U-235 with a half-life of 704 million years (Van Geet & Depaus 2016: p.10). Experiments test the effectiveness of isolating radioactive materials in local Boom clay, and are extended into the speculated futures projected by the half-life measurements. This leads to the aim of the project to isolate radioactive waste "from Man and environment" for hundreds to thousands of years, depending on categorisations of radioactivity (Van Geet & Depaus 2016: p.10).[10] In one sense, as the opening section of *Into Eternity* suggests, geological

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discourses of nuclearity regulate what is seen to matter as nuclear and not. Yusoff discusses the "environmental racism" of toxic nuclear legacies affecting indigenous territories (2018: pp.49-52), a clear example of which bodies are affected by radiation more than others. See also Sassen (2014: p.181) on radiation in Siberia. I return to this opposition between the different registers of 'you' as the thesis develops.

[9] Nuclear physics measures radioactive decay in terms of how long it takes for an unstable atomic nucleus to lose energy through the emission of radiation. As, according to quantum theory, it is impossible to know when a single atom will decay, this is based on the probability of a number of atoms to decay over time. It is measured in terms of the probable time for a sample to reduce to half of its initial value, or half-life. (Mott 2018)

[10] Updated definitions refer to "humanity and biosphere". (Themann 2019)

repository projects are oriented toward future generations, opening questions of an ethics of responsibility to future people and how to navigate this call to an unknown future. At the same time, however, considering the timescales at stake in the HADES research, it can also be extended further than the next generation. Indeed, if repository design is to remain synchronous with the material fact of radiation, then it must be extended much further. The half-life of Uranium-238, which makes up the majority of spent nuclear fuel, is 4.46 billion years. This coincides approximately not only with the 4.6 billion year age of the Solar System, but also with the 4.5 billion years from now predicted by current astrophysics as time of death of the Sun.[11] More immediately, the next ice age is predicted in between 6000 and 20,000 years,[12] while the Onkalo site is designed for 100,000 years storage. Bearing the facts of these material timescales in mind, deep geological repositories are designed for "without future maintenance" (Smudge Studio, 2010b, para.6), probing into a future where human engineers and scientists may no longer exist to monitor and control operations.[13]

Through this projection of a future without maintenance, the site invokes a temporality indifferent to human care. Its thinking and material construction is premised upon registering and modelling conditions in the present, which will not entirely depend on the priority of their human sensors. The repository landscape captured with lingering shots in *Into Eternity* in one ultimately of complete indifference to its photographers and their cameras. Philosopher Ben Woodard (2011) has argued that the radical futurity invoked by eco-crisis remains largely wedded to an anthropocentric horizon, understood in terms of future generations of people**.** This can be seen in the opening address of *Into Eternity* with its focus on protecting the marker-subject as imagined future human body. The proposed design 'without future maintenance' of radioactive waste repositories, however, opens up multiple scales of death and extinction beyond this horizon, that of the continuum of deep time.

[11] Where it will become red giant and engulf the Earth before cooling and shrinking towards a white dwarf. (Foukal 2008: p.432)

[12] Although current climate models suggest future ice-ages have now been 'put off' due to the amount of human activity produced CO2 in the atmosphere. (Ganopolski, Winkelman & Schellenhuber 2016)

[13] A situation captured in the radioactive waste management industry term 'passive monitoring'. (Meyermans 2019)

'Deep time', has been understood primarily in relation to the past, opening human cultures and civilisations to an amplified geological or cosmic scale, stretching back billions of years. Historical uses of the term can be traced to Enlightenment geology, attributed to James Hutton's 1790s analysis of the geochemistry and stratified formation of Siccar Point in Scotland (1997), and later developed in Charles Lyell's writing in the 1830s.[14] The 'angular unconformity' observed by Hutton is described in his writing as clear evidence of long intervals separating the formation of rocks, cycles of uplift and deposition over millions of years. Following Hutton, Lyell describes "incalculable periods of time" (1832: p.165) of slow upheaval and subsidence of continental masses, and the glacial pace of landscape formation and drift (p.176). For both writers, empirical observations are drawn upon to make statements about a timescale, which extends back before human civilisations. This is encountered as incalculably vast from the perspective of a human observer, or impossibly slow from the perspective of embodied human experience. Hutton's analysis of deep geological time is radical in its challenging of Biblical timescales, initiating a paradigm shift in thinking the relation of the human species to its 'outside' (in this case, times before its existence). What becomes evident from the study of nuclear waste management, however, is a speculative engagement with deep time as a continuum stretching not only into an immense past, but also into an uncertain and speculatively hypothesised future. Thinking deep time through Uranium isotopes opens a scale that includes human experience, while also being anterior and ulterior to human species existence. One effect of this is a conceptualising of the present as dependent on the future, always haunted by its own future extinction. The deep geological repository, as the examples of Onkalo in *Into Eternity*, the EURIDICE project and HADES Underground Laboratory

[14] See Stephen Jay Gould's (1987) discussion of the work of James Hutton and Charles Lyell, for example. There are debates over such dating, and it is not clear that either scientist actually used the term 'deep time'. Cutler (2009) traces the term back further to the pioneer of astronomy and geology Nicolas Steno in the 1660s. Such histories suggest that rather than being limited to earth science, "the discovery of deep time combined the insights of those we would now call theologians, archaeologists, historians and linguists – as well as geologists" (Gould 1987: p.4). More recent uses such as those by Parikka (2014) draw on Siegfried Zielinski's (2006) analysis of the long-term imbrication of media artefacts, using 'deep time' to open up non-anthropocentric perspectives for materialist analysis.

show, suggests not only a call to future generations, captured as a narrative of protection in the film, but also a more radical confrontation with species death and planetary extinction, and so the rendering contingent of these timescales alongside deep time. To emphasise a divergence from this geological history of deep times of the past, I use the term *radiological deep time* to describe the specific temporality emerging from radioactive half-lives, and go on to develop it over this chapter. Through the centrality of Uranium to nuclear materiality, radiological deep time is bound up with the future and planetary scale (as Uranium can be traced to the formation of the Earth), toxicity and slow decay.

1.2.2. Arche-times and Extinction

Conceptualising the world as human and non-human is not only a problem for philosophy. Nuclear waste management, through imagining and designing for the billions of year futures of radioactive matter, approaches it as an ecological necessity. Drawing on recent discussions within realist philosophy, however, where speculative access to the non-human real through rational process has been proposed, can open up the stakes and complexity of this challenge. Beyond calls for inter-generational infrastructure, the deep timescales of the nuclear also entail a radical rethinking of the category of 'the human'. Philosophers Ray Brassier and Quentin Meillassoux have both drawn on the materiality of extremely long timescales in recent work. Ray Brassier, in *Nihilism Unbound* (2007), draws on the fact that the sun will die to argue for the 'truth of extinction' as philosophical concept. Solar catastrophe, Brassier argues, points to a 'blotting out' of future possibility, which human existence could orient itself towards. He describes extinction not in terms of the end of biological species but as "that which *levels* the transcendence ascribed to the human" (2007: p.224). Extinction cannot be a limit for thought to overcome, as is it after thought itself, operating as death infecting life, "everything is dead already... the solar catastrophe needs to be grasped as something that has already happened; as the aboriginal trauma driving the history of terrestrial life as an elaborately circuitous detour from stellar death" (p.223). In Brassier's concept, knowledge of the fact of extinction creates a non-anthropocentric awareness of the death of thought (the collapse of the terrestrial horizon rather than

just existential death), which forces a disenchantment of humanity's own privileged position at the centre of a world *for-us* (whether figured through, for example, subjectivity, consciousness or *dasein*) – we are already dead, and it is not only humans who have a privileged relation to death. If James Hutton's work initiated a paradigm shift in thinking humanity's relationship to a transcendent deity, then the truth of extinction inherent to thinking radiological deep time suggests a further shift. It entails an understanding of humans as decentred within an ecological environment, rather than defining the limits of such an environment from a transcendent position. Stephen Jay Gould in his explication of deep time through geological discovery, myth and metaphor (1987: p.11) proposes two 'image thoughts' for deep time.[15] 'Time as arrow' suggests an ongoing narrative of linear progress, "a story of linked events moving in a direction" (p.11), which he connects to a Western Judeo-Christian tradition. 'Time as cycle' suggests repetition of the same, "apparent motions are part of repeating cycles" (p.11). Both images, however, suggest metaphorical readings of deep time *for-humans*, from the perspective of a figure separated from it. Brassier's work suggests an alternative image, where the truth of extinction effects a rational process ungrounding anthropocentric thought from within.

For Brassier, the truth of extinction is described as "stripping the [human] of its privilege as the locus of the correlation" (2007: p.224). The 'correlation' refers back to his analysis of the work of Quentin Meillassoux earlier in *Nihil Unbound*, "correlationism insists that there can be no cognizable reality independently of our relation to reality" (p.51). In his work *After Finitude* (2008) Meillassoux presents a critique of what he identifies as an anti-realist *correlational* tradition in post-Kantian continental philosophies. Correlationism is defined through its refusal of the absolute, and its wedding of thinking to being – one can only have access to the correlation between thinking and being, never to either term apart from the other (2008: p.5). It is through this tradition, he argues, that philosophy has become inadequate for thinking the 'great outdoors' of the non-human real, confining itself to subjective relation, out of step with

[15] 'Image thought' as a way to make thinkable through images, as in Deleuze & Guattari's use of the term, "the image thought gives itself of what it means to think, to make use of thought, to find one's bearings in thought." (2010: p.37), and taken up by Mullarkey in his use of the diagram to explore relations of immanence and transcendence. (2006: p.176)

ways that contemporary astrophysics, geology, or palaeontology can make statements referring to non-terrestrial timescales. Science, in Meillassoux's words, is able to 'think' these statements, where post-Kantian philosophy cannot without contradiction, limiting philosophy's ability to make any claims about the real (2008: p.9-10). Meillassoux illustrates this problem through the thought experiment of the 'arche-fossil'. This is described as a 'material support' for scientific statements that make hypotheses about times anterior to terrestrial life, a time he describes as 'ancestral reality'. An isotope measured by a nuclear scientist, for example, functions as an arche-fossil, supporting a statement to be made referring to ancestral reality, or "indicating the existence of ancestral…event" (p.10). A 'dia-chronic statement' such as describing the billion year decay of radioactive half-life, introduces a temporal discrepancy between thinking and being, "the meaning of the dia-chronic statement about a radioactive decay older than all terrestrial life is only conceivable if it is construed as absolutely indifferent to the thought that envisages it" (p.117). It can't exist as given to a subject as it exists in the absence of givenness as such. The correlationist is unable to account for making verifiable and meaningful reference to the ancestral without running into contradiction. Through the dia-chronic statement, Meillassoux goes on to argue, thought's capacity to think what is, whether thought itself exists or not, is unveiled – thought thinks its own contingency.

I introduce this argument here as it offers a more radical reading of *Into Eternity* and so of the marker-subject and the context of radioactive waste storage more generally. The film emphasises safety as a key concern, communication with future people, the triumph of engineering and a dramatised awe of encounter with long timescales Bringing in this philosophical realist context is a way of potentially moving beyond this awe-struck affect into cognition of the radical impact of deep time on human thought now. Meillassoux is astonished by the arche-fossil, and following the tradition of Hutton, uses this astonishment to rethink humanity's relationship to its outside; how the very conditions of communication or safety are challenged through its thought. In the deep geological repository, projected designs are based on arche-statements on Uranium half-lives, meaning they are bound up with the non-correlational. Nuclear waste storage is *for-humans* in the sense of protecting them from dangerous radiation. At the same time, it challenges this by evoking a temporality indifferent to human exceptionality.

Radionuclides will continue to diffuse through clay after the death of human thought, and this impacts on thought now. The "very slow decay" (Bodansky 2004: p.70) of radioactive materials forces a confrontation with the inevitable non-spectacular demise of human and non-human formations over an extremely long time.[16] As I will discuss in later chapters, this challenges an image of dramatic apocalyptic endings, which serve both to re-affirm human finitude,[17] and limit action and responsibility by presenting disaster as inevitable.[18] Instead, if taken seriously, the philosophical impact of the deep geological repository project ungrounds anthropocentric thought. It forces a rethinking of categories of the human subject as having no privileged relation to thought or death, and no transcendent relation to its planetary environment. In Stephen Jay Gould's (2001: p.13) discussion of deep time, he figures the arrow of deep time as 'irreversible' – always moving forward, never returning. Drawing on the truth of extinction and the arche-fossil, it can be figured differently here, inciting thought to hurtle towards an unknown limit of its own future decay, while returning like a heat-seeking missile to disjoint itself in the present. This becomes 'irreversible', in another sense, as a looping incision into the reciprocal 'reversible' co-constitution of being and thought – in that they no longer map onto one another as exchangeable terms, defining the limits of their own situation.[19] Through this extension of timescale, the marker-subject as future universalised figure is replaced with a subject-to-extinction, ungrounded by its own contingency.

It is this 'irreversible cut' that is radical in Brassier's and Meillassoux's work for philosophy. In environmental terms, the inability to safely store dangerous radioactive

[16] See Rob Nixon's *Slow Violence and The Environmentalism of the Poor* (2013) on the 'invisible' everyday environmental damage done away from more catastrophic media images.

[17] See Elizabeth Povinelli's critique of the 'drama' of human finitude as end, in her discussion of 'extinguishment', "how has the drama of finitude necessitated a particular drama about a minute segment of the vast form in which entities are?" (2016: p.94)

[18] See Demos 2017: pp.18-19.

[19] It is closer in this sense to Francois Laruelle's deployment of irreversibility against the circular co-constitution (auto-positioning) of a philosophy in its own terms, "irreversibility…denies any kind of reciprocal determination between thought and the Real or between the Real and the world" (Gracieuse 2012: p.51). Following Brassier's analysis of Laruelle (2008: pp.146-148), the real of deep time can be understood as non-dialectical negativity, amputating the reciprocity of being and thought.

waste, which continues to be produced, makes thinking under conditions of non-correlational deep time a political urgency. Thacker emphasises the thinking of human and non-human worlds as not only a philosophical but also a political and cultural problem (2011 p.8), and many others have drawn on contexts of ecological crisis to argue for the necessity of thinking the non-human through re-conceptualising humanity's relationship to its environment.[20] Drawing on Meillassoux's argument serves to introduce a more complex critical focus to the environmental context of nuclear waste. Beyond industry or activist discourse of being pro- or anti- nuclear power, what urgent critical, epistemological or ontological questions has this crisis opened up, and how can this inform and develop thought now? At the same time, reading this context alongside the arche-fossil brings an environmental urgency to what could remain an abstract thought experiment, focused on philosophy itself as a discourse. An understanding of the human and non-human world, which I explore here through radiological deep time, will be developed not solely through philosophy, but also through the practice of art. What I want to ask in this study is what role, if any, art could play in such conceptualisation, and so, what impact the ungrounding force of the non-correlational real could have on current conditions of art. Before going into this further, however, I want to expand my definition of radiological deep time. I have argued in this section for the importance of the *arche*- temporality of ancestral reality for an understanding of radiological deep time. To think deep time, thought now is thrown beyond its own extinction. While retaining the importance of this universal scale, conditioned by Uranium half-lives, I will now go on to argue that this leap to the universal does not fully capture radiological deep time. Indeed there is a danger that Meillassoux's focus on the arche- as a separate ontological realm to the phenomenological can reinforce rather than challenge the imaginary of deep time as other to now. A focus on human extinction can serve to re-affirm rather than challenge an anthropocentric viewpoint, and discussions of the universal rational human subject can serve to occlude the differentiated causes and impacts of environmental harm. Finally, understanding radiological deep time as solely problem for or extension of cognitive thought misses its relations to toxicity, so affecting and mutating bodies. To conceptualise radiological deep time further then, I move beyond this speculative realist

[20] See Haraway 2015, or Braidotti 2017, for example.

framework, proposing a temporality not only imagined at scales of extinction, but also unfolding at multiple simultaneous scales and localities.

1.3. Navigating the Multiple Timescales of Radiological Deep Time

I have discussed so far the extremely long timescales of radiological deep time. These have provided a basis for philosophical questioning of humanity's position in the world. The fact of the death of the sun will exist independent of and indifferent to any human thought. At the same time, however, deep time as time*scale* can be understood as a method for thinking this fact alongside other temporal events such as the birth of the solar system, human species existence or a human life. I will argue in this section that it is through thinking radiological deep time as *scale* that we can conceptually navigate these simultaneously human and non-human temporalities.[21] Firstly, rather than thinking of universal timescale as a uniform pre-existing category into which other concepts (such as human time, Biblical time, half-life etc..) can be placed, I draw on literature to propose scale as a property that emerges from matter and human activity, having effect and agency in the world. Developing this through the radioactive waste management context, I examine what scales emerge from specific methods including computer models and simulations, and the performative acting out of disruptions to these models. Through this analysis, I propose that thinking radiological deep time at multiple interacting scales involves cultural, ideological, performative, chemical and geological factors, bound up with one another in complex ways. This leads me to the specific context of the 'Records, Knowledge and Memory (RK&M) Project' for marking nuclear waste sites for future generations. Expanding this beyond its current understanding, I propose the project as a key site for the intersection of these radiological deep time scales. Through this specific claim for 'the marker', it brings into contact the very long timescales of radioactive half-lives with other scales of harm, vulnerability, action, communication and decay. A critical focus on the project, which I go on to propose through art practice, considers how this could open important questions around thinking knowledge and deep time futures in this context, beyond and against production of the marker-subject.

[21] Joanna Zylinska describes scale as a "practical and conceptual device that allows us to climb up and down various spatiotemporal dimensions in order to see things from different viewpoints." (2014: p.26)

1.3.1 Scale as Emergent, Relational and Performative

Gabrielle Hecht, who has written extensively on nuclear sociologies, argues that:

> Scale isn't just about size or granularity. It's also about categories: what they reveal or hide, the ways in which they do (or don't) nest. And it's about orientation: how we position ourselves, what we position ourselves against, and what comparisons such locations do (or don't) authorize… But scales do not obey fixed ontologies. Geographers argue that scale is emergent, relational, and performative. (2018b: p.110)

Archaeologist Andrew Meirion Jones also draws attention to these qualities: "Scale is a performative element in the construction of materiality… bringing into relation, disparate elements of the environment. It is the collision of these different elements that makes the apprehension of scale an emergent and performative process." (2012: p. 32) Further elaborating on scale as emergent, in describing the universal scale of the Anthropocene, Joanna Zylinska draws on Karen Barad's 'agential realism' to argue for an understanding based not on the mapping of multiple perspectives onto a pre-existing scale, but as the "agential enfolding of different scales through one another" (Barad 2007: p.245, cited in Zylinska 2014: p.33), an 'intra-activity' of scales, against a model of geometrically nested temporalities (p.33). What this means is understanding scale, like categories such as human or non-human, not as relations between pre-existing units but instead dynamic relations between shifting entities, open to transformation through one another.[22] Such analyses of scale are important in thinking a contemporary context of catastrophic climate change, where 'derangement of scale'[23] becomes the norm:

[22] In the terms of Barad's agential realist ontology, 'intra-active' rather than 'interactive', "It is through specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful…relata-within-phenomena emerge through specific intra-actions." (2007: pp.139-40)

[23] See Clark (2012), discussed further in Chapter Two.

> What is evident, is that change is happening more quickly and surprisingly across multiple dimensions and scales than we ever thought possible. This means that although modelling and metrics are important, we can no longer use the past as a reliable indicator of the future. (GAR3)

The human as marker-subject, uniform scale against which all else is read, is inadequate for thinking such planetary-level changes, where there is an asymmetric relation between the local event, its cause and effect in a non-linear turbulent system. At the same time, an understanding of scale as measure transcendent to human existence also can't capture this process of intra-action it becomes involved with. Such definitions suggest thinking the universal scale of deep time neither as a singular timeline nor an induction from present to past, but as a more complex network of temporalities, in dynamic relation with one another.

Picking up on these key points on scale as emergent, relational and performative, three initial points can be taken for my argument: Firstly, the deep timescales invoked in Hutton's or in Meillassoux's work can be understood as emergent. They are not invented and imposed upon matter, but emerge from relations between physical properties of elements and socio-technological contexts of measuring.[24] The scale includes its measurer and its objects, while, as universal, it also exceeds both. As Zylinska argues, "the notion of scale cannot be seen as an external measuring stick that can be objectively applied to time and space but is rather part of the phenomena it attempts to measure." (p.30) While the 'arche-temporality' of radioactive decay pre-exists human thought, it only becomes part of a timescale with the development of technologies that measure it alongside other scales (e.g. years). This is different from the claim that the statement 'event x happened y years before humans' only has meaning *for-humans*, named by Meillassoux 'the codicil of modernity' (2008: p.13) - where the qualifier *for-humans* denies the literal meaning of the statement through adding a correlational frame. Thinking deep time in terms of scale suggests a way to retain the statement's literal meaning (the reality of the ancestral) while examining how

[24] See Clemens, who, in his wide-ranging critique of Meillassoux, points to the reliance of the arche-fossil on modern particle physics. (2013: p.62)

it comes into contact with human perception through scale devices. The scale does not exhaust or contain the ancestral event but is a method to access it, from within it. It is not the case that 'x happened y years ago – for humans', but rather that 'the scale can be traced to x – by humans', as the scale, emerging from x, has a causal genetic relation to it, and x continues to exist whether the scaling takes place or not.

Secondly, as performative, scales have effect on thought and action in the world. Relations can be considered, for example, between thinking material timescales beyond human existence, forms and contestations of environmental action.[25] Writers such as Elizabeth de Loughrey and T. J. Demos have been critical of the 'whole Earth' visual imagery commonly used in discussions and visualisations of the Anthropocene to create a sense of planetary scale.

[25] The actions of Extinction Rebellion (XR), for example, are premised on an understanding of 'mass extinction' as a current emergency within a 540 million year framework. The Wretched of the Earth's (2019) response to XR criticises its 'futural' focus by arguing for the importance of climate justice that includes both the responsibilities of specific historical forms of capitalist violence and planetary exploitation, and environmental impact on the Global South now. Deep timescales here are invoked to drive or obfuscate action. At the same time, 'deep' scales of material complexity of inter-related human and non-human actions and processes are necessary in understanding the connections that The Wretched of The Earth draw upon in their argument.

Figure 1.2: 'Blue Marble' image of planet Earth, taken from the Apollo 17 voyage to the moon, 1972. Image from NASA.gov.

The effect of such imagery, Demos argues, is to mask the differentiated impact and responsibility for climate change through a supposedly 'generic' image, actually embedded within specific military-corporate technologies (2017: pp.18-19). De Loughrey relates this use of totalising image to colonial histories of land enclosure (2014, cited in Gabrys 2018: para. 3). Such deployments of the totalising image apply not only to representations of the planet but also of deep time as a totalising measure, viewed from a position of nowhere. I discuss this further in conceptualising the 'planetary image' in Chapter Two. Deep radiological timescales, then, will be studied here, not as neutral containers for temporal events, but as categories which have performative effect. Art is one practice that is involved in the mobilisation and contestation of such effects.

Thirdly, understanding radiological deep time as relational means thinking the billion-year timescales of Uranium-238 alongside other scales.[26] This suggests a way to avoid

[26] Uranium-238 has a half-life of 4.468 billion years.

the 'anti-political' universalising of the whole Earth image (Demos 2017: p.19), flipside of the marker-subject imaginary. Using images to think at a planetary scale may be problematic but can also be useful in, for example, re-positioning scales of political action. Where this potentially has greater impact is when such scales are thought alongside and connecting to others – local, national, universal – rather than as definitive objective measures.[27] In this section, I want to think how the arche-scale interacts with others, and what kinds of effects this has.[28] In order to do this, I will first of all now focus in more detail on experiments taking place at the HADES laboratory, understanding these as methods for projecting deep time futures. This leads me to a definition of radiological deep time as a universal-scale temporality enfolding through other scales. I take this relation of 'enfolding' from Barad's ontology, where matter in process is enfolded into ongoing differential materialization. This suggests a definition of deep time not as external marking parameter but produced through its relations with other phenomena:

> Iterative intra-actions are the dynamics through which temporality and spatiality are produced and iteratively reconfigured in the materialization of phenomenon and the (re)making of material discursive boundaries and their constitutive exclusions…
>
> …It doesn't make sense to construe time as a succession of evenly spaced moments or as an external parameter that tracks the motion of matter in some pre-existing space. Intra-actions are temporal not in the sense that the value of particular properties change in time; rather, which property comes to matter is re(con)figured in the very making/marking of time. (2007: pp.179-180)

[27] See, for example, Srnicek and Williams' (2015: pp.5-25) critique of the localism of left activism as 'folk politics', unable to be scaled up in such a way that it can effect structures of power. What is lacking, they argue, are means of connecting the force of such local actions with the complex non-linear abstractions of contemporary power.

[28] On a practical level, this is one way to understand events such as the 'Stakeholders Roundtable' at Modern (2020) where local, national and global politics of radioactive waste futures are discussed alongside deep timescales that emerge from the materials at stake.

Drawing on this ontology of 'agential realism' to think deep time informs a situation where the question is not only how do humans think extinction, but also how are they shaped and transformed by it. It rethinks the marker-subject
not as bounded universalized individual but as entangled within other emerging processes. Entanglement here, following Barad, entails thinking phenomena in an active process of change in relation to one another. It also implies ethical questions on what comes to matter through scale, and what doesn't. This informs my approach in this study to thinking an aesthetics from within radiological deep time. Firstly, I now go on to focus on how this temporality emerges from experiments at the HADES underground laboratory.

1.3.2. Speculating on Deep Futures: Models, Predictions and Hypotheses

The scales of extinction discussed in the previous section emerge from the deep geological repository's relations with Uranium half-lives. Through its materiality the site becomes entangled with the universe. In this section I focus on how these extinction scales enfold through others. Deep future timescales are projected, for example, through computer modelling. The PRACLAY heater experiment at HADES in Belgium works with a 30m section of earth to simulate the impact of storing heat-emitting radioactive waste. Effects are studied and extended to model effects over "several hundred to several thousand years" (Van Geet & Depaus 2016: p.20). Migration experiments study how different types of radionuclides in the waste move through clay at differing diffusion speeds. Some are strongly absorbed by clay minerals, so on a scale of several hundred thousands of years will stay within a zone of a couple of metres, while others move at far faster speeds. The aim is to map how these diffusion speeds relate to scales of damage and danger to humans and the environment, and how they can be slowed down through storage. Such experiments are premised on the stability of Boom clay, (Van Geet & Depaus 2016: p.19), but must adapt to constantly shifting data such as climate change effecting future ice ages. In order to model these long-term futures, it has to operate at multiple scales at once, predicting events which could happen in days or years, and so changing the material make-up of the clay in millions of years. This method of future speculation assumes the ability to predict future events

from past experience to a certain extent. It quantifies and contains risk in a way where some risks come to matter more than others.[29] It is key then in an imaginary sealing of the marker-subject from risk of its dissolution. At the same time, however, as these futures become increasingly long-term, more contingencies are introduced, making conditions for prediction more complex, increasing factors of uncertainty and unknowability.[30] Radiological deep time in this sense, can be understood not only in terms of thought's leap to imagined billion of year futures through dia-chronic statements, but also as this shifting interplay of contingencies, where predictive technologies and probability modelling are disrupted, becoming increasingly 'partial' models of complex systems. Deep time multiplies the uncertain and unknown through unforeseeable feedback loops, disrupting technologies and decisions in the present. In predicting deep time futures, such computational and statistical models overlap with other scales, emerging from methods and objects of prediction. Shifts in governmental policy, for example, change the models, so the timescale of local and national government elections interacts with the material timescale of the radionuclide diffusion. While future modelling experiments operate on scales of hundreds of thousands or millions of years, radioactive waste storage projects have also highlighted the importance of thinking, simultaneously, in terms of how this is broken down into local generational scales. In the Belgian context, for example, this is highlighted through the societal dialogue, evidenced in consultation with community groups MONA (Mols Overleg Nucleair Afval, *Nuclear Waste Consultation Mol*) and STORA (Studie- en Overleggroip Radioactief Afval in Dessel, *Study and Consultation Group on Radioactive Waste Dessel*). As well as working with local communities who will live with the legacy of building projects in the near future, this also involves passing on technical skills and transferring knowledge of the sites to future generations. Radiological deep time

[29] In describing reactionary 'firmative' speculation (against the more radical 'affirmative' speculation), Uncertain Commons (2013) describe a kind of drawing the future into the present that exploits and forecloses the potentials of the future, through calculation, socialisation and globalising totalising models. They give an example of Fukushima risk modelling, where they argue that tsunami risks were downplayed, prioritising profit over safety (p.22). In this case, risks are based on inclusions and exclusions, prioritising the imagined future marker subject over others implicated in toxic risks, for example.

[30] As discussed by Maarten Van Geet. (Z33 2018)

emerges from such relations, but understood as intra-active, such positions and localities must also be subject to change in relation to planetary scales.[31]

Many other factors also impact upon long-term models. These are examined primarily through the lens of safety, using risk assessment procedures to speculate on ways that storage sites could be interfered with, leading to damaging leakage of radionuclides. This involves, for example, the modelling of disruptive climactic changes (Mobbs 2014), as well as speculating on the impact of potential future human interference, such as future drilling of boreholes. (Sillen, Marivoet & Zuchetti 2001). Such speculations are deployed as management and containment of risk. What I would like to argue here, however, is that such future-predictions, as methods for mapping dynamic interrelations between scales of radiological deep time, through building collective fictions, can also take on more critical roles in challenging the marker-subject and developing experimental methods for attuning to deep time.[32] Such speculations include not only imagining and designing for what might happen if sites were disturbed, but also *why* sites would be disturbed – how might future societies evolve in such a way that future people would want to interfere with the storage sites? This kind of deep future scenario planning based on a logic of anticipating interruption to computational models has been used within nuclear waste storage since an American project in 1991, documented in the Sandia Report (Hora, Winterfled & Trauth 1991). This interdisciplinary project assembled groups of experts from a range of fields, including geology, environmental sciences, statistics, sociology, futurology and Hollywood scriptwriting. Together they devised scenario plans on how human societies may evolve over the next 10,000 years, in such ways that they would disturb the still dangerous radioactive waste at the WIPP (Waste Isolation Pilot Plant) in New Mexico, USA:

> We have asked, 'What social conditions and individual or group motivations might result in penetration into the WIPP repository--however outlandish,

[31] While the marker-subject is too 'universalised', it is also too 'localised', restricted to the waste burial site locality, rather than understanding the eruption and transformation of multiple localities through the distributed toxicity of the waste. I discus this further in Chapter Two.

[32] I discuss this relation of 'attuning' in Chapter Two.

> irrational, deviant, perverse, or even repugnant they may be to us personally…Let all things be considered so that the marker teams can comprehensively devise ways of marking or creating passive barriers that reduce the probabilities of all imaginable penetrations becoming future reality. Thinking the unthinkable is part of our task... The scenarios, however, may be less unthinkable than they first appear. Each is based on developments for which precursors already exist, from feminist theory and post-/(and anti-) positivist beliefs to rudimentary artificial intelligence, computer viruses and space travel. (Hora, Winterfeld & Trauth 1991: Appendix C, p.38).

Through such anticipatory staging of the 'non-computable', these 'human interference scenarios' focused not only on how to mitigate the impact of disruptions, but also provided detailed propositions of how human society may change to motivate specific intruders. While at times seeming absurd, they have material effects. This is both because repository designs adapt *as if* they have happened, and also through their performative force in collective reshaping of future imaginaries, directing and contesting how futures shape the present. Deep time unfolds in pre-emptive anticipation of scripted invasive scenarios. As new scenarios emerge from continued changes and threats, so future designs adapt again, and so on. The Sandia Report include scripted situations, where social changes lead to, for example, anti-science feminists, Mexican bandits or out-of-control robots invading the site based on specific beliefs. Such personifications of 'otherness' through radically irrational feminism, non-human agencies and invaders from other countries clearly reflect the fears of a specific post-Cold War masculinist claimed-as-universal rationality - the 'deviant, perverse' threat to fantasies of the marker-subject and a non-porous separation of dead matter and human life, oppositions I return to at the end of this thesis. The projected deep future timescales are embedded within histories and ideologies of their time,[33] opening questions of continued importance – Who's imaginary? Who and what does it include and exclude?

[33] "The future is not a natural dimension of the mind. It is a modality of projection and imagination, a feature of expectation and attention, and its modalities change with the changing of cultures" (Berardi 2011: p.7-8, cited in Srnicek 2011: p.6).

While being critical of this discourse in its production of otherness to shape specific future subjectivity, as well as its focus on apocalyptic futures against everyday reality of nuclear toxicity, I am at the same time interested in it here as method for deploying fictions as knowledge of radiological deep time. Such deep time scenario plans draw on available computational data and modelling projections of the time to make more speculative abductive leaps into hypothetical futures.[34] From within a fabric of intra-relating phenomena, they draw connective lines, or diagrams, between phenomena, making hypothetical connections as partial models of radiological deep time from within. This is not proposed as a universal scale or image, but through its use of the temporary 'scenario', it is a model open to future collective revision, potential method for performing and re-questioning knowledge of radiological deep time in its complexity, through a collective imagining of intersections of multiple scales. These future scenario plans, can be seen, in other words, as an exploration of human and non-human entanglements at scales beyond human existence, conditioned by the half-life durations of nuclear materials. By asking questions such as how potash mining practices, testosterone, interpretative bias, radionuclides and granite could interact over millions of years, the work anticipates more recent new materialist explorations of human and non-human ecologies such as Jane Bennett's argument for expanding the matters of concern of democracy beyond solely human actors (Bennett 2010: p.108).

Following my analysis in this section, scales of radiological deep time are understood as embedded within social structures and ideological power relations, *as well as* the non-human horizons of the arche-, so must be analysed as both, affecting and affected by them. Speculations on nuclear waste futures show how its cultural, performative,

[34] Abductive reasoning, from C. S. Peirce (1998) is the process of using available data to form the most likely explanatory hypothesis, "a method of forming a general prediction without any positive assurance that it will succeed" (Wouters 1998: p.121). It has been analysed as a rational process "inextricably bound up with creativity" (Wouters 1998: p.130). This is taken further by Burrows and O'Sullivan, arguing that abduction "involves an experimental attitude, a pragmatic modelling of different realities which proceeds through imagining and imaging, performing and making, alongside more abstract reasoning" (2019: 349). It is important here as technique for a hypothetical leap to deep time futures from within its phenomenal relations, where hypothetical futures don't simply repeat the present. Indeed this draws on the legacy of James Hutton, who, as Gould argues (2001: pp.72-75), against a reputation for empirical inductions, made speculative abductive leaps in his 'discoveries' of geological deep time.

chemical and geological aspects are mixed up, intra-acting in dynamic relation,[35] open to unknown futures, demanding speculative methods. The Records, Knowledge and Memory (RK&M) project to mark nuclear waste sites has developed its formats, imaginary and cultural lure from the proposals of monolithic monuments to danger I was critical of at the start of this chapter. Instead, however, it can be reconsidered as drawing on this relatively forgotten history of multiple contradictory and contested future projections. While the Sandia Report scenarios can be seen as instrumental in producing the reactionary marker-subject, they also suggest directions for its rethinking. Opening the RK&M project to its entanglements with radiological deep time as I have outlined it in this chapter, suggests a context for its challenging and re-imagining through art practice. It is here that potentially fictions, projections, models and myths of deep futures are focalised and brought into question. I go on to discuss this in the concluding section of this chapter.

[35] As Parikka has argued for a geology of media, it is an "investigation of the mineral and substrate materialities *as well as* the materialities of production, management of global labour processes, and various other materialities that are always entangled" (2014: p.11).

1.4. Conclusion: Rethinking the RK&M Marker

In this chapter, I have been guided by the question of conceptualising radiological deep time in order to challenge the imaginary of the marker-subject. Starting from the address to a future 'you' in the film *Into Eternity*, I was interested in the contradiction between understanding this as directed to a specific human figure or to the human species more generally. From this I proposed that focusing on the immense material magnitude of Uranium half-lives embedded with deep geological repository research opens up questions beyond an anthropocentric focus on future generations of people. Developing this through concepts taken from Meillassoux and Brassier's realist philosophies, I argued that the repository sites are bound up with a thinking of extinction that brings into question definitions of humanity and its relation to its environment. Thinking this through the materiality of the site suggests an environmental problem rather than only a philosophical one, where long-duration materials leave a toxic planetary trail. From this, extending Enlightenment geological tradition, I proposed the concept of a radiological deep time continuum that, as well as stretching back into long-term pasts, also extends into long-term futures, feeding back to disrupt relations between thought and experience now. Against focusing only on thought's leap to an arche- realm separate from the phenomenological, I proposed understanding the universality of deep time enfolding through multiple intra-active scales, including phenomena of sense and experience. These emerge from materials and methods, including modelling and speculative performative fiction, connecting thoughts of post-planetary extinction, geological simulation, and performances of human and non-human interactions.

To finish this chapter, and lead into the rest of the study, I will return briefly to the project I mentioned at the start, that established at the intergovernmental level of the Nuclear Energy Association (NEA), on the Preservation of Records, Knowledge and Long Term Memory across Generations (RK&M). As I have shown, this international project aims to address the question of how to 'mark' radioactive waste repository sites for the future. Developing from the focus of 1990s discussions on marking sites for safety

purposes, the project extends the dialogue to include how knowledge of nuclear waste sites can be recorded and passed on to future generations of people.[36] What I have proposed here is that, beyond solely questions of safety or communication, this project actually becomes an focal point within these multiple scales of ungrounding and dynamically intra-active radiological deep time. By connecting the ungrounding ground of its local site to the universal scale of deep time it becomes a potential laboratory for rethinking categories of the human, and knowledge of the world as human and non-human.

While the project involves dialogue with local communities and other 'stakeholders',[37] it also entails an engagement with long-term timescales of radioactive harm and planetary exhaustion, designing for long-term futures with "no oversight" (Verdun 2014: p.83). The concept of a marker for future, drawing on my argument so far, involves considering the importance of the cultural, political and economic context of radioactive waste storage, alongside the scientific measuring of long-term futures. Indeed, the project is bound up with thoughts of how these contexts (the marker as object for the natural sciences, and as ritualistic cultural object) infect and disrupt one another, and how its knowledges are renewed in uncertain futures. Since its emergence, it has adopted an interdisciplinary approach, involving, for example, material scientists, architects, environmental designers, anthropologists, linguists, archaeologists, astronomers and geomorphologists (Bryan-Wilson 2013), and this multiplicity of approach has been highlighted as a methodological necessity, "there is no single mechanism or technique that, by itself, would achieve the preservation of RK&M over centuries and millennia. Rather, an integrated set of mechanisms and techniques – technical, administrative and societal – is needed to address the various timescales and to support one another" (Verdun 2014: p.9). The project of marking deep geological repository sites involves, among other factors and scales: forms of intergenerational communication; future-oriented semiotics; current human labour, research, expertise

[36] See, for example, events such as *Assembling Nuclear Heritage*, Kingston University (2019), and *Nuclear Art and Archives*, Dundee Contemporary Arts (2017), which focus on roles of collecting, curating and museums in the transmission of knowledge in this context.
[37] The approach to who constitutes this body is varied and contested within different countries, see Meyermans 2019.

and discussion; speculations on 100-year, 1000-year and 100,000 year futures; technological dating of 4.5 billion half-life; stochastic decay processes of Uranium; mineral ray absorption and the diffusion of nuclides through clay; speculative design, ritual and folklore. On one hand, it ungrounds and dismantles the marker-subject. On the other hand, against the 'derangement of scale' of the Anthropocene it offers potential as focal point for navigation from within these overwhelmingly disparate threads.[38]

Through its strange and specific temporality, the RK&M context can be drawn upon as a key site for addressing critical questions of anthropogenic knowledge in ways that go beyond purely a focus on nuclear waste. Through its questioning of future knowledge and memory at long-term scales, it performs the kind of conceptualising of the human and non-human world that Thacker proposes. It does this however, not as philosophy but on a plane where philosophical thought is opened up alongside other non-philosophical approaches, made urgent through environmental crisis. These include the material decay of objects over deep timescales, scales of harm, the performative enactment of future fantasy, community participation, probabilistic decay rates and myth. This is not only a question of producing, transmitting or preserving knowledge, but also of questioning and critically reshaping what knowledge or agency could be in this specific context. To do this however, the concept of the marker must be challenged and re-thought more speculatively. It must be imagined not as some kind of external message passed on to future people, but through its immanence to radiological deep time, part of the ungrounding force of extinction, hypothetical leaps into the unknown and a multiplicity of scales emerging and disrupting such localities as the human and the site. Bryan-Wilson (2013) is critical of the lack of engagement of the marker project with the visual analysis of art history and the critical perspective of contemporary art. Following this, I propose that an engagement with radiological deep time through art practice can rethink the marker and address these questions. At the same time,

[38] It is such critical questioning of the 'marker' in this context, that I aim to explore through my practical workshops (Documentation of Practice: Sections 1, 3, 11, 13), which function as sites for this discussion as well as the production of objects. In this way, my ideas of challenging the 'marker' have developed through these workshops alongside this theoretical writing.

however, within a context where art is immanent to what it seeks to represent, or as Brassier has discussed, “thought is embedded in the reality which it seeks to know.” (2014: p.77), this must also at the same time become a questioning of its own conditions, of visual analysis and critical perspective itself. These thoughts lay the foundations for the chapters to follow where I draw on this context to focus on potentials and problems for art in claims to ‘represent’ radiological deep time, discussing first of all the aesthetic relation of attunement.

CHAPTER TWO: Attuning to the Hyperobject: Half-Life Art Practices and the Problem of the Deep Time Sublime

2 1 Introduction

2 2 Radiological Deep Time as Hyperobject

2 2 1 Aesthetics and The Derangement of Individual Experience

2 2 2 The Planetary Image and Reduction to Data

2 2 3 Art Practice as Attunement to the Hyperobject

2 3 The Anthropogenic Deep Time Sublime

2 3 1 Half life aesthetics

2 3 2 Stunning Images of Deep Time

2 3 3 Kantian Sublime as Limit Concept

2 3 4 Undoing the Compensation of Reason

2 4 Conclusion – Art against the Sublime

2.1. Introduction

The previous chapter focused on developing an ontology of radiological deep time to challenge the marker-subject. I argued that this can be understood through the universal materiality of toxic half-lives as they enfold through multiple intra-acting scales. I shift focus in this chapter to the question of how such a temporality could be known. This is an inherently political question as I have argued that nuclear timescales are embedded within asymmetric networks of planetary resources, power, vulnerability and harm. Aesthetics here, I will argue, has potential to connect scales of experience, extinction and toxicity from within deep time. This acts against obscuring power interests in deferring deep time as other and alien to human politics and climate emergencies now. The deep geological repository imaginary, discussed in the last chapter, produces a specific subjectivity, separated from and transcendent to its toxic materials. Thinking according to the 'hyperobject', on the other hand, continues to rethink the subject of radiological deep time embedded within and emerging from a complex more-than-human scale.

This chapter is structured in two main parts. The first part draws on philosopher Timothy Morton's concept of the 'hyperobject' as a way to understand radiological deep time as a very large finitude, which can't be sensed or comprehended through individual experience. This is important for my argument as it suggests a way to understand representation, data, art, viewers and materials as all immanent to this object. There is no outside, in other words, and no binary opposition between humans and deep time, opening the question of how to comprehend it from within. Thinking according to the hyperobject becomes a way to challenge narratives of control and mastery of deep time, connecting the materiality of radioactive waste to its uncertain and extended toxic legacies. Individual sense data is inadequate to map the hyperobject as it cannot be universalized across a highly complex non-linear system, where causes produce effects at unexpected scales. At the same time, it cannot be captured through technological images at planetary scale, which occlude localized differentiated experience, by presenting a 'planetary image', separated from its object. As data is

returned to the senses as image, deep time data visualisations are bound up with ideological interest and histories of totalizing colonial technologies, masked through neutral and objective styles. I focus here on the diagramming of a tendency toward invisibility and stability from data in my research at HADES. Deep time futures are here staged as 'saved' for-humans, obscuring environmental problems. I am critical of how art has been deployed within this register by the nuclear industry as transparent communication of this move toward invisibility. Against this, I draw on Morton's theory of 'attunement' to the hyperobject to start building an alternative aesthetic structure. This suggest operating within the hyperobject, modelling its form, connecting cognition and sensation in the present with the universal scales of its materials. It forms the basis of what I go on to develop in my final chapter as interscalar methods of sampling.

The second part of the chapter focuses on the sublime as a problematic structure for understanding this subject / hyperobject relation. I draw on a history of 'stunning images' of geological deep time, alongside contemporary artworks that index radiological deep time scales through data. A common response to emerge in such representations of the long-term durations of deep time is a sense of awe and wonder at its overwhelming immensity. It evokes specific affects, in other words, through disrupting relations between faculties of imagination and reason, evoking Kant's analysis in *Critique of Judgment*. From this. I propose the aesthetic structure of 'the Anthropogenic deep time sublime'. This is proposed as drawing on a Kantian structure, while establishing a new paradigm where, within a context of human-induced climate change, reason intensifies rather than compensates for the horror of imaginative limit. It is problematic, I argue, as it limits understanding of the human / deep time relationship through re-imposing the subject as limit point. This is inadequate, not only in in the withdrawal from action its affect of hopelessness invokes, but also in its limiting of the role of art and aesthetics in extending or rethinking knowledge through interfacing deep time. I finish the chapter by focusing on points where the artworks escape this sublime structure, suggesting directions which I pick up and develop in the final chapter.

2.2. Radiological Deep Time as Hyperobject

2.2.1. Aesthetics and The Derangement of Individual Experience

I described in Chapter One how radiological deep time can be analysed as a complex entity, unfolding at multiple scales, including and beyond its experience in the present. In this sense, it can be understood more generally in terms of what the philosopher Timothy Morton has defined as the 'hyperobject'. Morton describes the hyperobject as a specific kind of entity "massively distributed in time and space" (2013b: p.39). He gives examples such as, "global warming, nuclear radiation, tectonic plates, biosphere [and] evolution" (p.39), emphasising their emergence from existing ecological conditions, "the object that is already there" (p.45). Morton uses the term to attempt to define "profoundly different temporalities than the human-scale ones we are used to" (p.45). He has discussed the hyperobject named Hiroshima, for example, as:

> An event that continues to play out, because radiation lasts and lasts. And it plays out not simply in the place called Hiroshima, and not simply in the physical distribution of radioactive particles, and the psychic distribution of fear, but also the experience of the stigmatised *Hibakusha*, in dissemination of world media. (2016: p.169)

Focusing on the dispersed toxic materiality of radiation, in other words, reveals limitations in locating it within a specific geographical site alone, or within analysis limited to only quantitative Sieverts or affects of fear, but instead in their complex inter-relation.[39] Radiological deep time, as I have defined it so far, can be understood as a

[39] In relation to my practice, in other words, the 'marker' is inadequate as confined to one site, leading to my development of 'distributed' markers as discussed in Documentation of Practice: Section 10 and informing development of the HADES Commission at multiple sites (section 14). This aims to make relations between the repository site and 'local eruptions' in other parts of the world a formal quality of the work itself, attuning to the hyperobject of deep time. It challenges a use of the marker to illustrate the gradually 'making safe' of the site that I go on to discuss in this Chapter.

temporally figured hyperobject. Through its immense scale or complexity, Morton argues, the hyperobject cannot be seen or sensed in its entirety by an individual human subject defined separately to it. Instead, humans are immanent to hyperobjects, they "end the possibility of transcendental leaps outside physical reality" (2013a: p.76), allowing for no metalanguage. He describes this immanence as the object's quality of 'viscosity' – we can have no critical distance from the hyperobject as we are always immersed within its range. (2013b: p.39) The hyperobject cannot be exhausted by perception, and the more we struggle to distance ourselves from it, the more 'stuck' we become. Morton evokes a context where, as discussed in the previous chapter as an effect of the deep geological repository, distinctions between a human subject in the foreground against a background of 'nature' are eroded, "we find ourselves inside them, part of them yet not part of them" (p.39). Thinking according to the hyperobject removes the foundations of the marker-subject.

This opens an epistemological question, if we cannot stand outside of it, then how could we gain knowledge of the hyperobject from within? Morton's analysis suggests that we can use a variety of methods for this. He describes, for example, a framework of punctual local events within a larger object, discussing feeling rain as a "less real" local manifestation of climate change (p.41). What is lacking in this example, however, is a navigational process to model real climate change through connecting this local sensation to a 'more real' global mesh of human and non-human entities. We could feel rain every day, in other words, without ever gaining knowledge of climate change as hyperobject. There is an asymmetric relation between the local event, its cause and effect in a non-linear turbulent system, where a system that produces emergent effects can't be reduced to individual components.[40]

Consider local eruptions of radiological deep time effects. Nuclear waste prepared for long-term storage at European repository sites contains uranium-238, traced to the

[40] The GAR Report (2019: p.7), for example, describes the complex correlation and feedback loops in assessing risk on a planetary scale. Srnicek (2012: p.2) discusses the neoliberal economy as system, which in its unboundedness from local co-ordinates, and its far-from-equilibrium non-linearity extends beyond finite human comprehension. For more details on dynamics of complex systems see Bar-Yam (2019).

formation of the Earth's crust 4.54 billion years ag. Uranium is mined and imported from elsewhere. Ore deposits are common, for example, in the precambrian quartz-pebble composite in the Krugersdorp region of South Africa, where they were mined since the 1960s by the AngloGold corporation, now part of the AngloGold Ashanti company. Today, while mine ownership is taken up by the CNUC (China National Uranium Corporation) and collaborations with Russian groups, sites in Krugersdorp lie abandoned. Settlements are exposed to high levels of radioactivity through leftover toxic tailings of uranium sand.[41] With lack of funding and regulation, these are dispersed by wind, plants and burrowing animals such as the aardvark, causing erosion and decanting into the water table. In 2016, members of the Tudor Shaft settlement at Mogale City, Krugersdorp, protested against their relocation due to the toxicity remaining in the local area, which will outlast their own lives:

Figure 2.1: Protests against relocation of the Tudor settlement from toxic Uranium mine shaft dump, Mogale City, Krugersdorp, South Africa, 2016, image https://krugersdorpnews.co.za/312897/those-houses-are-meant-for-us/

[41] See Hecht (2018).

In Krugersdorp, within the radiological deep time hyperobject, inconceivably vast times of toxicity appear with little visible cause. This reflects the "breakdown of co-ordinations" Tsing et al. describe in the merging of forms of space and time of the Anthropocene (2017: intro, np), or the 'derangement of scale' used by Tim Clark (2012) to describe a disrupted link between individual consumer choice and environmental change. Whether consuming in the Global North or confronted by its waste and effects in the Global South, this derangement and dislocation is a real experience, reflecting scale-shifting fictions:

> Something vast, inconceivably huge was moving up ahead of me… He turned and his turning was like some geological event, the erosion of a mountain range or the undulation of mohorvic discontinuity itself. (Self 1995: p.32)

Deep time as hyperobject removes individual human action or experience as imagined uniform scalar measure. Unlike Will Self's 1990s short story Scale, quoted above, however, this is no longer a morphine- induced aberration from the norm, but instead normalised as default state through erratic accelerated climate change, "surprise is the new normal" as the 2019 UN Report on Disaster Risk puts it (GAR 2019: p.4). This has consequences for knowledge within the radiological deep time hyperobject, and also for ethics. It is in the interest of the nuclear power industry, for example, to emphasise containment and safety. This is aided through a sense of disorientation, making no clear connections between the actions in Mogale City and the waste produced elsewhere. Such 'cutting off' of distantly connected effects operates through positing deep time as a distant and deferred otherness, opaque and separated from its everyday impacts in multiple localities. 'Local' here comes to be confined to some sites while excluding others, funding and consulting with villagers near to planned repositories, for example, while discounting eruptions in other localities through the non-linear feedback loops of deep time. Tracing and tracking intra-active entanglements immanent to the hyperobject becomes then an ethical as much as epistemological task, against management of narrow definitions of toxicity.

It is here that I turn to aesthetics, not as philosophical theory imposed upon art, but as a way of thinking the hyperobject from within. This draws partly on Fredric Jameson's

(1990) definitions of aesthetics as mode of mapping relations between individual subjects and the global structures they inhabit. Jameson's argument is developed by political theorist Nick Srnicek in proposing an 'aesthetics of the interface' I discuss later in this chapter.[42] Such tracing and tracking within the hyperobject, in other words, acts as a mode of orientation within a complex non-empirical system. At the same time, however, such definitions of aesthetics must be expanded in relation to the intra-active relationality I outlined in the previous chapter, and the situation discussed above. Such an understanding draws on *aesthesis* as sensing not restricted to humans. It also encompasses shifts in the sensorium relating to technological and ecological changes. Some definitions of the Anthropocene, for example, have focused on it as an aesthetic event, where sense and perceptual systems become refashioned at accelerated and disorientating rates, described in terms of both oppression and potential.[43] Aesthetics, in this context, can be understood as relations of perception and sensation within the hyperobject, both as cognitive navigation, and as reshaping in relation to other phenomena, both orienting and disorienting. Mackay, Pendrell and Trafford have argued for a 'speculative aesthetics' describing not the mannered look of 'an aesthetic' but rather "the structure of the aesthetic component of experience. When the latter is regarded as plastic rather than transcendentally immutable" (2014: p.3). This is based on belief "that cognition grasps a real not of its own making, and that its capacities may be reshaped as a function of that real" (p.4).[44] I follow this general understanding of aesthetics as structuring and reshaping experience from within the real of radiological deep time. Here then, aesthetics is key in the politics of scale I have discussed. I have

[42] Jameson's discussions of disorientation within the mutations of postmodern hyperspace are given a temporal twist in thinking deep time. Elevator transit deep into the geological repository comes to replace his allegorical focus on the Bonaventure hotel elevators (1991: p.36), surrounded now, not by artificial lakes and cocktail lounges but by toxic waste that will outlive the system that generated it.

[43] As Raqs Media Collective have argued, for example, "without a recalibration of the senses, at the level of our global species-being ... we cannot conceive of another mode of production, another set of social relations, another ethic." (Davis & Turpin 2015: p.8). See also O'Sullivan (2012: p.4) on aesthetics, following Spinoza, as not only the naming of forms of experience, but also will to experiment and go beyond those forms.

[44] They propose that such aesthetics can potentially "interrogate the conceptual underpinnings of representation, and can furnish materials for an understanding of how experience is structured by various material regimes…understanding the structuring of the aesthetic as act of political force, and its relations to subjectivation" (2014: p.4).

discussed the aesthetic construction of the marker subject. I now move on to discuss its mirroring in the 'planetary image'.

2.2.2. The Planetary Image and Reduction to Data

One way to extend knowledge of the massively distributed hyperobject, is through measurement devices which go beyond sensible intuition before returning information to senses as data. The hyperobject as 'very large finitude' suggests, on one hand, its scale (difficult to conceptualise), but also the other hand, its measurable material reality (as opposed to infinity). Considering the deep geological repository, the immense scales at stake invoke thought of human extinction, but specific radioactive isotopes can be measured, based on the probability of decay over time. This adds further complexity to Morton's proposals. This is a time, which is difficult for humans to imagine, but which can be sensed through the use of technological devices. This leads to a doubleness in defining the hyperobject, as it can "be thought and computed but not directly touched or seen" (2013b: p.37). While it remains too massively distributed to sense directly, it is at the same time, still measurable and computable, suggesting the need for technological augmentation beyond the immediately sensible. In the case of radiological deep time, deploying techniques such as probability modelling and measuring ionizing emission allow its conceptualisation as complex abstraction.

Such measurement through technical devices invokes a specific knowledge register for the hyperobject, that of its reduction through computation to data. This is evident in many forms, for example, in the HADES laboratory, where the deep time scales involved in radioactive half-life are presented as data visualizations:

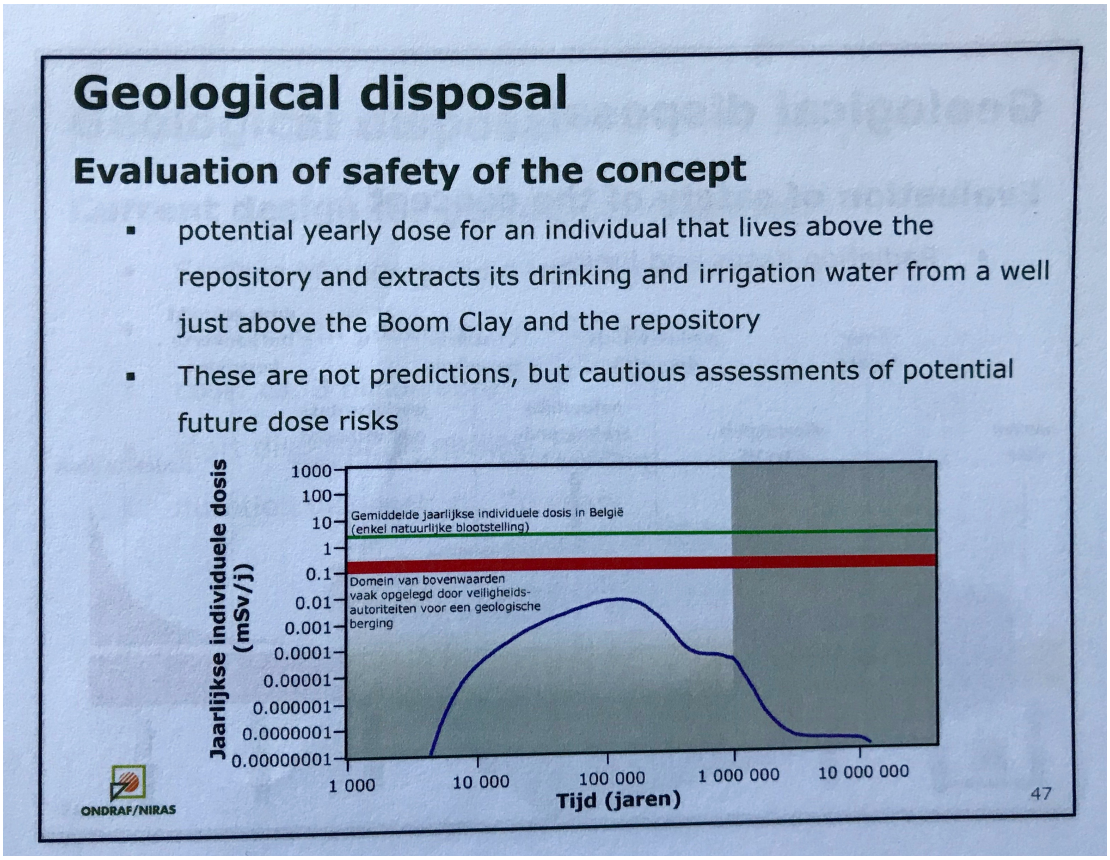


Figure 2.2: Assessments of future dose risks. Example of a representation of deep radiological timescales through the graph, from presentation at HADES. The graph highlights a gradual slope towards zero dose, constructing a visual narrative of future safety. Image: Van Geet & Depaus 2016: p.24.

I argued that the act of feeling rain is inadequate to understanding the hyperobject through its reduction to non-universalisable localised experience. This data register, on the other hand, opens further problems. Considering the performative effect of its deployment of scale, it is always ideological, in that it excludes as much as it shows. This focus on managing a gradually 'fading away' toxicity, for example, is staged through the visual narrative of a series of graphs approaching a 'safe' level of 0. This draws on the authoritative visual language of the data visualisation to model 'the future', which is always a specific image of deep time. What is missed by such imagery includes a more dispersed and unequal vulnerability to toxicity, or the shifting of the straight red line of 'local dose risk'. This would include, for example, the local actions of the people at the Tudor settlement now, and less predictable factors in future predictions over ten million years into the future. Certain scales of material, experience and action, in other words, are excluded from a carefully controlled narrative of what constitutes

radiological deep time or not, through the graphic discourse, presenting an oversimplified version of cause and effect for a non-linear environment.

It is then particularly interesting to analyse how art can become instrumentalised within radioactive waste management as transparent 'communication' of such industry-produced data. The work by William Verstraeten for the Habog interim high-level waste storage site at COVRA, the Netherlands' nuclear waste management agency, is a good example of this. The work consists of painting the building orange, while over a period of a hundred years (where the waste will be held before entering deep storage), it is gradually re-painted in lighter and lighter tones until no paint is visible at all.

Figure 2.3: Habog interim high-level waste storage site, COVRA, The Netherlands, image: https://www.covra.nl

This visual analogue of the graph approaching zero is bound up with the same discourse of invisibility, part of COVRA's controlled narrative of safety, harm and decay, through its tending toward disappearance. The focus on the hundred-year scale excludes the longer-term harm of millions of years of toxicity, when the waste is moved from its interim storage to underground containment, remaining part of the environment, simply out of view. An image of 'nature' here is deployed as part of this trope of invisibility, with paintings inside the building proposed as representing the 'natural' landscapes that will remain when the waste is made safe and disappeared (WNN 2008). Rather than as hyperobject including the painting, site, waste and broader ecologies, nature is imagined as something ideal and separate to humanity, the zero on the graph

to which its lines always return.[45] Further, in literally storing artworks on site, while claiming that radioactive waste storage is no different to other forms of storage such as the storing of paintings in warehouses (Verhoef 2019), the COVRA deep time narrative misses anything about the materiality of its objects (waste, paintings) as themselves real natural objects embedded within networks of toxicity.

While 'feeling rain' remains stranded in local experience, technological claims to universal modelling are its myopic flipside, missing out this experience completely, proposing a view from outside of planetary scale. This 'planetary image' is problematic in its totalising view from nowhere, its imaging of nature as idealised and separate, and its obscuring of the power interests in its image-making. I understand it here as part of the marker-subject / planetary image dyad, restricting thought of radiological deep time. This claim to total view has been much criticised. Jennifer Gabrys, for example is critical of the planetary as "figure of massiveness…its invocation suggests total dominion, the rolling out of behemoth systems that hold the planet and all of its entities in a space of complete capture" (2018: para 3).[46] This is true not only of the 'Whole Earth' images she discusses but also these totalising data visuals toward extinction or salvation. As the graphs and artwork show, the data register is not encountered as an unfiltered mass but as an already interpreted and visualized image presented in an objective-looking form. As T.J. Demos has argued in his writing 'against the Anthropocene', such visualizations can serve to seduce while masking the political interests behind the technologies of representation being deployed as truthful images (2017: pp.18-19). This is clear in this context, where there are interests in selecting specific data as management of deep time futures of care and harm, and where art is harnessed and deployed as explanation, visitor attraction and cultural capital. Taking this analysis further, the data register can be understood as part of what James Bridle has called 'computational thinking', where computation becomes culture, replacing conscious thought (2018: loc 586). Computation diminishes understanding, Bridle

[45] The association of the deep geological repository site with an idealised natural environment is common throughout promotional materials. The Horonobe underground laboratory in Japan, for example, is marketed through the image of the reindeer.
[46] As mentioned in Chapter One, Gabrys here draws on Deloughry's (2014: p.261) critiques of the totalising image as embedded within colonial visual rhetoric. Gabrys proposes a different view 'from below' through the forest itself.

argues, as it renders us unable to think the world in a non-computational way, inciting conspiracy theories and fake news in its gaps (loc. 174). What is excluded from data visualisations, according to this argument, becomes not only bracketed off, but actually unthinkable, leading to the need for new methods to think beyond it. A final point to make here is that the production of data doesn't just represent nuclear timescales, climate and environmental changes, but is actively part of them, generating the waste it models. Global data centres consumed more power than the UK in 2015, for example, (loc 924) and this includes energy generated by nuclear power (Cook & Van Horn 2011: p.21). Thinking according to the hyperobject becomes a way to think this immanence to the ecological environment of the data itself in its materiality. To do this, the graphs must be 'fictionalised' in the sense of re-imagined not as totalising but as partial models of radiological deep time, alongside other performances of data such as the Tudor Shaft protests, stripped of claims to transcendent representation.[47]

While individual experience is inadequate for knowledge within the hyperobject, then, so is transforming it to a planetary-scale image through data. Here, another form of reductionism is applied, not accounting for the complexity of the object across multiple scales and entanglements. Data excludes as much as it includes in order to stage and control an image of radiological deep time, obscuring the specific power interests of image technologies, and representation itself as part of the hyperobject. The planetary image and the marker-subject form a dyad limiting in such conceptions. Art can reflect this limitation either through restricting itself to localised experience, to universalised visualisation, or jumping between both as two sides of the same coin. I will now go on to propose an alternative approach.

2.2.3. Art Practice as Attunement to the Hyperobject

[47] By taking the universalised scale as material, it rethinks it from representation of the real to partial model from the real, recalling in a sense Laruelle's use of the 'fiction' in his writing, see Schmid (2012: pp.133-4). I return to this process in discussing sampling and unpicking the frame of the alreadymade in the final chapter.

What I will argue in this section and go on to develop over the thesis is that between, on one hand, an incomprehensible duration, and, on the other hand, localised experience, art practices can be understood as methods to navigate between these asymmetrical registers.[48] I have argued so far that remaining at the scale of the individual human or at the scale of universalised data is inadequate for developing understanding of the more-than-human entanglements of radiological deep time. Against interests in deferring deep time as other to human politics and its effects in the present, aesthetics is proposed here as contributing to a connection of scales of materials including sensation. I will address this first of all here through developing what Morton describes as the relation of 'attunement' between art object and hyperobject (2013b: p.49). In arguing for the importance of art and aesthetics in conceptualising the hyperobject, he alludes to the possibility of "not simply art 'about' hyperobjects, but art that evokes hyperobjectivity in its very form" (p.39). Representation understood in terms of such 'aboutness' is rendered problematic in this context, as it suggests a transcendentalising separation of the art subject from its (hyper)object. In emphasising instead the hyperobject's viscosity as its quality of eroding such separation, art propositions can be proposed as immanent to that which they evoke or represent, and a formal enquiry, through art, into temporalities or other qualities of the hyperobject. Attunement suggests a way to think of artwork not 'about' the deep time of radioactivity, nuclear waste or the deep geological repository, but as part of it. It is described, for example, by Davis and Turpin as a mode of attention for new realities, relations of perception and sensations outside of the human, "attuning ourselves, through poetry, art…to pay attention to other times, developing techniques to think through the limits of our temporal frameworks, and then think beyond them." (2015: p.13)

In the previous chapter I discussed the address of 'you' in the film *Into Eternity* as specific production of subjectivity. This was analysed as constituting the marker-subject, separated from the toxicity of deep time as hyperobject, unchanged over time, subject of salvation from an endlessly deferred apocalyptic future. This critique was extended to the imaginary of the deep geological repository project more generally,

[48] This observation has been developed through reflection on my *Pazugoo* project (See Documentation of Practice). The work aims to incite a conceptual navigation between its localised encounter in the present and the planetary trajectories of radioactive half-lives.

premised on claims to separate toxic objects from their imagined future subjects. Artwork as attunement to radiological deep time as hyperobject shifts this address, against the subject/object separation, to reformulate a subject immanent to its complex network. Artist Kota Takeuchi's video *Finger Pointing Worker* (2011), for example,[49] shows a protective-suit clad human figure standing in front of the Fukushima Daichii power plant in Japan, looking into a mobile phone and pointing back, outside of the screen, through an unseen security camera, to viewers of the work.

Figure 2.4: still from *Finger Pointing Worker* (2011), image https://kadist.org/

Formally, the work recalls Vito Acconci's *Centers* (1971), 22 minutes of the artist pointing at a camera, creating a self-aware loop between artist, screen and viewer, contained by the duration of the video. Both works stage the active interpellation of viewing subject through pointing. Takeuchi's work expands this video loop. however, to

[49] An anonymous video posted on YouTube in the wake of the Fukushima Daichii nuclear disaster in 2011, The video was later framed as work of artist Kota Takeuchi through the *Open Secret* (2012) exhibition, where the artist is figured as representative agent of 'finger pointing worker' protesting against his labour conditions.

also include the surveillance network, the file's circulation through social media and the nuclear plant filling the frame, its footage marked and owned by Tokyo Electric Power Company Incorporated. The anonymity of the suit, lack of a named identified figure or author unsettles a defined centre of such a loop. Its timing, inscribed into the camera data, just after the tsunami-induced accident at Fukushima in 2011, expands the narrativising of nuclear disaster beyond spectacle to point to its viewer as implicated within a planetary climate hyperobject, networks of energy and waste. Expanding beyond the limit of a terrestrial horizon, its pointing expands the conditions of its own operation to the more-than-human temporality of radiation. The video, rather than a representation of radiological deep time, becomes an attractor within it, loosening its viewer into its surrounding environment.[50]

Attunement, then, can be understood as a mode of experimenting with relations between art's methods of 'showing' and the sense-exceeding nonhuman hyperobject they become bound up with. The 'finger pointing worker' video, operating from within the networks it defines, can be understood as a stitching of localised experience (the 'you there' of its addressee) to the beyond-planetary abstraction of the radiation hyperobject. Through attunement, it draws on the senses in order to re-adjust their transcendent positioning, expanding them across an amplified scale, connecting perception and sensation to a temporal continuum that exceeds them. This avoids drawing a binary opposition between 'the human' and 'deep time' where deep time remains opaque and unknown, and the human unchanged. Instead, through this connection, the local site of encountering the work is opened into a trajectory towards universal scale. In one sense, attunement acts as epistemological method, giving agency to cognition in making connections and navigating across the radiological deep time hyperobject from within. At the same time, it has agency itself in affecting perceiving subjects. The artwork and the hyperobject don't simply reproduce one another, in other

[50] Developed further theoretically in Chapter Four, this is what I have aimed for through practice with the production of *Museum Index Pazugoo* objects, which reference buried Pazugoo objects around the world. In exhibitions of work (Documentation of Practice: Sections 2, 4, 9, 13) the viewer is configured as another agent within the radiation hyperobject, along with the work, rather than as an external point to give it all meaning. In practical terms 'the viewer' will never see or experience the work as a whole, but they can access it through this gallery encounter.

words, but reshape each other through experimental connective processes and methods, twisting subjects and objects within a radiological deep time continuum. For the rest of the chapter, I will focus on this relation between sensation and reason in artworks attuning to radiological deep time, considering how this creates and challenges new types of sublime aesthetics.

2.3. The Anthropogenic Deep Time Sublime

2.3.1. Half-life Aesthetics

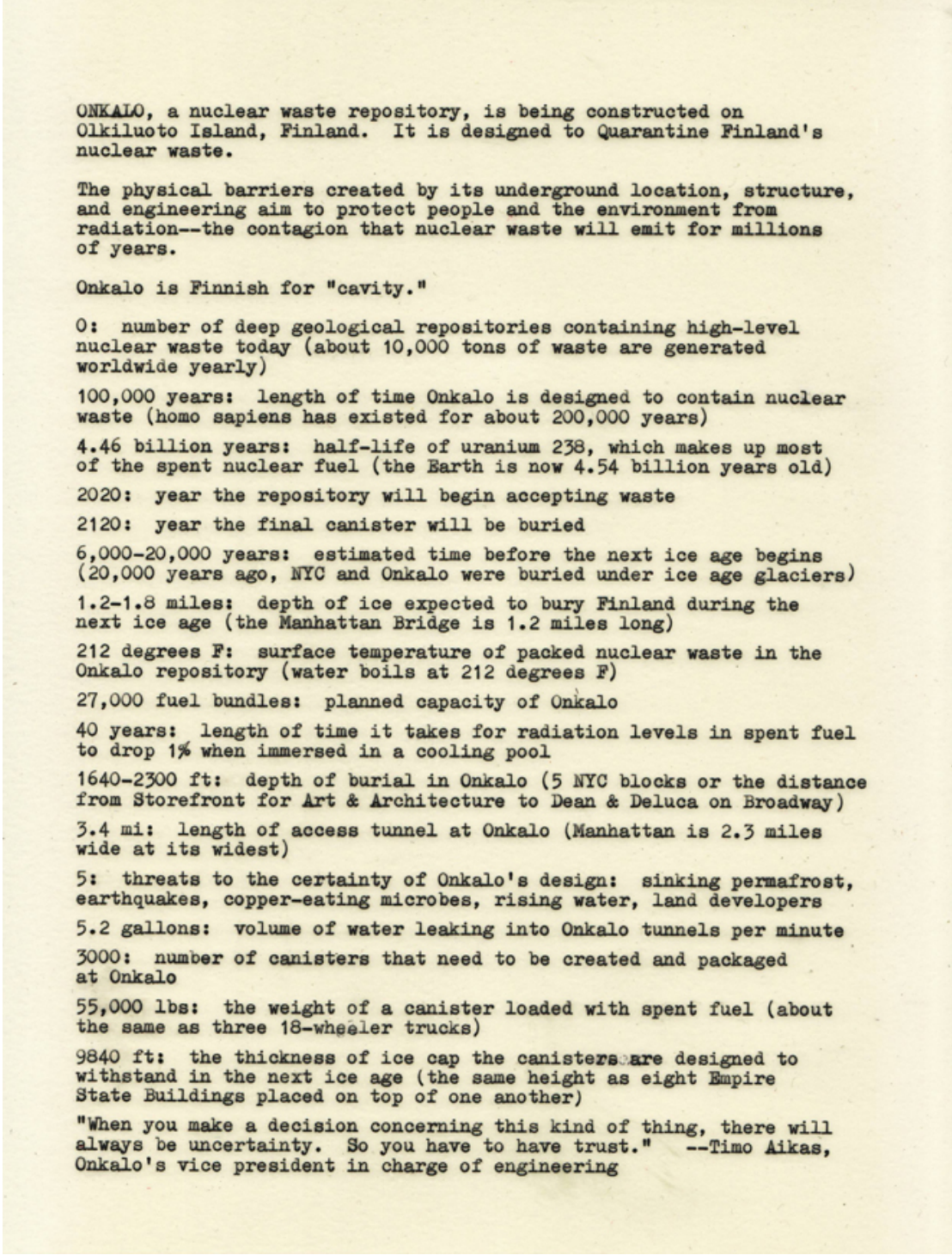
My argument for understanding radiological deep time as hyperobject has led to a focus on art practice as mediator between human sensation and cognition and the complex objects it is enmeshed within. It shares affinity here with what political theorist Nick Srnicek (2012) has called the 'aesthetics of the interface' - method for mapping the more-than-human complexity of the neoliberal economy. Srnicek's analysis, alluded to earlier in his reference to Fredric Jameson's cognitive mapping, is useful in drawing attention to the political urgency of such methods. Beyond Morton's focus on the hyperobject ontology, he focuses on power interests inherent to such expanded networks. If capitalist technologies are already operating at hyperobject-scale, complexity and speed, in other words, then building collective technological interfaces becomes a way to re-orient within this network, against it remaining opaque while it continues to serve extracting profit and exploiting resources globally. In relation to this, Srnicek highlights the danger of what he calls an 'aesthetics of the technical sublime'. This is another problem for the data register I have described, where as well as being reduced to specific reductive images, it can, on the other hand, remain at an overwhelmingly large and complex scale, unable to be cognised at all, producing subjects overawed by big scales of data, reducing any capacity to comprehend or act. Srnicek points to the role of art practice in reflecting or intensifying this disorientation, describing works by artist/musician Ryoji Ikeda, for example, as mapping data systems in such a way "designed to overwhelm and incapacitate…perception recoils at an incomprehensible vastness whilst cognition and reason sits back and black boxes it." (p.5)

The relation of perception to reason through a language of the sublime is particularly relevant to aesthetics of radiological deep time, not only due to the complexity of its data,[51] but also the materiality of the long half-lives of Uranium isotopes, which can

[51] For example, the tangled complexity of future factors in prediction technologies.

seem impossibly vast and distant to a human observer. Artist duo Smudge Studio, for example, for their work *Containing Uncertainty* (2012) researched the Finnish *Onkalo* deep geological repository also represented in the *Into Eternity* film. Their responses were varied in form, reflecting what they described as difficulties in cognising the site at "the edges of cognition" (Smudge 2012). This included short essays, lists, bentonite clay models, a schematic diagram and a lump of Gneiss bedrock described as "approx. 2 billion years old" (Smudge 2012):

Figure 2.5: Gneiss bedrock, part of the work *Containing Uncertainty* (2012) by Smudge Studio, image: http://smudgestudio.org



ONKALO, a nuclear waste repository, is being constructed on Olkiluoto Island, Finland. It is designed to Quarantine Finland's nuclear waste.

The physical barriers created by its underground location, structure, and engineering aim to protect people and the environment from radiation--the contagion that nuclear waste will emit for millions of years.

Onkalo is Finnish for "cavity."

0: number of deep geological repositories containing high-level nuclear waste today (about 10,000 tons of waste are generated worldwide yearly)

100,000 years: length of time Onkalo is designed to contain nuclear waste (homo sapiens has existed for about 200,000 years)

4.46 billion years: half-life of uranium 238, which makes up most of the spent nuclear fuel (the Earth is now 4.54 billion years old)

2020: year the repository will begin accepting waste

2120: year the final canister will be buried

6,000-20,000 years: estimated time before the next ice age begins (20,000 years ago, NYC and Onkalo were buried under ice age glaciers)

1.2-1.8 miles: depth of ice expected to bury Finland during the next ice age (the Manhattan Bridge is 1.2 miles long)

212 degrees F: surface temperature of packed nuclear waste in the Onkalo repository (water boils at 212 degrees F)

27,000 fuel bundles: planned capacity of Onkalo

40 years: length of time it takes for radiation levels in spent fuel to drop 1% when immersed in a cooling pool

1640-2300 ft: depth of burial in Onkalo (5 NYC blocks or the distance from Storefront for Art & Architecture to Dean & Deluca on Broadway)

3.4 mi: length of access tunnel at Onkalo (Manhattan is 2.3 miles wide at its widest)

5: threats to the certainty of Onkalo's design: sinking permafrost, earthquakes, copper-eating microbes, rising water, land developers

5.2 gallons: volume of water leaking into Onkalo tunnels per minute

3000: number of canisters that need to be created and packaged at Onkalo

55,000 lbs: the weight of a canister loaded with spent fuel (about the same as three 18-wheeler trucks)

9840 ft: the thickness of ice cap the canisters are designed to withstand in the next ice age (the same height as eight Empire State Buildings placed on top of one another)

"When you make a decision concerning this kind of thing, there will always be uncertainty. So you have to have trust." --Timo Aikas, Onkalo's vice president in charge of engineering

Figure 2.6: printed text, part of the work *Containing Uncertainty* (2012) by Smudge Studio, image: http://smudgestudio.org

I will return to this work and its use of material from the repository site in my next chapters. For now, I want to highlight how the presentation of this rock along with the description of its immense timescale and text including magnificently large number of

years inherent to the site draws attention to this affect of overwhelming scale. Such affect is also dominant in the popular imaginary of geological repositories. *Into Eternity* was received as awe-inspiring, for example, "my jaw descended…unimaginably mysterious" (Bradshaw 2010), while its publicity material focused on immense 'eternal' scale overpowering a human figure:

Figure 2.7: Promotional image for *Into Eternity* (2010), image: http://www.ecolopop.info

To consider how art could challenge such representations, I will now introduce two artworks which attune to radiological deep time. I will argue that they become bound up with sublime aesthetics, while also suggesting methods to go beyond them. I first of all present them briefly here as a way into thinking the sublime in this context, then I return to them in the conclusion of this chapter. Both engage with deep time through the specific temporal context of radioactive half-life, using number to index immense scale. *A Temporary Index* (2016) by artists Thomson & Craighead is a series of counters, which reference timescales of contamination at specific deep geological repository sites around the world. Each counter, ticking down in seconds towards zero, marks the time before the waste at the sites is considered safe for humans. Unlike the planetary image

of the COVRA work, however, this is a zero never to be seen or experienced by its human viewers, remaining out of reach.

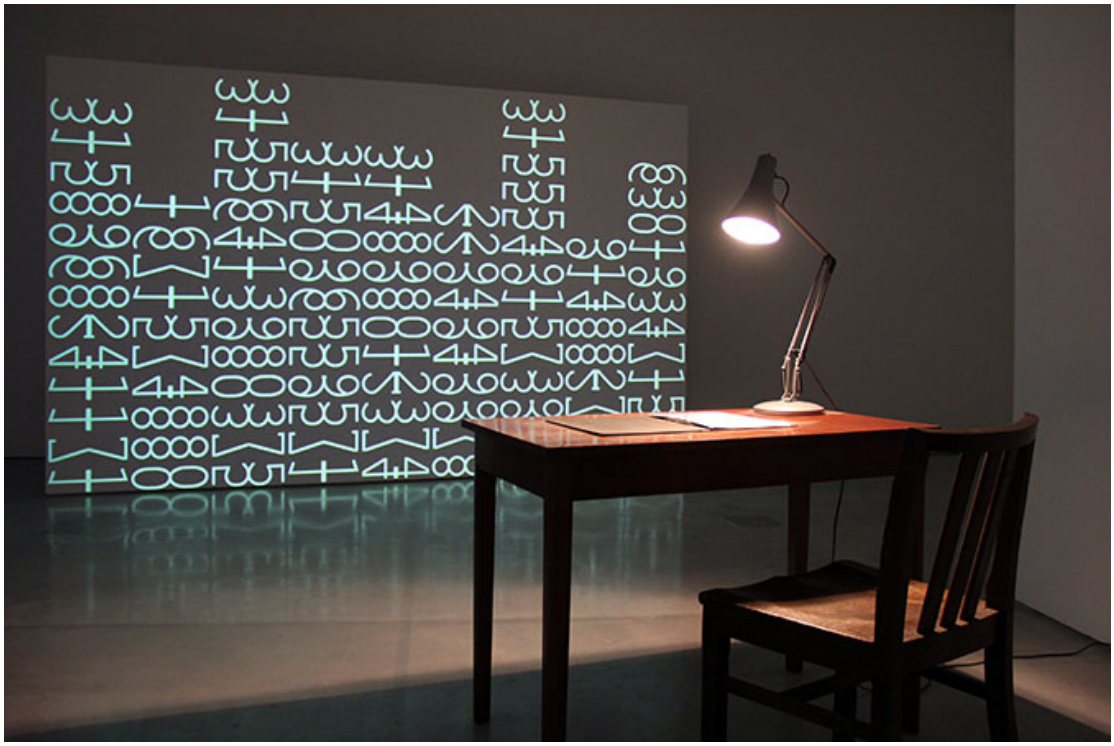


Figure 2.8: *A Temporary Index* (2016), Thomson & Craighead, installation view, image: https://www.ucl.ac.uk/slade/slide/temporary_index.html

Figure 2.9: *A Temporary Index* (2016), detail of installation, image: karst.org.uk

Erika Kobayashi's *Half-Life Calendar: Radium* (2014) uses measurement of half-life of the isotope Radium-226, to produce a calendar where years are ticked off (and left open to be ticked off in future) from Madame Curie's discovery of Radium in 1900 until its 'safe level' of radiation in the year 3503. This timescale is paralleled with Kobayashi's personal and fictional inter-generational narratives expressed through writing and the drawing of a chain of daughters. This parallels the scientific language used in the decay chain of Uranium as it decays into a series of related 'daughter' isotopes, becoming gradually more stable over long periods of time.

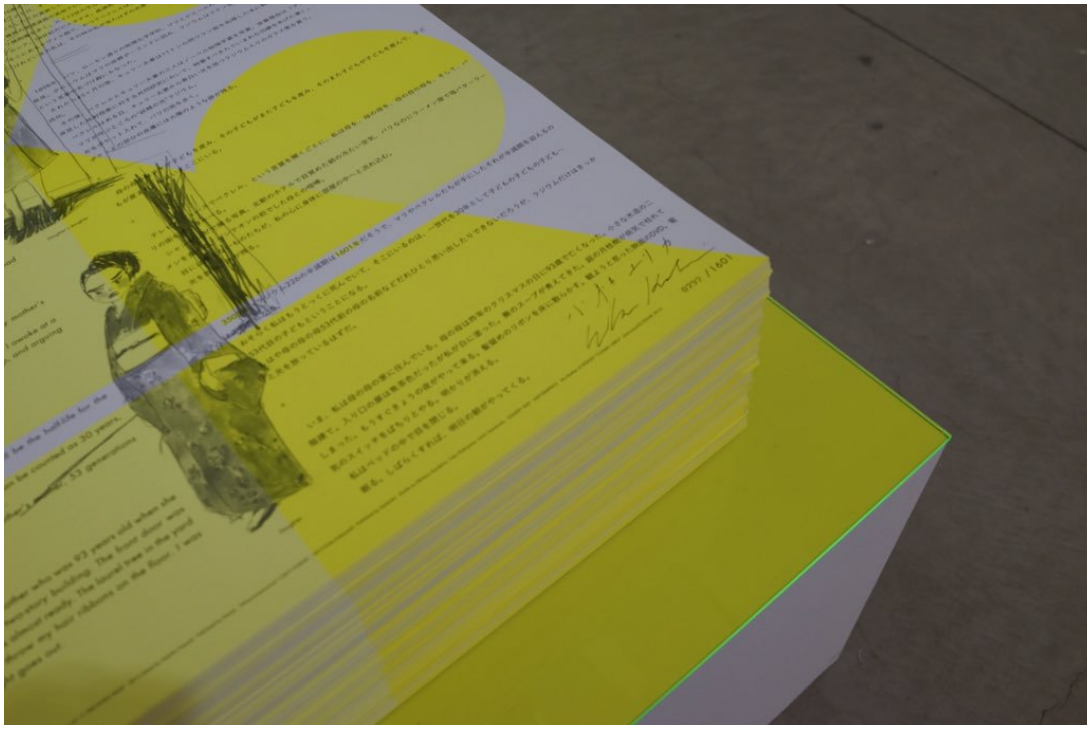


Figure 2.10: *Half-Life Calendar: Radium* (2014), Erika Kobayashi, stack of 1601 double-sided silkscreen-printed A2 posters, image: erika kobayashi @flowertv

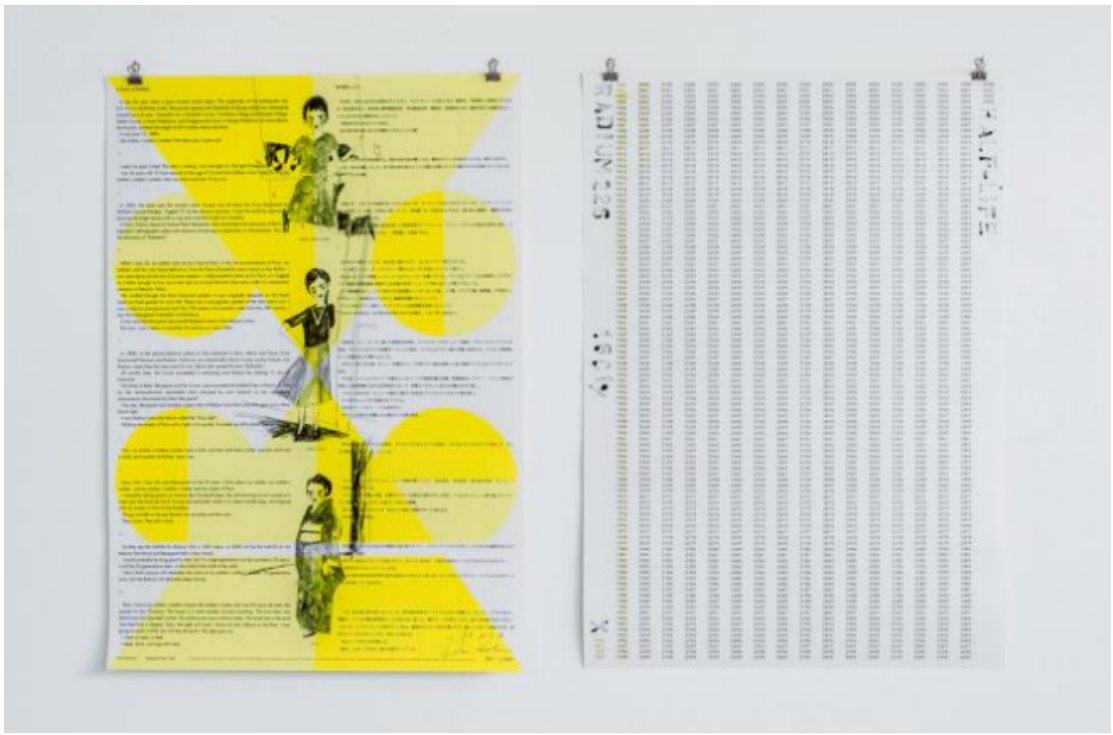


Figure 2.11: Both sides of the poster, showing the illustrated narrative and calendar as list of years, image: karst.org.uk

Both works incite awareness of the passing of time as invocation of the temporal scales of radioactive half-life, connecting lived experience to a continuum that exceeds it. They

can be considered in this sense as forms of attunement to the temporal qualities of the radiological deep time hyperobject. Through this process, by invoking and overriding the importance of present experience (through indexing non-experiencable times), they emphasise and direct to forms of rational conceptual process over affective experience. Within a history of long-durational artwork, they emphasise the partiality of their encounter within a longer finite timescale, in this case, guided by the temporality of their materials, inciting a reasoning of the limits of sensual experience.

2.3.2. Stunning Images of Deep Time

Through their visualisation of a temporal continuum beyond human experience and species-existence, the works can be located within a historical context of images of deep time. Hutton recorded his response to the angular unconformity of slate at Siccar Point in Scotland discussed in the previous chapter, "the mind seemed to grow giddy looking so far into the abyss of time" (Hutton, cited in Gould 1987, p.62), illustrating his *Theory of the Earth* (1788) with this plate, depicting slate deposits plunging into the depths of the Earth:[52]

[52] This affect of wonder is of course not a limit point for Hutton, who, like Meillassoux astonished by the arche-fossil, moves from his seduction by the image/landscape to the production of theories from it.

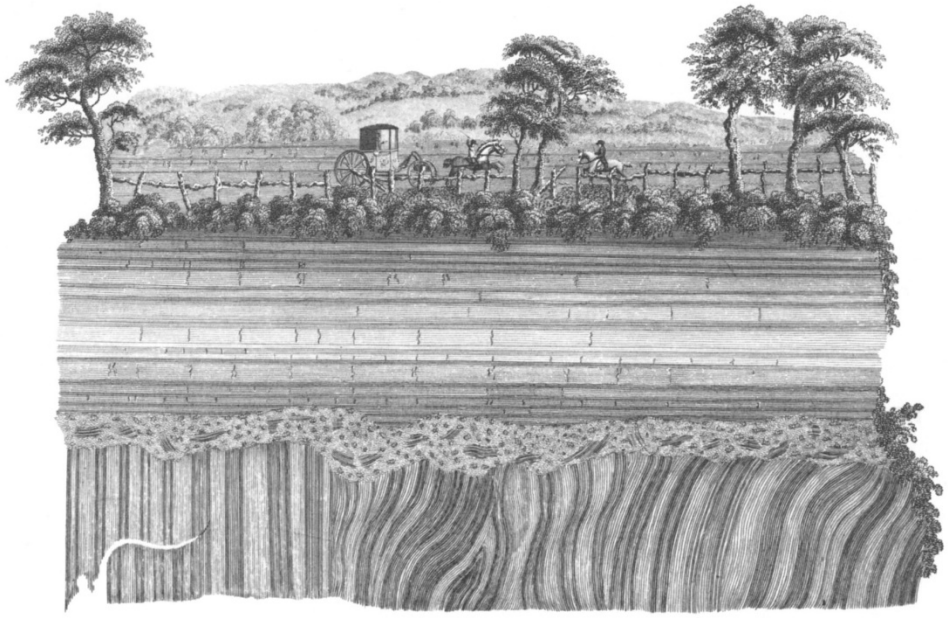


Figure 2.12: Engraving after a drawing by John Clerk of Eldin (1787) of the unconformity at Jedburgh: Plate III in the *Theory of the Earth Volume 1*, by James Hutton, image: commons.wikimedia.org.

In his *Deep Time of the Media* (2008), media theorist Siegfried Zielinski discusses this illustration, describing its stunning affect and representation of the 'strange foreignness' of deep time (p.8). Stephen Jay Gould re-prints the image in his elucidation of deep time in *Time's Arrow, Time's Cycle: Myth and Metaphor in the Discovery of Geological Deep Time* (1987), describing his own "stunned" response to it (p.62) and Hutton's expressed wonder at the vastness of time (p.64). This history of deep time is bound up with the affect of the stunning image, making its viewers giddy through presenting the immense overwhelming otherness of its timescale and duration. Whether describing the geological past, or extended into speculated futures, it serves to reinforce deep time as something other to human life, captured through an image separated from it, images *of* deep time, rather than from within. Through the stunning image, deep time becomes object of wonder and contemplation for humans, rather than something they are implicated within. This in turn disavows a sense of responsibility for processes such as climate change seen as 'other' to the present. Radiological deep time

as hyperobject has made such a transcendent and distant view impossible, leading to a demand to reformulate what constitutes an image in this context.

In describing the importance of technologies in what he characterises as the 'contemporary sublime', Simon Morley describes its accompanying immediate affect, "'Wow' often tends to be our initial lost-for-words response to such intimations of otherness or infinity" (2010, p.1). Such response suggests a distancing effect, a detached and spectacular play of awe-inspiring destruction from a safe distance. It is this position that is described by Joanna Zylinska in her analysis of the deep time as apocalyptic world-without-humans future imagery of the TV series *Life After People*, "the repetition of the trauma of extinction and the ensuing annihilation…is aimed at shaking up the people on the other side of the screen while simultaneously restoring their sense of wholeness, control and peace, thus allowing them to enjoy the spectacle" (2014: p.108). Zylinska's description captures the doubleness of this 'wow' affect as it, on one hand, 'shakes up' through the shocking awareness of the contingency of human life, while simultaneously on the other hand, 'restores control' through its compensatory distancing frame. In psychoanalytical terms, the image is compensation for loss, foreclosing the shock of human extinction through creating an imaginary sense of plenitude. In this case, as can be seen in popular cultural imagery of nuclear as disaster, the seductive pleasure of spectacular Hollywood imagery replaces understanding or social action. The sublime is mobilised against knowledge or care. The framework that Zylinska here evokes of securely positioned subject against an overwhelming omnipotence of nature (pp.108-9) operates as a reverse of the marker-subject. Rather than a future subject posited as saved by the present, it produces a present subject 'saved' by the staged future apocalypse. I will now draw on this to analyse the Anthropogenic deep time sublime in more detail as a post-Kantian structure.

23.3. Kantian Sublime as Limit Concept

The Kantian sublime, as it begins with an object rather than a concept, is a form of 'reflecting' aesthetic judgement. Rather than posited as quality of that object, however, it is expressed in a feeling of conflict between faculties of imagination and reason. The

subject, put in contact with "absolutely large" objects,[53] either mathematically or through encounter with natural landscape (the 'dynamically sublime'),[54] experiences a mix of pleasure and displeasure at the non-purposive power or boundless scale of nature. This comes from an initial aesthetic satisfaction as the imagination is directed away from sensory experience (in its failure to grasp the object) towards the infinite, but then a frustration at the incapacities of the imagination to comprehend the infinite, and also (in the case of the dynamically sublime) fear of the threatening object.

In being taken to their limits, the faculties of imagination and reason become dislocated,[55] and for Kant, this insufficiency and loss is transformed to positive gain, as inadequacy of imagination becomes judgement of that inadequacy, "the sublime is that, which in the very ability to think of it demonstrates a mental capacity that surpasses every measure of the senses" (§25, 1987: p.105). In directing reason away from sensory experience, the activity of the faculty of reason is revealed as an increased mental capacity beyond the senses,"Ideas of reason…though no presentation adequate to them is possible, are provoked and called to mind precisely by this inadequacy, which does allow of sensible presentation" (§23, p.98). Further, in the case of the dynamically sublime, the subject is also enhanced (in capacity, and morally) through encounter with the threatening force of nature, as the possibility of disinterested contemplation of such a scene suggests a security for reason, immune from its physical threat. It is this aspect alluded to by Zylinska in her image of the securely distanced viewer of the post-apocalyptic scene.

Recent criticisms of post-Kantian thought, following Meillasoux's arguments against correlationism, consider such 'positive gain' in Kant's argument as actually part of a trajectory of diminishing the role of reason through its confinement to analysis of subjective relation. As the sublime is a negative experience of limits, it is not able to

[53] Objects that are not infinite themselves but suggest infinity as they are large "absolutely rather than in comparison" (§25, 2000: p.103), i.e. not just comparatively larger than a smaller object, but one that in comparison with, everything else is small.
[54] Whether through looking at a painting, a real view, or encountering a landscape by other means such as a dream, makes no difference to Kant's argument.
[55] A dislocation Sprod connects to the affect of shocking artwork, where something happens to hold at bay nothingness (2012: pp.104-5).

make any positive claims about the object independent to its intelligibility-for-us. The sublime operates as a 'limit-concept' in a sense analogous to how Kant describes noumena, "not the concept of an object, but a problem unavoidably bound up with limitations of our sensibility…As sensible intuition does not extend to all things without distinction, a place remains open for other and different objects; and consequently that these latter must not be absolutely denied, though – since we are without a determinate concept of them – neither can they be asserted as objects for our understanding" (A287-8, 2000: p.380, cited in Braver 2007: p.41). The sublime, understood in this sense, becomes a process of actually instantiating finite limits, drawing edges, where the un-apprehended is not denied, but given no qualities in itself nor power in constitution of the unchanging subject crucial to Kant's transcendental idealism.[56] To adopt Meillassoux's terms, we cannot represent the sublime object without it becoming for-us. Further, as Brassier (2010: p.68) has highlighted in reading Meillassoux, if reason is confined to the phenomenal in this way, then it can provide no argument against faith as access to the noumenal, producing a structure of fideism, i.e. faith appears at the limits of reason. In direct contrast with Kant's description of the mathematical sublime, and against this correlational fideism, Meillassoux reactivates a Cartesian thesis to move beyond the limit-concept, "all those aspects of the object that can be formulated in mathematical terms can be meaningfully conceived as properties of the object in itself. All those aspects of the object that can give rise to a mathematical thought (to a formula or digitalization) rather than to a perception or sensation can be meaningfully turned into properties of the thing not only as it is with me, but also as it is without me" (2008: p.3). The deep time sublime image, then, reinforces a restriction of reason through presenting the unknowability of a negatively-defined-nothing beyond its limits.

2.3.4. Undoing the Compensation of Reason

[56] As Braver describes the 'Kantian Paradigm' as a key component of his history of the development of anti-realism in continental philosophy. "If phenomenal reality does not possess an inherent order itself, but instead receives it from the subject's activity, then in order to preserve the universality, singularity and determinacy of this order, that is, in order to make it permanent and intersubjectively reliable, Kant must require the organizational faculties of all subjects to remain the same at all times" (2007: p.49).

Returning to *A Temporary Index* as example, I will argue now that it draws on this Kantian structure, while also differing from it, and from the Hutton 'stunning image' example, through a more specific and complex post-Anthropogenic address, which includes the reality of the object-without-me posited by Meillassoux within the situation of the work. This serves to undo the compensation of reason proposed by Kant, adopting a different attitude toward the non-phenomenal realm, while running into further problems.

The radioactive half-life data presented, firstly, collapses Kant's mathematical and dynamically sublime by presenting numbers at massive scale (directing imagination toward the infinite), *and* a representation of the nuclear landscape as powerfully threatening to the human subject. Its aesthetic reflection initially follows a similar structure to that described above, where the relation between sensual unboundedness and rational binding is unsettled through imagination being taken to its limits. A first difference can be seen through its use of mathematical process to index the sublime object. Following Meillassoux, the duration of radioactive half-life can be understood as a quality of the nuclear waste object independent of the viewer, indeed as its duration exceeds the life of the viewer, then it must be considered in these terms. This fact is not experienced as necessarily overwhelming. What it does, however, is disrupt the necessary centrality of the subject both in Kantian terms, as uniform experience-organising reality-constituting structure; and, in post-structuralist informed terms as 'completing the work' (as the work itself has a duration that exceeds the subject).[57] Following this, a further difference emerges through the mobilisation of fear within this structure. For the Kantian dynamically sublime, this was seen as invoked and pleasurably overcome through the security of safe distance. In this example, however, rather than reason purely overcoming the physical threat of radioactive matter, it also registers a deeper threat, that of the Anthropogenic decentring not only of present experience but also of the human species, discussed in detail in the previous chapter, as contingent within an amplified scale. Thought registers, in other words, not an ability to think outside of represented horrors, but an awareness of the destructive force of

[57] This is discussed further at the end of Chapter Three.

human-induced climate change, and its effect of putting thought into contact with its own extinction.

The artwork extends this as a performative production, through the affect and cognitive response of its encounter. The structure of the Anthropogenic deep time sublime unfolds through reason doubling, rather than compensating for, the horror of imaginative limit. Staging the destructive inadequacy of senses, but with no spectacle of destruction to enjoy or comforting position to return to, it is Kant's 'disinterested' subject-position that is swept away by the Anthropocene, understood in this sense as an unavoidable 'interest' for the human in nature. In this example, the potentially sublime opacity of the numbers is made more complex through the presentation of supplementary information, inciting a rational process based on perceiving the numbers *and* what they are perceived *as.*[58] The work, read in this way, while drawing on and partly undoing the structure of the Kantian sublime, actually has further ungrounding effect through its imbricating of the subject within the decentring force of the geological Anthropocene. This evokes a different kind of fear from the morally improving disinterested response Kant describes, suggesting instead a kind of humiliation of humanity through cosmic indifference. Fear is mobilized and registered as a shock or decentring force. It can be argued, as Alex Williams (2013) has done, for example, that this leads to an affect not of shock but of hopelessness, generating feelings of powerlessness, leading to inactivity and withdrawal. Eugene Thacker, on the other hand, in discussing the horror of confronting the world-without-us of human species extinction, proposes this affect as something, potentially at least, more positive – an attempt to think the Planet (his term for the world-without-us) as a kind of non-philosophical knowledge.[59]

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[58] As both sense (registering stimulus) and knowledge (classifying an object as something), in Kantian terms.

[59] "I would propose that horror be understood not as dealing with human fear in a human world (the world-for-us), but that horror be understood as being about the limits of the human as it confronts a world that is not just a World [the world-for-us] and not just the Earth [the world-in-itself], but also a Planet (the world-without-us). This also means that horror is not simply about fear, but instead the enigmatic thought of the unknown…horror is a non-philosophical attempt to think about the world-without-us philosophically" (Thacker 2011: pp.8-9).

2.4. Conclusion – Art Against the Sublime

Understanding radiological deep time as hyperobject has been useful in conceptualising thought as immanent to it, and pointing to epistemological problems, bound up with political problems. It describes a situation where local causes can't map onto an asymmetric complex network, and reduction to the register of data visualisation limits thought to this representation, leading to a derangement of scale. The anthropogenic deep time sublime is the reflection and intensification of this derangement. It affirms dwelling in the terrifying-pleasurable affect of immense inhuman scale, creating a sense of awe and wonder. Scales seduce through a magnitude, which remains ultimately opaque, leading to a kind of stunned indifference, rather than understanding or action. At the same time, the sublime aesthetic structure re-affirms the centrality of the human subject that gives it meaning. This is figured as the individual consuming or art viewing subject, at secure distance from environmental catastrophe, confronted by spectacular images of extinction, decay or destruction that hold real devastation at bay. It becomes a way of evading the present by holding off deep time as indefinite apocalyptic future. To finish this chapter, I will focus on ways in which the practices I have discussed suggest escape from this structure.[60]

Firstly, the artworks challenge the sublime through the deployment of other scales. The focus on intergenerational scale in Kobayashi's work, for example, is a way to break down the immensity of deep time. By creating a narrative thread of slow gradual change, year to year, generation to generation, the work avoids focus on a sublime leap from now to extinction. It also challenges the sublime through its exhibition and distribution. The takeaway poster, to be looked at later, introduces a reflective temporality, further breaking up the immersion in overwhelming number. *A Temporary Index* resists a focus purely on an affect of seductive magnitude through its

[60] In terms of my own practice here, its use of mythic fiction is proposed as a method to avoid the sublime. Rather than jumping straight into facing the immensity of radioactive half-lives, in other words, it draws upon cultural traditions of storytelling and personification as fictions for crossing long time scales through gradual modifications. This is developed through workshops and exhibitions, coming together for example in Documentation of Practice: Section 13.

simultaneous presentation of information in the form of written texts on a desk. These strategies suggest interrupting the sublime structure through interjection of another temporality. They then become ways of connecting universal scales of deep time to other scales of material and experience. I go on to elaborate on this 'interscalar' method in Chapter Four.

Secondly, attunement can be understood through the works as a process of modelling material conditions of radiological deep time from within, rather than making images *of* deep time. This modelling has a necessary material relation to the situation it is immersed within, independent of its viewer. It is drawn from the deep time hyperobject rather than imposed upon it. At the same time, as the title of *A Temporary Index* suggests, the model is also open to unknown futures as revisable, subject to change as its conditions change, staging its own mutation and implication within an 'outside' it cannot be separated from. The impossibility of modelling the radiation hyperobject as a whole is approached not through a drama of incapacity in the face of magnitude, but through production of hypotheses from within it as partial models, as I discussed in relation to the Sandia performance fictions in the previous chapter. Rather than the sublime presentation of number Srnicek discusses in Ikeda's work, which, in terms of its affect, could be any-number, *A Temporary Index* presents these-specific-numbers as an interface with technologically derived data. This draws attention to the duration of the work, determined by the contingencies of its materials through half-life measurement, indifferent to its subjective affect or interpretation in the exhibition setting. While this may intensify the feeling of horror, it also suggests an indifference to this feeling, refusing its determining of the work. The extended cognition of the sample-interface shifts focus away from the affect of subjective exposure toward thinking conditions of the object's appearance – where in the world-without-me have these numbers come from?

Thirdly, the mirrored display of number as totem in *A Temporary Index* draws attention to number as image, and as ritualistic force, Unlike the HADES graphs and COVRA artwork discussed at the start of the chapter, the works build fictions to transform the data, rather than claiming to represent it directly, staging an awareness of its own interfacing as a kind of 'performative materiality' I develop further in the final chapter.

Finally here, Srnicek's focus, following Jameson, on orientation and mapping is useful in considering a resistance to the obfuscation of complex networks made unknowably sublime in the interests of power. Extending analysis of the sublime, however, has shown how these artworks function not only as such orientation methods but also affect viewers in complex and disorienting ways. I will consider this further in the final chapter.

CHAPTER THREE: *El Chaco*, Contemporary Art and the Problem of the 'Alreadymade'

3 1 Introduction

3 2 Defining the Alreadymade

3 2 1 The El Chaco Meteorite Transplanted into Documenta 13

3 2 2 The Alreadymade Horizon

3 2 3 Circumstances Readable by Art or The Contemporary Art Two-Step

3 2 4 Radical Uncertainty: Contemporary Art and the RK&M Project

3 3 Conclusion

3.1. Introduction

In the last chapter, I was critical of the 'deep time sublime' as subjective limit against the ungrounding force of deep time, made unknowably and irreducibly opaque. In this chapter, I am critical of a different structure - safeguarding against the impact of deep time by reducing it to existing knowledge frameworks. I focus on this here through proposing the specific contemporary art methodology of the 'alreadymade'. My definition is expanded from an analysis of the Guillermo Faivovich and Nicolas Goldberg artwork *El Chaco* (2012) as included in Documenta 13 in 2012. The work proposed to relocate the 60 tonne meteorite 'El Chaco' from its landing place in north-central Argentina to Kassel, Germany, for the Documenta exhibition. After protests following a dispute with members of the indigenous Moqoit people, for whom El Chaco is held as a sacred link between the spiritual realm and the Earth, the relocation was cancelled. Through this failure, Documenta's claim to present the non-human perspective of the meteorite (as an object as old as the Earth, existing before the human species) actually revealed how such perspectives and temporalities are contested, already embedded within other cosmologies, rituals, publics and cultures. By proposing to make the meteorite 'public' through its exhibition, in other words, as well as the tension between an object *for-us* and *without-us*, the question of who constitutes this *us* was also brought into focus.

The work *El* Chaco is described by Documenta 13 curator Carolyn Christov-Bakargiev as "cosmic alreadymade… an act that can be interpreted within the frame and history of the conceptual readymade" (2012: p.3). Following this, I argue, *El Chaco* draws on an art history of the readymade to frame these inexperiencable timescales, other cosmologies, its failures, debates and contestations under specific correlational conditions. Through this description, attention is drawn to the 'alreadymade' methodology more broadly - understood as the registration of processes, temporalities and materialities that do not necessarily prioritise the human, staged under conditions that re-affirm the centrality of human experience. Such an analysis suggests a departure from Meillassoux's 'arche-fossil' philosophical device to ask what would happen were the fossil designated an artwork. Indeed the Documenta exhibition, as a specific curatorial attempt to engage with non-human centred perspectives, can be read in parallel to Meillassoux's

experiment, questioning the conditions of both scientific and artistic propositions on the nature of reality. I argue, however, that this claim to non-human perspectives is undermined by the structure of alreadymade. Rather than Documenta presenting art alongside other knowledges, as it claims, the non-anthropocentric becomes a truth-condition *for art.* 'Contemporary art' itself is ultimately asserted and prioritized as transcendent frame for the potentially ungrounding force of 'nature' or the non-human.

The final part of the chapter draws on the concept of the alreadymade to consider its relevance to the deep geological repository RK&M project, leading into the next chapter. Art historian Julia Bryan-Wilson has argued that the critical perspective of contemporary art has been lacking from this project. I agree with her point that aesthetic strategies of doubt and ambiguity can open up critical questions currently lacking. At the same time, however, the case of the alreadymade suggests art being transformed by as well as contributing to this context, its own meaning-making frameworks rendered contingent by the timescales at stake.

3.2. Defining the 'Alreadymade'

3.2.1.The *El Chaco* Meteorite Transplanted into Documenta 13

The introductory catalogue text by Carolyn Christov-Bakargiev, the artistic director of Documenta 13 in 2012, opens with the title 'i. to see from the point of the view of the meteorite'. The use of an infinitive form, generalised subject and this cosmic perspective suggests a focus in the Kassel exhibition, and in the Documenta 13 project more broadly, on what such a 'non-human perspective' could mean for art. This is reflected in the description of the project on its website as addressing the theme of "anti-anthropomorphism" (Documenta 2012). It opens the paradoxical question of how to use the conventional exhibition format, dependent on exposure to perceiving human subjects, to address the decentring of those very subjects. More specifically, the meteorite perspective described by Christov-Bakargiev refers to *El Chaco* (2012), an artwork by Guillermo Faivovich and Nicolas Goldberg:

Figure 3.1: The El Chaco meteorite, in Chaco province, Argentina, image: https://d13.documenta.de

Figure 3.2: The artists with a model of El Chaco at Documenta 13 in Kassel, image: http://revistacarbono.com

For this work, the artists set out to remove the largest fragment of the 4.5 billion year old 'El Chaco' meteorite from its landing place in north-central Argentina and relocate it to Kassel for the Documenta exhibition. After protests following a dispute with members of the indigenous Moqoit people, for whom El Chaco is held as a sacred link between the spiritual realm and the Earth, Documenta cancelled the loan deal on the grounds of liberal openness towards and respect for the wishes of other involved cultures:

> Documenta 13 stated that no loan of the El Chaco meteorite would be further requested without a full endorsement by the *pueblos originarios*, the traditional custodians of the land of Chaco, by the local community as a whole, and in careful consideration of the beliefs and principles of those custodians today. (Christov-Bakargiev 2012: p.30)

Failing to achieve this fantasy of inclusive consensus on behalf of the community as a whole, the lump of rock remained in the exhibition as a double looming emptiness, neither fully in its Argentinian resting place, from where it was Photoshop-transplanted into the exhibition catalogue, nor fully in Kassel, where it was evident only through minutes of a meeting capturing the decision of its non-arrival.

The meteorite is fascinating to me in the context of this study in its doubleness. On one hand, as a dematerialised non-object lost in transit, dependent for its meaning on its exhibition framing, it is exemplary of an idealist object within the post-conceptual tradition of contemporary art.[61] On the other hand, like the arche-fossil for Meillassoux, it is a material index of deep time, registering ancestral timescales inexperiencable to its viewer in the present. The exhibition, then, is proposed as a connector between these registers, ending up as a failure to reconcile them. This becomes, then, a different proposition from that of Meillassoux. Through proposing and attempting its physical removal, the meteorite has to be engaged with not only as an object for thought but also as specific material object already embedded within culture. Rather than positing its material temporality as a thought experiment for the astonished philosopher, in other words, it is instead proposed to be made sensorially available to a 'public' through the

[61] Lucy Lippard described the paradigm of the 'dematerialised art object', where concept is prioritised over material form, "during the 1960s the anti-intellectual, emotional intuitive processes of art-making characteristic of the last two decades have begun to give way to an ultra-conceptual art that emphasizes the thinking process almost exclusively." (Lippard 1973: p.43) Peter Osborne's definition of contemporary art focuses on its continuation of this tradition with the claim that "contemporary art is postconceptual art" (2013: p.3), focusing on historical destruction of medium, form or style as categories, leading to "an expansion to infinity of the possible materials for art." (p.48). The contradiction between the ontology of contemporary art and Meillassoux's speculative materialism is addressed by Malik (2015).

contemporary art exhibition. The failure to do this, however, reveals how such temporalities are contested, already entangled within other cosmologies, rituals, publics and senses. [62] By proposing to make the meteorite public through its exhibition at Documenta, as well as the tension between an object *for-us* and *without-us*, the question of who constitutes this *us* is brought sharply into focus – who is this object for and not for exactly? While the relocation of the object was claimed as "the imagination of temporary togetherness" (Christov-Bakargiev 2012: p.31) it also ended up facing the question of who and what is excluded from such horizons of being-together. While Meillassoux's argument is premised on unquestioned statements made by science on fossil-matter, the nomination of arche-fossil as contemporary art object, through *El Chaco*, serves to bring critical questioning to such frames of meaning, whether of science, philosophy or art, through attention to what they also suppress.

3.2.2. The Alreadymade Horizon

The *El Chaco* artwork, named after the 'El Chaco' meteorite, itself named after the El Chaco region of scrub and swamp plain crossing Paraguay, Bolivia and Argentina, was described by Christov-Bakargiev as an act that "can be interpreted within the frame and history of the conceptual readymade." (Documenta 2012: p.60) This provides a way to understand this gesture in more detail, and as a more general strategy. Art historian Thierry De Duve has written on the early 20th Century history of Duchamp's readymades, "The readymade…emphasized material, production processes and utility, but as a means to isolate the institutional value of the name of art to the detriment of all aesthetic value and all use values, both now losing their point and purpose" (2005: p.109). The readymade, as object transplanted from a non-art to an art context, is understood in this sense through a strategy of bracketing off – drawing attention to

[62] These questions around the different methodologies of art and philosophy in relation to the meteorite, radioactive waste or arche-fossil have developed not only through this analysis of Documenta but more recently and pointedly through my practice-based research. The act of burying demon marker objects (Documentation of Practice: Sections 6; 7), for example, opens questions not only around abstracted thoughts of temporality but also who participates in deep time's relations to culture. This work has also led me away from the more universalising arguments of some of Meillassoux's claims into considering this tension between the specific materiality of the deep time object and the dematerialised paradigm of its encounter (described In footnote 59), which I aim to address in this chapter.

value-making institutional parameters while closing off other values, histories and production processes. *El Chaco*, within this tradition, clearly draws on the institutional framing of dOCUMENTA (13) in order to point to and nominate the meteor and its removal as art (for a contemporary art audience and market), asking what is at stake in the temporal clashes alluded to in its accompanying description:

> The appearance of this cosmic 'already made' on Friedrichsplatz constitutes a temporal paradox reminiscent of the mysterious monolith in Stanley Kubrick's *2001: A Space Odyssey* (1968). Yet it is not a message from the future but a remnant from the birth of our solar system. A sheer embodiment of mass and gravity, it coexists anachronistically in our current dematerialized and digitalized world. (Documenta 2012: 60)

The readymade described by De Duve is 'already made' in the sense that it is made by a factory labourer or craftsperson before being designated as an art object, (2015: pp.109-110) alluding to a production time outside of its exhibition. In this sense, however, the term suggests a specifically inhuman cosmic register – i.e. the meteorite is already made before the existence of humanity – which I will draw on in my development of the concept. In the case of the already made, it is this deep timescale that becomes, initially, 'bracketed off' by the work. Following the curatorial description above, the object 'appears', suggesting a necessary relation to perception of an audience. Already this establishes a tension, between the appearance *for-us*, of an object that exists *without-us*. This opposition between the time of experience and the ancestral time of the meteorite offers a more productive collision, I would argue, than the proposed curatorial reference to the digital as dematerialised, which is problematic.[63] The work is precisely anachronistic then, not only in terms of coming from another time, but in staging different regimes of temporality, where the deep time of the meteorite comes to occupy the anthropocentric time of the contemporary art exhibition. The exhibition is

[63] Works such as Gabrys (2013) and Parikka (2015) have discussed the materiality of the digital. Gabrys describes the wires, waste dumps and data centres with "errant chemicals, Xylene, trichloroethylene, Freon 113 and sulfuric acid…from the manufacture of seemingly immaterial technologies." (2013: p.1), drawing attention to the material infrastructure and implications beyond ideologies of the digital as dematerialised.

open to this intrusion, through its invitation, while, at the same time, it keeps it closed off, through the meteorite's failure to fully appear within the exhibition's own parameters. The 'alreadymade' can be understood as the registration of processes, temporalities and materialities that do not necessarily prioritize the human (the point of view of the meteorite), and the staging of these processes for humans (the appearance on Friedrichsplatz) as contemporary art exhibition. As artistic strategy, it extends the tradition of the readymade into an engagement with objects anterior to terrestrial existence – a staging of the arche-fossil for contemporary art.

The readymade, following John Roberts's argument for its 'deflationary logic', expands art to include "alien …non-artistic things…made with very little labour", so binding the artist to "the intellectual demands of re-contextualizing extant objects in order to change their sign-value" with the consequence that "art can be made quite literally from anything" (Roberts 2010: pp.82–83). The alreadymade takes this 'alien' as a specifically non-human perspective. Art within the readymade tradition, then, becomes a frame of meaning for any-object-whatever. Taking this further, this logic informs the more general historical paradigm of contemporary art itself, understood as a set of conditions for the production, distribution and understanding of art. 'Anything can be art' is now a commonplace, as Julian Stallabrass points out in his opening definitions of the term 'contemporary art' (2006: p.12), but only, paradoxically, within the framework of art itself.[64] Following this, as art can not be defined as such through its own materiality, then it depends for its meaning on its receiving subjects. As Cox, Jaskey and Malik point out (2015: p.30), while artists and curators have taken up realist or materialist themes in their work there has been relatively little attention to how such theories actually challenge the post-Duchampian legacy of the term *art* itself. Through 'co-determining' interpretations and sensations, art under this paradigm prioritises subjective interpretation to give it meaning. Contemporary art, therefore, in Meillassoux's terms, is fundamentally correlational. As Malik has argued, "contemporary art as the aesthetic

[64] As Aranda, Wood and Vidokle (2009) discuss in attempting to define 'contemporary art', there is simultaneously "no objective structure or criterion with which to organise artistic activity from the past twenty years or so" and also "a fully formed cultural project, complete with logics of inclusion and exclusion not so different from those of the modernist project" (para 1-3). It becomes defined precisely through its claims to be anything-at-all.

experience of sense- and value-making, as the co-constitution of the art object *and* subject, assumes correlationism and reproduces it, affirms it, in every moment of its open-ended experience." (Malik 2015: p.186). This leads to a paradoxical situation for the alreadymade, both subject-dependent and prior to terrestrial thought.

It is the deep time of the meteorite that challenges this structure. It does this in two ways. Firstly, the-quite-literally-anything of the alreadymade is threatened by the quite specific something of deep time materiality, exceeding so not reducible to the correlational framework. Secondly, through the Moqoit cosmology, where the apparent universal open-endedness of the contemporary is occupied by another universality that does not neatly reduce into its frame, disrupting its consensus.[65] This suggests a tension between, on one hand, being *open to*, as affirmation of existing subjectification, and, on the other hand, being more radically *opened by* and so changed by the reality of deep time, refusing the correlational readymade or alreadymade structure, through the haunting re-emergence of what it suppresses. [66] This is not the end of the alreadymade, however. I have argued so far that it brackets off the non-human, as, following de Duve, the readymade brackets off criteria such as use and aesthetic values. At the same time, however, complicating de Duve's argument, the alreadymade also isolates and foregrounds the non-human. To do this, it must make deep time or the non-human 'affordable' within its own parameters. I call this the alreadymade 'two-step' and go on to discuss it next.

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[65] I have developed this first point partly through experimenting with the 'alreadymade' in my own practice, including materials from the HADES underground research lab (Boom clay, sound) in installation (Documentation of Practice: Section 4) leading to thoughts on the artwork/viewer relationship developed in Chapter 4. The second point informs more recent developing practice including marking nuclear toxicity in collaboration with local memorial practices at Maralinga (Documentation of Practice: Section 6) and tracing the colonial nuclear legacy of Belgium's Uranium (Documentation of Practice: Section 14).

[66] See Negarestani "Through affordance, openness is represented at the level of *being open* (to) not *being opened* (the plane of epidemic and contagion: plagues, contaminations, possession, etc.) 'I am open to you' means, I have the capacity to bear your investment or 'I afford you' (this is not an intentional conservative voice but what arises as the fundamental noise produced by the machinery of different levels of organization and boundary, and finally organic survival); if you exceed this capacity I will be *cracked, lacerated and laid open*." (2003: para.1)

3.2.3. Circumstances Readable by Art or The Contemporary Art Two-Step

The conflict over *El Chaco* could be read as the incommensurability of claims staked for the non-terrestrial – a clash between contemporary art and indigenous cosmologies. At the same time, however, failing in the physical removal of the rock, the work succeeds in compressing a set of concerns – postcolonial struggle; cosmologies; the investment of spirit in rock; pre-terrestrial timescales; bureacracies of transport; the suspense of delay; and so on – into its horizon, as they come to constitute the expanded materials of the work. In other words, as alreadymade, it is not just the case that the meteorite object becomes art (for a specific exclusive audience) but that as an ever expanding and devouring structure, all critique, alternative cosmologies and so on, become part of the work as well. The artwork *El Chaco*, understood within the conventions of contemporary art, comes to name not only the meteorite object, but all of its surrounding discussions and objections, described, for example, in terms of a kind of 'institutional engineering' including lobbying, composing within and between institutions.[67] This 'set of concerns' constituting the artwork includes the Moqoit cosmology and the radical decentring force of deep time, alluded to in the work while at the same time absorbed into it. It is here that the alreadymade can be understood at its most ravenous - consuming and digesting any critique to form part of its own expanded materials, through a layer of *aboutness*. This is the 'contemporary art two-step'. Rather than the looting of a sacred object unsettling the conditions of the work, in other words, the work becomes about looting a sacred object. Rather than being opened by deep time, it becomes about deep time, and such aboutness is always for-humans. I will now go on to explain this further.

El Chaco, through its registration of materialites anterior to terrestrial timescales, performs Christov-Bakargiev's claim for dOCUMENTA (13) as a kind of non-anthopocentric knowledge production:

> dOCUMENTA (13) is driven by a holistic and non-logocentric vision that is

[67] http://www.cosmocosa.com/faivovich-golberg-meteorite-el-taco/93/, my translation

> shared with, and that recognizes, the knowledges of animate and inanimate makers of the world. The attempt is to not put human thought hierarchically above the ability of other species and things to think and produce knowledge [...]. [This attempt] makes us more humble, able to see the partiality of human agency, encouraging a point of view that is less anthropocentric. (2012: 31)

The point of view of the meteorite, as material presence preceding human thought and experience, forces the thought of humankind's contingency, potentially re-aligning the priority and centrality of a specifically anthropocentric point of view. The claim for a less anthropocentric point of view, however, runs into the initial paradox of then staging this as an art exhibition for humans. Christov-Bakargiev goes on to address this through a reconsideration of the importance of 'art' as a defining term in relation to knowledge:

> Different forms of knowledge lie at the heart of the active exercise of reimagining the world. What these participants do and what they 'exhibit' in dOCUMENTA (13) may or may not be art. However, their acts, gestures, thoughts and knowledges produce and are produced by *circumstances that are readable by art, aspects that art can cope with and absorb*. The boundary between what is art and what is not becomes less important.
> (2012: 31, my italics)

What this argument does, however, while claiming to deprioritize 'art' as a category, is to re-prioritize the importance of art and specifically the exhibition as the primary cohering production of knowledge and meaning. The exhibition, as a container for practices of both art and non-art, comes to play the role of institutional enclosure. The idea of a meta-system that can cope with, absorb and make readable any kind of art and non-art suggests not a de-prioritizing of the category of art, as is claimed, but instead the re-affirmation of art, understood in its contemporary sense as a set of conditions for the experience, interpretation and understanding of any- object-whatever (Vidokle and Wood 2012). Christov-Bakargiev's argument here maintains a power for the exhibition-form as that which registers other productions of knowledge, makes them count as knowledge in art's own terms. Her use of the non-anthropocentric in this case becomes

a truth-condition *for* art, while 'art' itself is ultimately asserted and prioritized as transcendent from the potentially ungrounding force of 'nature' or the non-human. The concerns surrounding and constituting *El Chaco*, including its temporal tensions and political resonance, become 'circumstances readable by art' presided over and made readable by the benevolent and sensitive-to-difference host institution, all points of view absorbed by the blank and expanding meteorite-shaped hole.

Social anthropologist Marilyn Strathern (2018) has discussed how knowledge practices tend to make the worlds they know, conditioned to reinstate themselves, leading to epistemic gaps. Art as described above operates in this way. As machine for making readable in its own terms, it sets conditions for knowledge, which it delimits, absorbing knowledges without itself changing. These are the conditions of the alreadymade – as anything from 'outside' becomes part of the work, it insulates itself within a pseudo-universal horizon – seeming limitless while actually a historical paradigm for producing objects and subjects within its frame. Under a logic of interpretive pluralism, in other words, contemporary art, open to its receivers, can *mean* anything, so long as it means within its own parameters and institutional boundaries. The act or feeling of 'giving meaning' itself is foregrounded, staging and affirming a sense of subjective freedom and autonomy within a consensus where all opinions matter. Reflecting dominant productions of neoliberal subjectivity, [68] the viewer of the readymade is addressed as a free independent subject, while actually being delimited within a broader institutional frame, bound up with ideological interests. It offers freedom on its own terms, a negative *freedom from* constraints, where the valorising of individual self-expression and meaning-making, guaranteed by inherent indeterminacies of works under its condition, are set under conditions of exception from social norms, while actually being limited to a pre-assigned range of possibilites within a paradigm. Its appearance of universal unboundedness relies on those historical institutional conditions (critical, economic etc..) that create art's meaning and effects not as universally contemporary

[68] See for example, "neoliberal subjects are controlled *through* their freedom. They are fundamentally obliged to be free – free to govern and enhance themselves…Exercising freedom means becoming atomized units of production and consumption and being constantly exposed to uncertainty and danger" (Valiaho 2014: p.20).

but as bound up with the specific interests of globalising Western neoliberalism, an ideological contingency made most evident from analysis of practices at its edges, moving in and out of its borders, such as the failures of *El Chaco*. It is the transplantation of the specific deep time materiality of the meteorite into the contemporary art frame that threatens it, pointing to excesses and exclusions. Through the alreadymade two-step, however, this threat and contestation is itself made part of its expanding frame.

3.2.4. Radical Uncertainty - Contemporary Art and the RK&M Project

In a special 2009 edition of *October* as *Questionnaire on 'The Contemporary',* art historian Julia Bryan-Wilson's discusses the deep geological repository RK&M project in this context. She argues for 'looking past' the contemporary moment as method for art history. While her argument suggests a role for art within the RK&M project, I will argue that it also highlights ways in which the conditions of contemporary art are themselves challenged by radiological deep time. Bryan-Wilson is critical of the marker project's lack of engagement with the image analysis and "radical uncertainty" of art history and art practice (2009, p.5). She draws on how art was excluded from discussions around marking the Waste Isolation Pilot Plant in New Mexico, USA:

> The committee that the government assembled to design this marker notably did not include art historians or practicing artists. The omission is striking: though the design team included anthropologists, linguists and engineers, no-one specifically trained think about how *images* function across time was invited to participate in the project. (2009: p.5)

This led, she argues, to an uninformed use of art historical forms and references, and the lack of a more *critical* approach she defines as 'radical uncertainty' where:

> Images and practices clarify social relationships as well as destabilize positions and scramble histories…Such speculations are rooted in theoretical understandings about the doubts and contingencies of meaning…that there is

friction and slippage within interpretation. (p.6)

Her analysis forms a valid critique of the original 1991 marker proposals for the WIPP, which I go on to discuss at the start of the next chapter. The situation has started to change more recently, evidenced by processes of artistic and curatorial consultation. The 'International Conference and Debate on Radioactive Waste Management and Constructing Memory for Future Generations' (Verdun 2014), for example, suggested a shift from focusing on preventing human interference to preserving records, and some opening up of critical questions around the process, such as reflecting on the role of artistic practices in the project. The role of art here, however, was still largely figured as mode of communicating, "weaving a link from one generation to the next" (p.127) rather than offering the critical perspective in the present Bryan-Wilson suggests. Discussions around art have also tended toward its instrumentalization by the industry, as production of marketing images for example, or as process of 'trust-building' with local communities.[69] More recent events have evidenced a more developed and greater range of engagements with the project from an art practice perspective.[70] Such shifts have also been reflected in policy changes. The 'Arts, Culture and Education' component of the Key Information File (KIF), drafted by the Expert Group on RK&M, for example, discusses the importance of art in terms of its "critical awareness of visual culture…exploring conceptual and invisible concerns" (2017, p.2), as well as its role in transmitting knowledge. The role of art and the artist in this context continues to remain complex and contested, its criticality or utility developed in ongoing discussions, commissions and projects.

[69] My first visit to HADES, for example, was guided by the marketing team of the laboratory who retained an editorial interest in which and how images were used. While premised on security, this also involved discussions on how best video/photography could document and communicate their work to a public. Themann (2019) shows how art has been understood within a discourse of 'building trust' with local communities, or what could be understood as educating them from the industry perspective. The role of art in this context as instrumentalised or as autonomous research method was a main discussion point at Modern RT (2019).

[70] Such as *Overground Underground* at Z33 in Hasselt, Belgium (near to the HADES lab) and *(In)human Time* at University of Amsterdam (both 2018)

Drawing on my discussion of the alreadymade in this chapter, however, the scope of the debate can be extended. This goes beyond the question of artistic consultation on markers, opening more general tensions between the historical paradigm of contemporary art, the imaginaries at stake in the RK&M project, and art's relation to the real of environmental catastrophe. On one hand, following Bryan-Wilson, it can be seen that the project of marking buried nuclear waste sites is transformed in some ways through the intervention of art practices and art theoretical analysis, opening it to more critical questions around knowledge, politics and temporality. At the same time, however, the inverse is also the case. Rather than art's contribution to the repository context solely reflecting back a definition of contemporary art, in other words, it is also the case that contemporary art itself is transformed through the process.[71]

Bryan-Wilson's claim for the importance of critical ambiguity of contemporary art can be put within a historical context where the theoretical understanding over doubts of meaning she describes has been informed by legacies of post-structuralist thought, a major influence on how art is understood and given meaning within the paradigm of contemporary art today, as pointed out by Cox, Jaskey and Malik, "for the last generation and a half, critical art practices and theories have taken up post-structuralist, psychoanalytic and Marxist challenges to conventions of originality, authorship and identity. Within this paradigm, art is construed as always caught up in webs of discourse and interpretation without origin, end or ground" (2015: p.26). As they go on to discuss, however, "it is precisely these assumptions and conventions that are directly and explicitly challenged by the resurgent interest in realism and materialism" (p.26). The conditions Bryan-Wilson identifies above, for example, as central to contemporary art (doubts over meaning, interpretive slippage) open up aesthetic and theoretical stakes of the marker project, while at the same time *they themselves* are rendered contingent by the materiality of timescales at stake, "with the sun's death your insoluble questions will be done too…grounds for raising such questions as well as the place to do

[71] This is something I have aimed to address in my practice, considering how this practice-based research can be a new form of knowledge within the RK&M context, but also draw on this context to be critical of its own conditions as contemporary art. I take up these general claims in relation to the specifics of my practice in the 'Practice as Research' section following the dissertation.

this will no longer exist" (1991: pp.8-9) as Lyotard puts it.

Interrogating the alreadymade then is not to re-stage the arche-fossil as a problem for a tradition of anti-realist philosophy, but to ask a parallel question
How do the realist temporalities of nuclear waste become a problem for art within an anti-realist paradigm? The understanding of art in this sense as not having meaning that is in itself resolvable, makes it always open to interpretation, its meaning being resolved by another (viewer, critic), under the institutional semiotic conditions of contemporary art. Ambiguity and doubt, in other words, is always *for-a human subject* who resolves it, completes its meaning (as provisional, open again to another). The fact that the sun will die is not subject to such ambiguity, not dependent on another for its meaning. While the critical perspective of contemporary art, as Bryan-Wilson points out, is lacking from debate, it is also the case that its very conditions of meaning are undermined by its object of study, through the materiality of radiological deep time. The RK&M project suggests not only a lack of art but also its potential transformation.

3.3. Conclusion

The point of view of the meteorite is an incommensurable time. Returning to the initial claim for Documenta 13 as speculative non-anthropocentric knowledge production, it can be argued that this is undermined through the dominance of the alreadymade, which prioritizes art as a set of parasitical interpretive conditions for existing knowledge, safeguarded through a layer of critique. At the same time, the resurgence of the alreadymade suggests ways that artists are turning to non-human temporalities as a matter of political urgency, leading to proposals for rethinking relations of exteriority internal to a system. Within the alreadymade structure, non-anthropocentric knowledge is proposed and staged through a form that re-prioritizes the presence of human experience, and exercise of cognitive freedom with its own frame. Art as exhibition runs into the further problem of what it means to stage such debates, re-addressed to spectators in some way, without therefore re-affirming existing subjective priority. The alreadymade, like the sublime, limits knowledge of deep time through subjective limit. While the anthropogenic deep time sublime was understood as making the real opaque and unknowable through imposing the subject as negative limit, the alreadymade reduces the real to a set of pre-existing institutional correlational conditions.

In uncanny parallel with the Moqoit cosmology, Documenta 13 proposes the materiality of the meteorite as a connector between ancestral and phenomenal realms. Through doing so, however, it reduces the ancestral realm to the phenomenal. Deep time's disruption to its claims of universality is made affordable through the liberal openness of the loan cancellation, which "celebrate[s] the material and spiritual heritage of the world and all its peoples" (Documenta 2012: 31). This simultaneously rejects the alternative cosmological investment of the Moqoit, while, at the same time, affording it through reducing it to its horizon, expanding the bounded limits of contemporary art through an economical and strategic engagement with its outside. The time of the meteorite is acknowledged and desired but proves difficult as a 'circumstance readable by art' because of its excess energetic unreadability. Its difficulty is highlighted by the Moqoit request, which reveals contemporary art's claim to a universal inclusivity of interpretation as actually contingent, because other conflicting 'readings' are at stake.

In parallel with Meillassoux's question of how post-Kantian philosophy could be extended through an engagement with the non-human-dependent real, Documenta 13 poses and stages an analogous question for contemporary art. The alreadymade, like the arche-fossil, indicates the existence of 'ancestral reality' anterior to terrestrial life. By bringing an object into art from its outside, it draws critical attention to the conditions that give it meaning. At the same time, by doing so, it limits itself to this frame, separating itself from other scales and agencies both the object and its viewers are entangled with. By approaching the arche-fossil through physical removal rather than object for thought, *el Chaco* opens further problems, creating a tension between, on one hand, contemporary art as frame of meaning for any-object and, on the other, an outside that can't be afforded, revealing its own conditions as contingent. As my analysis of *El Chaco* has shown, the alien object claimed by Documenta as universal 'mystery of being' for 'the human race' occluded another outside, the Moqoit cosmology, including different understandings of care for and responsibility towards the meteorite object, leading to the tensions of the exhibition.

Philosopher Elizabeth Povinelli draws attention to such tensions in her analysis of Meillassoux's arche-fossil, asking what the arche-fossil object would mean for Binbin and Bilabang, members of a family she is working with in Australia as part of the indigenous Karrabing Collective. They are already invested in fossils and truth statements, as Povinelli describes, "clearly my friends think and act as if there are stakes in how one attends to the human and nonhuman things…to the mutual involvement of all things in the immanent arrangement of existence" (2016: p.69). While Meillassoux asks under what conditions meaningful truth statements can be made about the arche-fossil, Povinelli argues this is premised on a sense of detachment, the feeling of the object as a distant outside, while missing other narratives and understandings bound up with it. From this, she is critical of Meillassoux's claim for a particular definition of 'the human' as universal. This is a discourse familiar to Binbin and Bilabang, she argues, through narratives of colonialism where "a specific , particular thought written by specific particular people opens a way of thinking the absolute for all people…everyone has the capacity to reach the absolute through what only some of us created" (pp.73-4) This rhetoric of civilisational capacity, she argues, leads to a primitivist discourse where

Binbin and Bilabang themselves become arche-fossil for colonial culture, reminder of an outside before settler history. The 'representation of catastrophe' is always 'for-us' – the world-without-humans, as a landscape defined by human presence or absence, is always for-humans. Speculative realist philosophies, and their curatorial take-up such as in Documenta 13, have focused on relations between the in-itself, the without-us and the for-us. The already made, however, is a reminder that in claiming to represent 'the real' without acknowledging its theories and objects as part of that real, the 'us' remains unquestioned and exclusive.

While *el Chaco* stands in as a powerful example of the already made, the concept can also be understood more broadly, specifically in this study in relation to radiological deep time represented in art. As I have discussed, nuclear waste is a global environmental problem. Through the already made, it also becomes a problem for art in its existing paradigm, opening broader questions of how contemporary art could represent, conceptualise, or engage with the more-than-human real of global climate change. Responding to Bryan-Wilson, there is no slippage within interpretation of the catastrophic nuclear real. This is not to say that art should necessarily be abandoned in despair at its cosmic inutility. It is the case though that the introduction of art practice to the RK&M context opens up more theoretical problems than at first appears. Through radiological deep time, it finds itself living under the shadow of the dissolution of its own meaning-making frameworks. To make art in this situation is to operate within its institutional horizon of ambiguity and doubt, while also to point beyond this as limit, its own framing devices unpicked and riddled with contingency. This opens more general questions around how art attunes to and is transformed by radiological deep time, which I address in the final chapter.

Chapter Four – Interscalar Geo-fictions, Sampling, and the Radioglomerate Future Relic

4 1 Introduction

4 2 Nuclear Waste *against* Deep Time Communication

4 2 1 Apocalypse Deferred

4 2 2 Geo-fictionalising the Atomic Priesthood

4 2 3 Interscalar Vehicle against Capitalocene Derangement

4 3 Radioglomerate Aesthetics

4 3 1 Sample / Readymade

4 3 2 Sampling Deep Time: The Alienating Future Relic

4 3 3 Demonic Demand

4 4 Conclusion

4.1. Introduction

Following my critique of the sublime and alreadymade structures, in this chapter I propose an alternative aesthetics attuned to radiological deep time. To do this, I first of all, in 4.2.1, return to the RK&M context and some of the original proposals for 'markers' of nuclear waste storage sites in the early 1990s. I argue that criticisms of these can be extended beyond specific designs to the marker project itself more generally. The whole idea of marking repositories is bound up with narratives of deferred apocalypse and heroic salvation, restricted notions of toxicity and unquestioned concepts of knowledge, humanity and environment. Deep time within this narrative becomes itself a marker of human finitude. An alternative to a sublime approach to deep time futures can be drawn from Thomas Sebeok's 1984 report for the WIPP. His proposal of an inter-generational relay draws attention to the importance of mythic tradition in this context, and to the performative, constantly renewed nature of knowledge and its conditions. It is also, however, problematic, remaining anthropocentric and exclusive, embedded within colonial rhetoric in its imposition of new myths onto the land. My proposal here is for a 'geo-fictionalisation' of Sebeok's proposals, drawing on its methodology while opening it up through the materiality of the earth.[72]

I develop this first of all, in 4.2.2, through imagining a shift from marking the deep geological repository *site* to marking the radioactive waste itself. This shifts attention from containment to the ongoing contagious distribution of toxicity that the site, waste and artwork are all implicated within. The deep geological repository is understood as point of contact with the more-than-human hyperobject that exceeds it. I draw on the literal cutting open of barrels of nuclear waste at a laboratory for long-term storage and propose this as a way to build narratives through the radioactive materials, connecting the present with the local enfolding of deep time as I described it in Chapter One.

[72] This chapter correlates more directly with my practice. In terms of methodology, the arguments in the first three chapters have informed the development of my practice-based research, while this final chapter largely emerges from reflections on it. My claims for the 'geo-fictionalisation' process here are closely linked to claims for *Pazugoo* as well as the more general theoretical arguments in this chapter.

Against the derangement of scale of the sublime, the barrel becomes instead an 'interscalar vehicle' (Hecht) to conceptually navigate deep time.

In 4.3.1, I ask how artwork could become such an interscalar vehicle, arguing that this can be understood through the methodology of the *sample*. Drawing on an artwork described as 'sample/readymade' I propose the sample as a different relation to an outside than that of the alreadymade. It assumes an elsewhere that its encounter opens toward, foregrounding the artwork as partial model, remaining not fully determined by its viewer. Against the metaphoric sublime, the sample is metonymic, opening up the enclosing alreadymade frame along the deep time continuum. I develop this further in 4.3.2. by considering the sample from another time as *relic*. The relic twists the past into the present, connecting now to deep time and investing death with life, crossing ontological boundaries. The *radioglomerate*, however, as buried nuclear waste, inverts this temporality. As *future-relic*, its viewer becomes relic for-it. This leads to an analysis of the waste not as alien object but as *alienating*. This is understood both in terms of alienated objects, staging their implications within radiological deep time, and in alienated viewers, re-oriented within a more-than-human environment, stripped from an image of the transcendent self. Finally, in imagining a future perspective that undoes human exceptionality, I analyse this as a speculative ethics of the future radioglomerate relic. The RK&M Project is reconfigured, against the marker subject, as fabulating a progressive alienation, opening new directions for art within radiological deep time.

4.2. Nuclear Waste *against* Deep Time Communication

4.2.1. Apocalypse Deferred

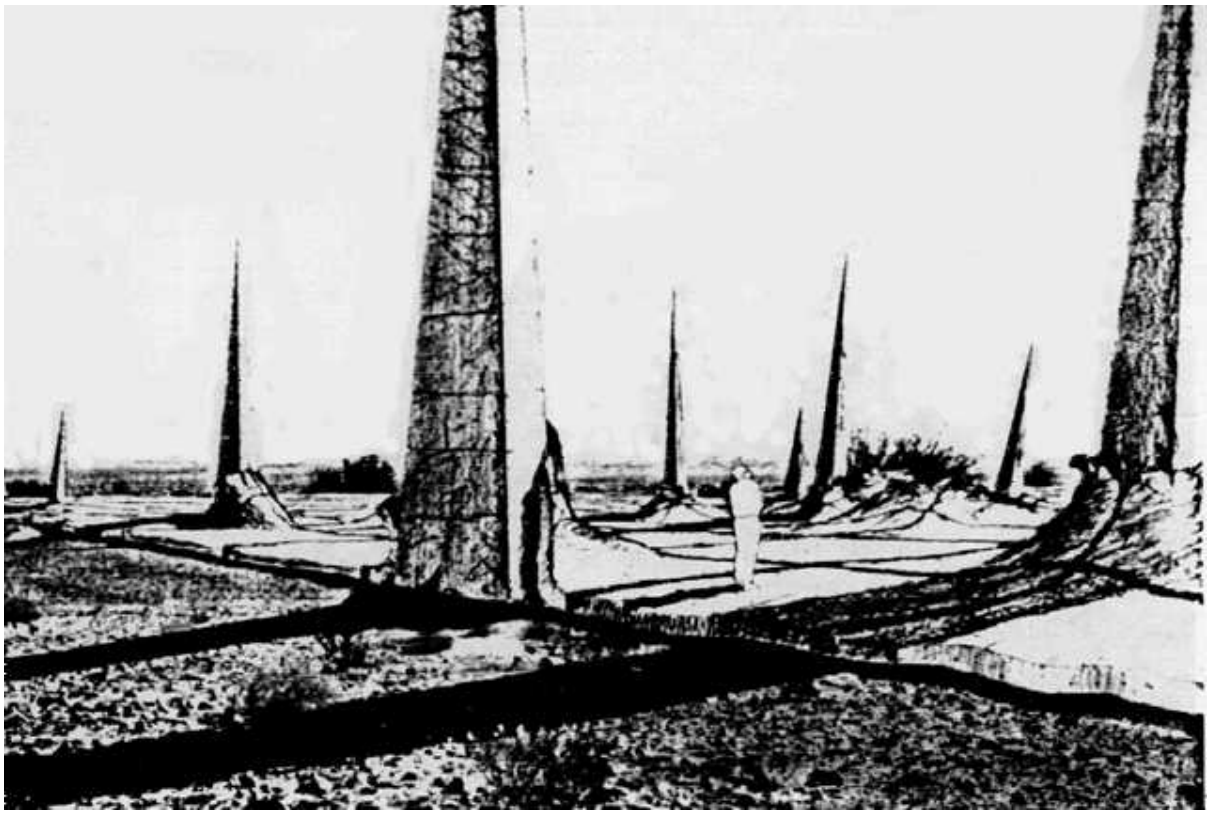


Figure 4.1: *Landscape of Thorns*, design by Michael Brill, illustration by Safdar Abidi, from Sandia National Laboratories Report, *Expert Judgement on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant*, 1991, image: https://urbigenous.net/library/WIPP/

Landscape of Thorns was one of a series of 1992 proposals for marking the site of high-level radioactive waste storage at the Waste Isolation Pilot Plant (WIPP), Yucca Mountain, USA. I discussed at the end of the last chapter how Bryan-Wilson has been critical of these designs due to their lack of consultation with art historians or the critical perspective of contemporary art. Other writers have also been critical. Hecht, for example, describes them as "more reliable as technopolitical signifiers in the present (in this case: *look! we've figured out how to communicate with our millennial descendants, so it's okay to bury the waste!*) than as effective media for the far future" (2018: p.22). The markers stage a kind of mastery of control over the future, in other words, which is

actually absurd. James Bridle in concluding his recent book on technology and the future, turns to the WIPP designs to describe them ironically as "sculpture[s] so terrible in form that other species will recognise [their] location as evil" (2019: p.251). Deploying overwhelming size and signifiers of fear, *Landscape of Thorns* also draws on the tradition of the sublime I have discussed.

More interestingly, however, such critiques can be expanded to the idea of the 'marker project' in general, and so the marker-subject. This is to consider the RK&M project not only as more or less bad sculpture but as claim to save the future from the environmental catastrophe of the nuclear. The whole premise of the project then becomes problematic. Donna Haraway, for example, has discussed how "in urgent times, many of us are tempted to address trouble in terms of making an imagined future safe, of stopping something from happening that looms in the future."(2018: p.1) Rather than 'staying with the trouble' of the present, as Haraway advocates, the proposed WIPP markers operate as both apocalypse and salvation, staging and deferring the drama of some humans destroying the world (for-humans) and other humans heroically saving it. This serves to reinforce the narrative that Zylinska has called 'rescuism' (2014: p.106), where it is imagined that heroic human action can 'save' the planet. This is problematic in a number of ways: it places responsibility onto individuals, generally through consumer actions, rather than examining social conditions; it re-introduces the very individualist thinking that climate change has undermined; and, of particular relevance in this case, it fantastically idealises a romantic Edenic past, which could somehow be returned to or protected. Artist Kayla Anderson (2012) has argued that such 'rescuism' stages an oversimplified relation between problem and solution, avoiding complexities of ecological crisis that demand radical re-imagining. Proposals such as *Landscape of Thorns* operate on the same logic as the representations of idealized nature at repository sites discussed in Chapter Two. By proposing that radioactivity will gradually disappear into 'nature', they are premised on the idealist binary of lost innocence / apocalyptic future, with humanity prioritized and figured, through the marker-subject, as barrier between.

Such designs reflect this narrative uncritically, not engaging with present contestations and future transformations of what counts as care and harm, or human. This serves to

reinforce both the universalising of specific experience as 'human', and the anthropocentric exceptionalism of 'disentangled' human finitude. In this Chapter, and in my practice, I consider other ways that art could draw upon this RK&M context, and so other ways it could address the more general critical questions it raises. I ask how art, beyond the sublime and alreadymade, could be a method for connecting localities of site and experience with the expanded and unfinished toxic territories of more-than-human spatial and temporal networks of radioactivity its viewers and works are implicated within. Rather than just 'transfer of knowledge' as the project proposes, how is knowledge itself transformed here in relation to ethics and radiological deep time?[73]

4.2.2. Geo-fictionalising the Atomic Priesthood

In order to address these questions, I turn first of all to the 1984 report for the Office of Nuclear Waste Isolation (U.S. Department of Energy) in consultation with the WIPP (Hora, Von Winterfeld & Trauth 1991). The report, written by commissioned semiotician Thomas Sebeok, asks what visual languages can be devised in the present as readable warnings in an unknown future, in order to avoid intrusion or interference. Interrogating definitions, problems and advantages of images, icons, signs and written languages, Sebeok argues that any message will decay and lose its intended meaning over time. In response to this, he proposes a 'relay' system, where 10,000 year futures are broken down into a series of inter-generational messages, reformulated anew by future groups of people. This opens the question of how such a process of recoding would be enforced in the future:

> The first recommendation, to wit: that information be launched and artificially passed on into the short-term and long-term future with the supplementary aid

[73] It is within this context that I situate the claims of my practice. All of the work presented here (Documentation of Practice) resists these narratives of salvation – staging the future as saved, and communication – assuming universal unchanged future humans. It does this through its distribution around multiple sites, its focus on discussions in the present, its focus on myth and mutation, and its burial to draw attention to the underground as much as the above ground monument. I will point out further direct connections between this chapter and the practice as it develops.

> of folkloristic devices. In particular a combination of an artificially created and nurtured ritual and legend. (Sebeok 1984: p.24)

Against designs for monolithic markers such as *Landscape of Thorns*, Sebeok's report suggests a different approach. As communication will change over time, then the constant renewing of knowledge through shared performative fictions is necessary. His proposal is an annual ritual, under the guardianship of a self-selected 'atomic priesthood', "a commission of knowledgeable physicists, experts in radiation sickness, anthropologists, linguists, psychologists, semioticians, and whatever additional expertise may be called for now and in the future" (p.30). Sebeok's future ritual method highlights the importance of a future-oriented critical renegotiation of meaning, making relevant of the sites to 'contemporary' moments of the future. The future is approached as a process bound up in the present, rather than as deferred. It is addressed through performance as a way to create new knowledge or communities of care. Sebeok's proposal also suggests, against Bridle's dismissal of myths as creeping into gaps of scientific knowledge (2019: p.251), and against the dismissal of the report at the time (Garfield 1994), the importance of folkloric tradition in this context. This can be understood both as an existing format for passing knowledge through time, and speculative possibility for building new collective mythologies. In this sense, it has potential shared affinity with Haraway's approach of speculative fabulation, "imagining and narrating collaboratively into the possibility space of the future" (Lemenager 2017: p.477). As myth, this must also be embedded into culture in a way which will survive, passed on and collected through archives, performative enactments or other institutions which must themselves be reflected upon. Rather than transplanting existing conditions to the future, this leads to a call for new modes and structural conditions for instituting knowledge and guardianship. It suggests a way of drawing on existing art institutions without falling into the alreadymade.

At the same time, however, Sebeok's report is also deeply problematic. It is anthropocentric in ways undone by the materiality of radiological deep time I have discussed, remaining within the framework of belief in communication with future people. While it avoids the apocalyptic sublime through its focus on intergenerational relay, it still perpetuates a story of salvation, where a small group of people will make

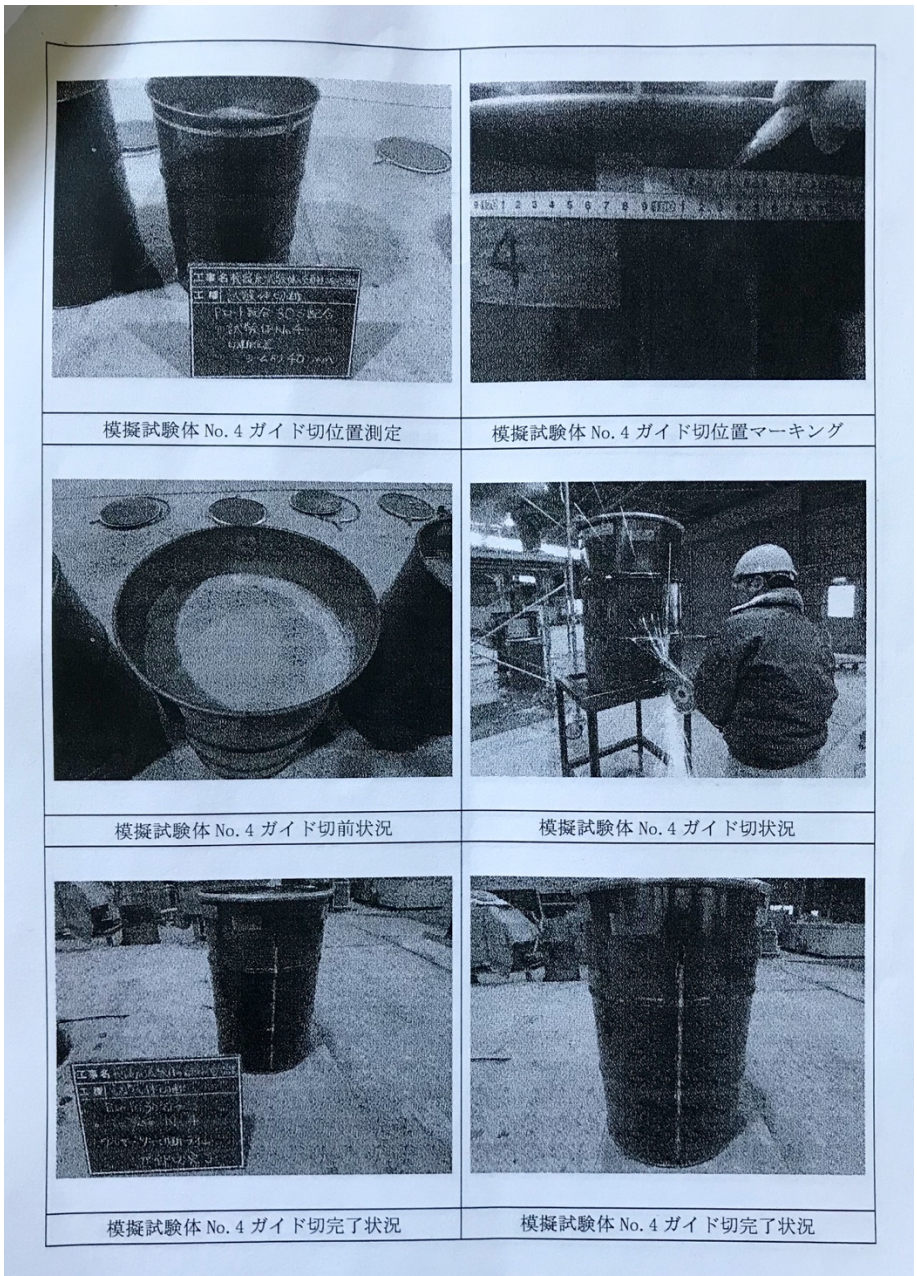
the world safe for other humans. Most importantly, these 'heroes' of the future are an exclusive group. There is no mention, for example, of inclusion of the local Shoshone and Paiute people, where the WIPP site at Yucca Mountain has significance as place of ancestral bones, and what stake they have in future human/non-human assemblages, or present folklore. Indeed the creation of new myths for the landscape can be read within a colonial rhetoric of erasing existing histories through imposing the 'new' history of the colonisers. Any analysis of which communities have been harmed in the nuclear process is subjugated to the more politically defused question of abstract communication methods, but this becomes ideologically loaded through his aim to keep knowledge of the site as secret of an elite Westerncentric group. In this way, Sebeok's proposals fail to realize the radical potential of their form. They remain embedded within colonial power relations, they restrict understanding distributed toxicity to a fixed geographical site, and they are premise on an ultimately unquestioned idea and centrality of 'the human' through deep time.

What I propose over the rest of this chapter then, is to take from Sebeok the importance of speculative fictions of the future, but develop this by rooting these fictions in the materiality and deep timescales of the contaminated earth. I propose, in other words, a 'geo-fictionalisation' of his proposals, where atomic priests are replaced by other figures discussed in this chapter, or tested in my practice. By fiction here I mean a process that removes the human as transcendental, opening up 'nature' and 'human' beyond what is known.[74] I also mean a mythic narrative, connecting local sites with universal timescales, human experience to more-than-human hyperobjects. I call it a geo-fiction as it emerges from the materiality of the buried radioactive waste, its histories and projected futures. This, I argue, shifts away from the idealist apocalypse/ salvation binary, always deferred to a future that circles around an unquestioned present. Instead, it draws on more-than-human futures as a way to undo the present, as an ethical call.

[74] See Konior (2017), drawing on Laruelle to argue for a science-fictionalisation of humanity.

4.2.3. Interscalar Vehicle against Capitalocene Derangement

My proposal for geo-fiction within the deep geological repository context, is to focus not on monumentalising the storage landscape, but instead on the radioactive waste itself:



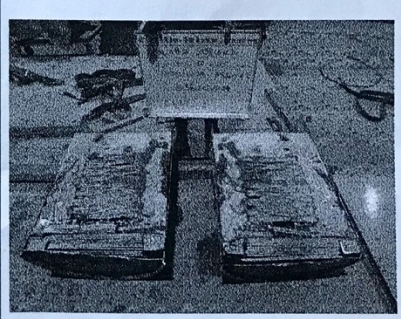
模擬試験体 No.7 切断完了状況

模擬試験体 No.7 切断完了状況

模擬試験体 No.10 切断前状況

模擬試験体 No.10 切断状況

模擬試験体 No.10 切断完了状況



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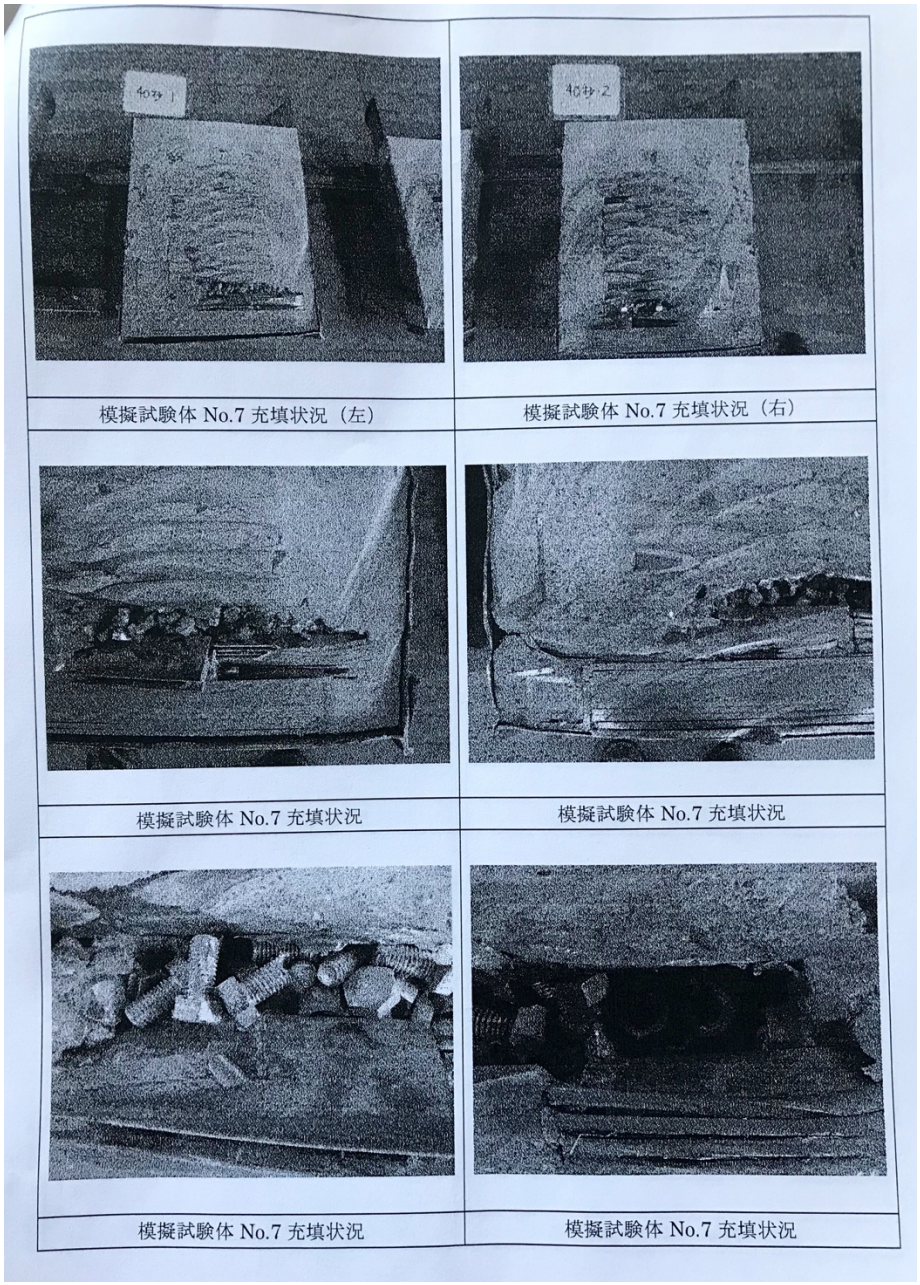

Figures 4.2-4.4: The cutting open of a barrel of radioactive waste for long-term storage at Horonobe Research Laboratory, Japan, image: Horonobe Research lab.

These images show the dissection of a barrel of radioactive waste for long-term storage at Horonobe Underground Research Center in Japan. The site, like HADES in Belgium, carries out testing on geological disposal for high-level radioactive waste. The process and its documentation is intended for safety purposes, examining the effects of storage on relations between materials, including gaps emerging through expansions and contractions. I propose using it here however as way into thinking a different approach to the existing RK&M imaginary. This process of unearthing acts as a counter-narrative

to the sealing off of waste away from future intruders in *Into Eternity*, instead drawing attention to the materiality of the waste as specific object.[75] Against marking the triumph of technologies of storage as indefinite postponement of harm, it can be asked what kind of marker the waste already is. The barrel stands as a recalcitrant leftover from modern utopian narratives of clean energy. It delineates and equivocates a collection of specific objects, formally arranged according to its dimensions. Ceramic pellets of spent nuclear fuel rods, high tensile coated alloy steel bolts from reactor fittings and domestic appliance fragments are all frozen temporarily to meld and leak over very long durations into new formations with the earth. Radioactive materiality penetrates objects and crosses boundaries, connecting narratives through uranium, formed in supernovas 6.6 billion years ago, traced to the formation of the Earth's crust, 4.54 billion years ago. Uranium ore deposits are distributed globally, 99 percent of which contain uranium-238 with a half-life of 4.5 billion years. Japan's uranium, for example, comes mainly from Australia, Canada and Kazakhstan. Japanese companies finance development of the West Mykuduk deposit in Kazakshtan in exchange for ownership of resources. Ore is crushed and leached in mills to concentrated yellowcake, enriched to be turned to fuel rods. Nuclear fuel powers the vast energy demands of data centres of cloud computing, including 38.7% of Apple's icloud.. Fuel rods serve a cycle, are removed from the core and left over as waste, lying in wait for future storage. Following my discussion of the local eruptions of radiological deep time at Krugersdorp, South Africa, in Chapter Two, it is through ungrounding the barrel these dispersed material histories can start to be connected.

I have argued so far that we need a different way of thinking radiological deep time in relation to humans, not only through sublime or alreadymade aesthetics, or through the existing RK&M framework. To do this means thinking nuclear waste not only at the distant scale of the arche-fossil but also in terms of how it intersects with both unequal planetary environmental crisis now and the more-than-human scales it is already

[75] This 'unearthing' parallels the 'earthing' employed in my practice through burials (Documentation of Practice: Sections 6, 7) with similar aim. For the March 2020 exhibition, *The Work of Time*, Z33, Hasselt, Belgium (related to Documentation of Practice: Section 14) I show a new A0 poster print diagramming this relation between earthing and unearthing, alongside myths of the underground and myths of flight.

embedded within. I have discussed the overlapping and proliferation of timescales within the Anthropocene, analysed in terms of a 'loss of co-ordinates'. To trace the deep temporality of the nuclear waste barrel, on the other hand, is to focus on connection and cognition over loss and gaps. It can be understood in this sense as 'interscalar vehicle' for knowledge within radiological deep time. I take this term from Gabrielle Hecht, who describes the concept as "a means of connecting stories and scales usually kept apart":

> Interscalar vehicles – theirs and ours – have political, ethical, epistemological, and/or affective dimensions. What makes something an interscalar vehicle is not its essence but its deployment and uptake, its potential to make political claims, craft social relationships, or simply open our imaginations. (2019: p.7)

Against the derangement of scale of the Anthropocene, or the leap to the universal of the arche-fossil,[76] the waste becomes interscalar when it is thought according to the ontology of radiological deep time I outlined in Chapter One. This is to consider how it indexes deep time neither as warning nor salvation from an apocalyptic future but as it enfolds through a multiplicity of real local scales, not restricted to the deep geological repository site, but proliferating territories of toxicity across the planet. Thinking the waste as interscalar vehicle shifts focus away from the sublime magnitude of deep time to emphasise these scene-shifting entanglements in power relations, conflict and colonial extraction of resources, technologies and spirits of capitalism. It connects a range of timescales, from deep times of extraction, through to industrial labour, toxic decay and planetary exhaustion, traversing mythologies and future timescales of harm and care, including its encounter in the present.[77]

Historian Dipesh Chakrabarty has argued that "the current conjuncture of globalisation and global warming leaves us with the challenge of having to think of human agency over multiple and incommensurable scales at once." (2012:p.1) Marking waste as interscalar vehicle suggests a way to start understanding agency at scales including the vulnerability of the individual miner, the economic regulatory network of what is

[76] See Robin Mackay's (2017) argument for the connecting thread of the plot against Meillassoux's "global with no consistent connection to any locality" (part 5: para 3).
[77] Within these terms I also propose *Pazugoo* as an interscalar vehicle.

designated radioactive, the spread of radionuclides through air, plants and nonhuman animals, through to scales of half-lives that index the planet. This means thinking humans both as the differentiated specificity that Chakrabarty names the 'human-human' and as the destructive species-force he calls 'the nonhuman-human' (2012: p.13), but could more accurately, I would argue, be called capitalism.[78] I have showed how the sublime and the alreadymade fail to do this, offering no way to navigate between the human and its extensive implications in the capitalocene. The aesthetics of the interscalar vehicle instead contribute to such a navigation, reconfiguring art and its viewers as agents complicit in these more-than-human structures of power.

The interscalar vehicle challenges what I analysed in Chapter Two as the sublime separation of the 'whole earth rhetoric' of the Anthropocene by refusing to remain at an awe-inspiring planetary scale away from its differentiated responsibilities and accountabilities. At the same time, it challenges the narrative of nuclear toxicity as a solely 'local' problem. Instead it suggests the importance of threading together different scales of political imaginaries and action. Hecht proposes understanding the Anthropocene precisely through waste, and further that such waste can act as key technique of Anthropocene epistemology, "it's *how* we know the geological, atmospheric and biophysical impact of human activity" (2019: p.3). Thinking according to the interscalar vehicle involves making hypotheses beyond sense-experience from available materials, while also connecting this data to other scales of experience. It proposes moving between scales while also attending to the politics of scale making, considering how and why certain scales are referenced or hidden as performative gestures. I have argued that artwork cannot stand outside of and make images of radiological deep time, I propose instead that it can become an interscalar vehicle within. This is to suggest it can navigate 'outwards' along the radiological deep time continuum, connecting narratives while reflecting critically on scales deployed. To think the artwork in this way requires further analysis, which I will go on to develop this over the rest of the

[78] Here I differ from Chakrabarty, where he maintains a separation between 'intra-human' structures such as global capitalism, and deep times of 'geo-bio-chemical processes of the planet' (2018), as I would argue for the importance of thinking capitalism as bound up with such processes.

chapter. I will focus first of all on understanding artwork in this context as ‘sample’, part of a broader political ecology of toxicity it is contiguous with.

4.3. Radioglomerate Aesthetics

4.3.1. Sample / Readymade

Art historian Kirsty Robertson writes about an artwork by Kelly Jazvac and Patricia Corcoran:

Figure 4.5: Plastiglomerate sample/ready-made collected by geologist Patricia Corcoran and sculptor Kelly Jazvac at Kamilo Beach, Hawai'i, 2012, image: Kelly Wood. Courtesy of the artist.

> The plastic and beach detritus had been combined into a single substance by bonfires. Human action on the beach had created what Corcoran and Jazvac named “plastiglomerate,” a sand-and-plastic conglomerate. Molten plastic had

> also in-filled many of the vesicles in the volcanic rock, becoming part of the land that would eventually be eroded back into sand…
>
> …More poetically, plastiglomerate indexically unites the human with the currents of water; with the breaking down, over millennia, of stone into sand and fossils into oil; with the quick substration of that oil into fuel; and with the refining of that fuel into polycarbons—into plastic, into garbage. From the primordial muck, to the ocean, to the beach, and back to land, plastiglomerate is an uncanny material marker. It shows the ontological inseparability of all matter, from the micro to the macro. (2016: section 1, para.2-3)

The 'plastiglomerate' term has been used to describe the plastic-rock hybrids formed by processes including human pollution, and claimed by some as indicative marker of the shift into the Anthropocene epoch (Robertson 2016: section 1, para. 5). As well as referencing the human and non-human agencies involved in its production, the object also embeds multiple temporalities. This includes the geological dating of the rock and the future slow decay of plastic, through its recalcitrant non-biodegradability.[79] I am interested here in particular, however, in Robertson's specific designation of this object as 'sample/readymade'. This uncertainty over how exactly to describe the object is also evident in Jazvac's own framing of the work, where it is described on her website variously as a readymade object, a plastic-based artwork and a new type of stone (Jazvac 2018). A journal article by Jazvac, Corcoran and their collaborator Charles Moore signals further hesitation, describing the work as 'stone' (inverted commas in original), anthropogenically influenced material, and, in interesting parallel with the deep geological repository RK&M project, as marker or marker horizon.

Such slippage suggests a productive disciplinary confusion around how these objects could be conceptualised specifically as art objects (named, authored and commodified as readymade works on the artist website), as objects of science, or of philosophy, and what happens in such collisions. Meillassoux's argument in *After Finitude* can be

[79] See Davis (2015) discussing plastic as substrate of advanced capitalism in relation to philosophies of finitude.

understood as premised on a contradiction in how science and philosophy frame an object (the arche fossil) through statements. Robertson's text starts to unravel a corollary opposition between science and art's framing devices and propositions. The object as 'readymade' can be understood precisely in terms of the 'already made' structure I discussed in the previous chapter, and Robertson points to some problematic aspects of reducing it to this explanatory framework.[80] The supplementary sample/readymade, though, evidences the insufficiency of either designation. It is through thinking this strange hybrid term of sample/readymade, I propose here, that tendencies toward interscalar aesthetics can be developed further.

The sample and the readymade suggest different kinds of relation to an outside.
The readymade or alreadymade, as discussed in the previous chapter, brackets off then ingests its outside (the labour of the worker making the object, disputes over ritualistic function, indigenous cosmologies etc..) under its own contemporary art conditions, determined by the market, which are imposed as a pseudo-universal horizon. It closes off from the whole it is part of, collapsing this into specific conditions of the now. To understand the plastiglomerate as readymade, in other words, is to understand it framed as art object, where nature, deep time or the real as more-than-human entities are always reduced to this correlational frame. Its indexed scales that exceed the human are collapsed back into a structure determined by necessary relation to the human subject. The sample, on the other hand, goes beyond its framing context to open out metonymically into a larger whole of which it is a part. It assumes an elsewhere.

As sample, the object foregrounds its own partiality. It claims to be representative of something larger outside the exhibition, of which it is a part. The exhibition itself, therefore, and the moment of encounter of the artwork, become a point of contact with something else, inaccessible through that moment and not fully contained by the exhibition. Work can never be 'completed' by a viewer as it remains always partial, part of an outside it is not identical with.

[80] This includes for example, a tendency for artists to celebrate rather than be critical of Anthropogenic pollution as it creates novel material for the art market, "a gesture that is cognizant of capitalism's love of the new, even as it replicates it." (2016: section 4: para. 6)

I will now briefly present two examples of art sampling sites in Japan in the immediate aftermath of the Fukushima Daiichi nuclear disaster of 2011. Shimpei Takeda's *Trace* (2011-12) series of cameraless photography work registers the reaction of photosensitive paper to contaminated soil at locations named in the work titles.

Figure 4.6: *Trace 3 Former Kasimigaura Naval Air Base. Soil Sample Data: Collected Date 1/3/2012. Weather: Sunny. Location Ami, Ibaraki (104.9mi/ 168.8km SW). Radiation Measurement: (Air) 0.415, (Ground) 1.007 musivert/h*

Through the methodology of the sample, the paper models a small part of a complex larger object of which it is a part. The artwork doesn't claim to represent the toxic site but rather becomes itself implicated in the contagious toxic event of dispersed radioactive contamination post-Fukushima.[81] As sample, the work also draws attention to itself as test or experiment, part of a broader framework of regulation and visualization of radiation levels. Viewers of the exposed image can trace it to the toxic event it references. Its exhibition, then, is not limited to the present moment of its

[81] As buried demonic markers gradually degrade and become part of the contaminated earth they inhabit.

affective encounter, but this is drawn upon to point to something else outside of this framework.

The sample is not as figure for deep time, standing in to be interpreted as an image for it, but immersed in it, a process of modelling its material conditions. Becoming sample, the artwork exhibits a perfomative materiality, staging its own implications in a real outside of itself.

Figure 4.7: ***Does this Soup Taste Ambivalent?*** installation detail, https://news.artnet.com/market/artists-to-serve-radioactive-soup-at-frieze-london-114962

At the Frieze Art Fair in London in 2012, through another kind of performative materiality, visitors were given the opportunity to themselves sample soup made from vegetables grown in Fukushima in the wake of the disaster. The performance, a work by Japanese brothers Tomoo and Ei Arakawa working under the name United Brothers, used this participatory strategy to draw attention to radiation harm as a combination of physical phenomena, regulatory mechanisms of measurement and cultural affects of fear. In this case, to sample the Fukushima soup, one has to ingest it, allowing radiation-exposed processes to enter into the body. The participating body as material enters into a network of human and non-human relations which form part of the Fukushima hyperobject. Through the sampling process, as with Takeda's emulsion coated paper, the digestive system-soup assemblage becomes part of the Fukushima hyperobject rather than an illustrative figure standing in for it. *Does this Soup Taste Ambivalent?* performs an anti-sublime interface not only through its deadpan affect – nothing

immediately happens - but also through this collapse of figurative distance, transforming participating bodies into partial models of Fukushima.

In proposing an aesthetic of the 'anti-sublime', philosopher Steven Shaviro has discussed the sublime as metaphorical transference, disaster experienced vicariously at a safe distance. This is undermined, he goes on to argue, by the literalness of real catastrophe, "figuration is erased, potentiality is reduced to definiteness and determination…No metaphor can survive being taken literally" (2012: p.38), and he proposes a deflationary aesthetic of flatness and inertia in its place. I followed this opposition in Chapter One, thinking the truth of extinction against the spectacular image of apocalypse. I would like now to add a further distinction, not only between the metaphorical and literal, but also between the metaphorical and *metonymic*. Writing in 1971, the linguist and literary theorist Roman Jakobson drew out this metaphor-metonymy opposition, analysing poetic devices through analysis of opposing types of aphasia conditions:

> The two opposite tropes, metaphor and metonymy present the most condensed expression of two basic modes of relation: the internal relation of similarity (and contrast) underlies the metaphor; the external relation of contiguity (and remoteness) determines the metonymy. (2010: p.232)

These modes of relation can be drawn upon here. Metaphor defines a similarity between discrete objects. Sublime aesthetics rely on such a similarity - between the awe-inspiring landscape and real apocalypse, for example; or between a staged affect of fear and literal dissolution of subjectivity. Metonym defines a contiguity between things, and it is here that connections to the continuum of deep time can be seen, where human experience dissolves into the more-than-human temporality of which it is a part.[82] The metonymic sample, then, becomes focal point for a process of generalisation from the experience off the art object to its environment.

[82] In psychoanalysis, the opposition has been mapped onto the metaphorical displacement of transference against the metonymic process of condensation (Baudouin 2015: p.18).

The sample/readymade, as double designation, draws on the critical framing of contemporary art, while also opening this up beyond itself, laid out and amplified into a larger scale, the exhibition frame twisted into its surrounding environment. The encounter with the work becomes part of a centrifugal process away from it, navigational procedure through radiological deep time.

4.3.2. Sampling Deep Time: The Alienating Future Relic

In drawing attention to the art object's complicity within deep time, other works have also drawn on the 'sample' description and method:

Figure 4. 8: Work described as 'sample from a future Natural History Museum', Julian Charriere, *Metamorphism XVII* (2016), installation view, *Adapt to Survive: Notes from The Future, HENI Project Space, Hayward Gallery, London*, 2016, image: thisistomorrow.com

This work from artist Julian Charriere *Metamorphism* series consists of a lump of electronic waste in cooled molten lava displayed in a glass vitrine. It is described as "an amalgam of cultural memories incorporated into a geological matrix, an imagined

fragment from a future natural history museum" (Charriere 2016). The work can be understood, in this sense, not as sample of another space, but of another *time*.

A sample from another time is what is known as a 'relic', an object unearthed by archeologists as marker of a time past, emphasizing the presence of that past within the present moment of its discovery. Perhaps this description of the relic more accurately coincides with Binbin and Bilawag's relation to fossils and bones that that of the arche-fossil (discussed at the end of Chapter Three). For them, as described by Povinelli (2016: p.61), the manifestation of ancestral bones acts as a connector to shared histories of territorial belonging and dislocation. The relic is a leftover, which won't go away. Negarestani has described how it "confounds chronological time by connecting Now with abyssal time scales" (2008: p.242). It is ungrounding through its literal exhumation, undermining the order of the strata, "it invokes or resurrects beings before their time comes… unlocking timescales which cannot be synchronised by chronological time" (p.239). The relic in this sense can be understood as a twisting of past into present, of death reinvested with life. As pointed out by Woodard, it is through the relic object "binding temporalities to phenomenologies" (2013: p.53-54) that Negarestani emphasizes, against Meillassoux, a continuum between phenomenal and ancestral realms. This gives the relic a ritualistic power, through its bringing to life of the dead. The relic focuses on contagious boundary-crossing over separation of ontological realms. Against the alreadymade, it twists the outside of the frame back within.

The relic, then, acts against the separation of deep time as other to now, enacting it instead as an eruption in the present. Against the sublime, it refuses to imagine deep time as unknowably immense, breaking down the protective barrier between subject and its outside. Against the alreadymade, it retains its power as exteriority folded into an inside, an anachronistic force, encountered while not fully afforded by the present. Common to culture as an unearthed past, I want to ask here what it would mean to also think the relic as contiguous relation between deep time *futures* and now. It is this inverted temporality that is evident in Charriere's work, where instead of a relic from the past we are confronted by a fragment from a future museum, as relic-to-come. It becomes an excavation of present culture from an imagined future space. This shifts the address of the work away from its present viewer, towards also including an unknown

future museum, for which its viewing subjects and their culture now become the sample. This serves to invert the dominant viewer-object relation of the alreadymade, as the viewer becomes sample or relic for-it.[83]

Against the imaginary of nuclear waste storage as separation and containment, the 'infinite quarantine' that Smudge Studio (2012) describe, I propose re-imagining it through the temporality of the future relic, defined by its potential to be unearthed, unknown by whom or what. Examining barrels of radioactive waste for long-term storage, it can be seen that the process Charriere stages for art is already happening anyway. Deep geological repositories proposed after testing at sites like HADES will, in future, consist of radioactive particle infused clay or rock, indexing residues of industrial nuclear power generation alongside the chemical weathering of silicate-bearing rock. Future archaeologists may unearth formations of microplastic-infected sediment as evidence of human-environmental interactions. On the other hand, they may not, as microbiological processes form other assemblages indifferent to an archaeological gaze. Drawing on the plastiglomerate term, I call these future relics coalesced through radiation to become part of the Earth 'radioglomerate'. While Charriere's *Metamorphism* aims to collapse distinctions between what are considered industrially synthetic and naturally produced objects, barrels of mined, produced and abandoned stuff, ready for long-term burial, are already doing this, in more complex yet less spectacular formations. While Charriere's future imagines a museum and viewers the same as now, radioglomerate imagines us now from the perspective of an unknown deep future.

Fossils operate as relic-connectors to the ancestral past, but for radiological deep time this must also be imagined from the future abyss of planetary extinction. Radioglomerate has potential to be exhumed, but whether discovered by future lifeforms or not, through it we now in the present become relics for something unknown, indifferent and alien. The project of marking nuclear waste sites, then, can

[83] It is the conceptualising of the relic in this section that comes more directly from reflection on my *Pazugoo* burials as a future relic-making practice, and its exhibition (Documentation of Practice: Sections 2, 4, 9, 13) as the alienating encounter that I go on to propose here.

potentially be seen as the kind of 'pivot' described by Benjamin Bratton in his discussion of Meillassoux's arche-fossil shifting from thinking ancestrality to descendance – not only connecting now to the past, but connecting deep futures back to the present:

> Just as we are forced to see in the fossil the contingency of a world that precedes thought, we are also forced to encounter in advance – as a measure of the present condition – the descendant for which we are the ancestor and for which we are the unthinkable fossil…for which our thought and trace will be as alien, inaccessible, and horrifying in its indifference as the cenozoic fossil is to us now. (2013: part 4)

Adopting this shift means understanding the fossil not only as alien object (as in Documenta where it is alien for contemporary art or in *After Finitude* where it is alien for post-Kantian philosophy), but also as *alienating*, catalyst for ungrounding or making-alien of the present moment of its experience, "being from elsewhere, the relic conveys to the believers their own distance, estrangement and foreignness" (Lukic 2013 p.70). It turns them to objects, as Binbin and Bilawag become objects for the bones they unearth, which think about them, remember them (Povinelli 2016: p.61). Against the imaginary of the marker-subject, the viewer of the future-relic becomes its object, alienated from the conditions that structure its understanding in the present. This is a different aesthetic experience to that of the sublime or the alreadymade encounter. Through the strangeness of being jolted out of already conditioned anthropocentric scales as part of a process of mutual orientation with an environment, it suggests an aesthetic experience of dislocation or sensual recalibration. I discussed earlier in this chapter one kind of alienation - through a self-aware staging of its own material implications within radiological deep time, artworks themselves are alienated, drawing attention to their own position within the real. As discussed in the examples of Takeda's and United Brothers' work, this suggests beyond just naming work as sample, it can be taken on as a procedure of performative materiality. The dislocating force of the future relic operates as another kind of alienation.[84] The artwork becomes alienating object

[84] Jameson's expression of the alienated gap between local phenomena and global conditions that structure them, discussed in Chapter Two, draws on alienation as negative subjection of autonomy to capitalist processes. This can lead to a problem, however, in

from the future abyss that samples its viewer, suggesting directions for structuring aesthetic experience in ways not reducible to the sublime or alreadymade. At the start of this thesis, I discussed the marker subject as a specific genre of human taken as universal. The alienating future relic, instead, fictionalizes the human through the art encounter.

4.3.3. Demonic Demand

The deep geological repository project sets out to create a 'natural' distinction between the spent, dead, fuel indefinitely incarcerated, and the life it damages. As I have discussed, this is premised on a narrative of anthropocentric salvation, haunted by apocalypse, supported by the figures of the marker subject and the planetary image. It is such separation of what counts of life and death that echoes what Povinelli has described as 'geontopower', the governance of regions of existence, their meanings, imports, and uses at the heart of the colonial ordering of things (2019: part 2 para 1). Geontopower maintains and claims as natural a distinction between life and non-life, setting political conditions for the assessment of all activity, suppressing other forms of knowledge, "colonialism did not merely destroy people and their lands, but attempted to destroy myriad non-Western understandings of the irreducible entanglement of

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assuming an authentic self, identity or nature, that the subject is alienated *from*. I use alienation here instead to suggest both a critical distancing from and dissolving of anthropocentric perspective, a process of stripping away the image of the transcendent self through orientation within an environment, in Haraway's terms, "becoming entwined in myriad unfinished configurations of places, times, matters, meanings" (Haraway 2016: p.1). In a sense this is the inverse of how Tsing uses the term (2015: p.6), where she describes alienation negatively as mode of individualism, 'standing alone' against such entanglements, to be abstracted and exchanged like goods. My definition is more in line with Brassier's discussion of alienation as a positive condition where the split of the thinking subject from 'the self' is "embraced as enabling condition for thought and practice. It incurs a defamiliarisation allowing semblance to be confronted as semblance from a vantage registering the discrepancy between how appearances are experienced and how they are produced." This is elaborated through strategy within noise and improvisation practice "to render opaque what is usually left transparent" (2012, no pages). In this case, the artwork is rendered opaque as 'performative materiality' and the subject's materiality within the real is made opaque through the encounter with the relic.

human and nonhuman existences that challenge the toxic imaginary of colonial and capitalist extraction." (2019: part 1 para 8)

It is the relic that disrupts the geontopower of the deep geological repository. Its exhumation is the haunting re-emergence of suppressed modes of life and relations to the more-than-human world. Defined by its potential future exhumation, unknown by whom or by what, the future-relic demands the imagining of a subject implicated within this ungrounding in the present. For Negarestani, this spatial, temporal and ontological twisting of the relic is that of the "inorganic demon or xenolithic artefact" (2008: p.223). The demon, lifeless until it occupies bodies parasitically, is local yet elsewhere. In Povinelli's *Geontologies*, when Binbag and Bilawag unearth the bones, it is the relic that makes an ethical demand on them, "a certain obligated co-responsiveness…
into an ongoing mutual orientation and involvement (cognitively, sensory, materially) within the landscape…embodied obligation was not a completed event, but rather ongoing efforts of attention to often nuanced interactions between human actions and other modes of actions" (2016: pp.79-80). The relic incites an ethics of distancing from the transcendent self through cognitive and sensory involvement with 'a field of intervolved materials'. Imagined speculatively within this framework of manifestation, it is the future relic that is not completed by its viewer but makes a demand on its viewer, as a speculative ethics with radiological deep time. This starts to outline an alternative aesthetic encounter to the sublime or alreadymade. While the sublime installs a subjective limit point against the real of deep time, the alreadymade is open to deep time, as much as it can afford. It is the relic that breaks down these structures, creating a different mode of subjectification through the art encounter, where the demonic relic funnels the outside through its viewer as host, alienating the self to produce a subject entangled within radiological deep time, through cognitive, sensory and material involvement. At the start of this thesis, I introduced the marker subject as a specific figure and practice of the human. This draws on Sylvia Wynter's discussion on challenging specific genre of the human most adequate to neoliberal proceeses, as outlined by Jennifer Gabrys:

> The "catastrophe" of climate change is also a "catastrophe" of the ways in which the "genre" of the human has been designated as an excluding and accumulating

> subject. Yet this mode or way of being human, as one limited genre, might also be questioned and transformed. [Wynter] suggests a project that attends to *being human as praxis* as a way to engage with the processes that sustain—and that might also remake—ways of being human…
>
> …The question of the planetary cannot be addressed without also reworking divisions of the human, and the injustices that result from these limited modes of being. At the same time, by attending to the planetary it is possible to consider how the prevailing genre of the human has excluded more-than-human entities and relations. (Gabrys 2018: section 2, para.6)

The RK&M project can be rethought as such a praxis of the human, attending to the planetary scales of radiological deep time. To geo-fictionalise Sebeok's call is to ask not how knowledge could be passed on by an elite priesthood, but to imagine the future relay as a progressive alienation, a fictionalization toward an unknown future. Imagining buried nuclear waste as future radioglomerate relic, it becomes a speculative materialist ethics in the present. Through art, its encounter and viewer become part of a reformulation of the human.

4.4. Conclusion

Criticism of designs for artworks to mark deep geological repository sites can be extended to the marker project more generally. The claim to communicate danger to future people is bound up with narratives of salvation and an idealized return to a state of nature, through the universalized marker subject, disentangled from its environment. Against this I have proposed using the project to fabulate an unknown vantage point on the present, considering how this challenges the marker subject as 'genre of the human', as well as the aesthetic structures of the sublime and alreadymade, suggesting new directions for art.

Returning to Sebeok's proposals for passing on nuclear knowledge through an Atomic Priesthood. I proposed a 'geo-fictionalisation' of this, focusing on a more materialist approach. To do this, I firstly proposed thinking art in this context as interscalar vehicle. This is a method for connecting localities of site and experience with the expanded and unfinished toxic territories of more-than-human spatial and temporal networks of radioactivity. Drawing attention to power structures and toxic networks art and its viewers are implicated within, it acts as epistemological method from within the intra-actions of radiological deep time.
I proposed a shift within the RK&M project from building monumental structures above ground to communicate with future people to focusing on the materiality of the radioactive waste itself. Already entangled with planetary human phenomena and unknown deep futures, the waste becomes a marker embedded within the hyperobject of radiological deep time, implicated within ecological crisis and its effects.
entangled with planetary human phenomena and unknown deep futures. RK&M becomes instead a way of moving through and reflecting on scales of imaginaries.[85]

Following this, I focused on developing some concepts for a more general aesthetics of radiological deep time. Against the alreadymade, discussed in the previous chapter, I

[85] This informs my current practice (Documentation of Practice: Section 14), where I am working with materials scientists to trace, as far as is possible, the make-up and origins of radioactive waste for storage at the HADES site.

proposed art as sample, moving beyond its framing context to open out metonymically into a larger whole of which it is a part. The sample assumes an elsewhere, turning the artwork into point of contact with an outside it and its viewers become complicit with. I discussed the sample/readymade as double designation, drawing on the critical framing of contemporary art, while also opening this up beyond itself, laid out and amplified into a larger scale, the exhibition frame twisted into its surrounding environment. An encounter with work as sample becomes part of a centrifugal process away from it, a navigational procedure outwards along the radiological deep time continuum. Artworks as sample enact a performative materiality, staging entanglements in the real of radiological deep time they are part of.

I then went on to focus on the relic. This was understood as a temporal sample, an object unearthed as marker of a time past, emphasizing the presence of that past within the present moment of its discovery, or twisting of past into present. The relic acts against the separation of deep time as other to now, enacting it instead as an eruption in the present. I argued that the strange temporality of buried nuclear waste, however, can be understood as a future relic, I called the radioglomerate. Radioglomerate demands the imagining us now from the perspective of an unknown deep future. It has potential to be exhumed, but whether discovered by future lifeforms or not, through it we now in the present become relics for something unknown, indifferent and alien. Art as future radioglomerate relic-to-be-unearthed becomes alienating, catalyst for ungrounding or making-alien of the present moment of its experience.

Art cannot stand outside of radiological deep time to image it, but can take it on as part of its materials, drawing attention to its alienating materiality within, its viewers become complicit with. Hecht describes radioactive waste as method for knowledge of the Anthropocene. Through the radioglomerate, however, it also becomes vehicle for transformation of the marker subject as genre of the human. Cutting open the waste barrel and excavating its interscalar histories is to unsettle the boundaries between what counts as death and life, transcendent humanity and indefinite quarantined materials, Against communicating knowledge, the RK&M project becomes catalyst for a transformation of knowledge in relation to care, speculative ethics of future entangling.

Conclusion

In summary, I have argued for a rethinking of the nuclear RK&M project in such a way that it engages with transformations of art and 'the human' in relation to the materiality of radiological deep time. Starting from the *Into Eternity* video and expanding this into designs and claims of nuclear storage more generally, I analysed the figure of the deep geological repository as a barrier between damaging radiation and human culture, or between life and death. This is imagined and maintained, I argued, through the fantasy of the marker-subject, a universalised position outside of ecologies of toxicity, defined against threats of apocalypse, while it can be challenged through artistic work rethinking the marker. In the first chapter I drew on the magnitude of Uranium isotope half-lives to conceptualise radiological deep time as a challenge to the imaginary of the marker-subject. On one hand, thinking scales of extinction undermines the necessity of an eternalized subject. At the same time, slow radioactive decay leaves a toxic planetary trail. While invoking the arche-realm as universalizing scale, I proposed understanding this through multiple intra-active scales, including phenomena of sense and experience, emerging from nuclear materials. I discussed the Preservation of Records, Knowledge and Long Term Memory across Generations (RK&M) Project as both production of the marker-subject, and potential site of its rethinking, connecting scales of local sites to deep time. I opened the question of what constitutes a 'marker' in this context, which I developed in later writing and through practice. This is reconceptualised not as an external message passed on to future people, but as immanent to radiological deep time.

In Chapter Two I, first of all, drew on Morton's theory of the hyperobject to describe a situation where local causes can't map onto an asymmetric complex network, and reduction to the register of data visualisation limits thought. The anthropogenic deep time sublime was proposed as the reflection and intensification of this derangement. It affirms dwelling in the terrifying-pleasurable affect of immense inhuman scale, creating a sense of awe and wonder. Deep time phenomena remain opaque, held off as deferred, while the individual human subject at secure distance from metaphorical disaster is re-affirmed within the structure. I considered here how artworks affirm and resist this

aesthetic structure, building interscalar connections, and modelling conditions of deep time from within it, for example. I discussed how *A Temporary Index* draws on the materiality of specific numbers as its materials shifting focus from subjective exposure to the conditions of appearance for this data. Following my analysis of artworks, I turned the example of *El Chaco* at Documenta 13, in Chapter Three, to consider how such more-than-human materiality becomes staged under existing conditions of contemporary art. I did this through the concept of the 'already made' which prioritizes art as a set of parasitical interpretive conditions for existing knowledge. Documenta 13 proposes the materiality of the meteorite as a connector between ancestral and phenomenal realms. Through doing so, however, it reduces the ancestral realm to the phenomenal. This rejects the alternative cosmological investment of the Moqoit, while, at the same time, affording it through reducing it to its horizon, expanding the bounded limits of contemporary art through an economical and strategic engagement with its outside. The already made indicates the existence of 'ancestral reality' anterior to terrestrial life. By bringing an object into art from its outside, it draws critical attention to the conditions that give it meaning. At the same time, by doing so, it limits itself to this frame, separating itself from other scales and agencies both the object and its viewers are entangled with. I discussed how the alien object claimed by Documenta as universal 'mystery of being' for 'the human race' occluded another outside, the Moqoit cosmology, including different understandings of care for and responsibility towards the meteorite object, leading to the tensions of the exhibition. Finally, in Chapter Four I returned to the RK&M context, arguing that claim to communicate danger to future people is bound up with narratives of salvation and an idealized return to a state of nature, through the disentaglement from its environment of the marker-subject. Against this I proposed using the project to speculate an unknown vantage point on the present, considering how this challenges the marker subject as 'genre of the human', as well as the aesthetic structures of the sublime and already made, suggesting new directions for art. I proposed a 'geo-fictionalisation' of Sebeok's ideas, focusing on a more materialist approach. I argued for art as interscalar vehicle, connecting localities of site and experience with expanded and unfinished toxic territories of more-than-human spatial and temporal networks of radioactivity. Practically, I proposed a shift within the RK&M project from building monumental structures above ground to focusing on the materiality of the radioactive waste itself. Already entangled with planetary human

phenomena and unknown deep futures, the waste becomes a marker embedded within the hyperobject of radiological deep time, implicated within ecological crisis and its effects. I proposed art as sample, moving beyond its framing context to open out metonymically into a larger whole of which it is a part. Assuming an elsewhere, the artwork becomes point of contact with an outside it and its viewers become complicit with. The sample/readymade as double designation, draws on the critical framing of contemporary art, while opening this up beyond itself, laid out and amplified into a larger scale. Finally, I focused on the relic. This was understood as a temporal sample, an object unearthed as marker of a time past, emphasizing the presence of that past within the present moment of its discovery, or twisting of past into present. The relic acts against the separation of deep time as other to now, enacting it instead as an eruption in the present. Buried nuclear waste, or radioglomerate, can be imagined as future relic. This demands the imagining of its present from the perspective of an unknown deep future. It has potential to be exhumed, but whether discovered by future lifeforms or not, through it the present becomes relic for something unknown, indifferent and alien, leading to a critical questioning of its own entanglement within deep time.

Over the course of this project, I have developed practical work in parallel to theoretical writing, making connections here via footnotes throughout the text. While there has of course been points of connection, my aim has been neither to illustrate ideas from the written thesis in practice, nor justify practice through writing. Instead I have aimed to develop a body of practice-led research and a written work, which both contribute to the research contexts I have outlined with a degree of autonomy, while contributing something original through their resonance. In practice, this has meant having lines of research evolving and mutating at differing speeds, in relation to one another. Roughly I started with theoretical research and writing, developed ideas through practice, and have ended back with writing to inform and shape future practice. Sometimes it has felt like writing 'catching up' with ideas emerging from practice but not yet articulated in this form, and sometimes vice versa. Sometimes the material realities of studio practice, working with objects and people, have undermined more speculative theoretical claims of the writing. At other times, writing has better identified and articulated problems within claims of studio work. Many questions remain not fully addressed. While

currently involved in commissioned work by a nuclear waste management agency, for example, I still need to test and reflect further on relations between critical claims and instrumentalization, including practical issues such as access to specific sites as well as agencies of specific communities. The practical work opens up questions around colonial appropriations and cultural objects, which are still being worked out.
The writing contains many underdeveloped threads including the speculative fictions of scenario planning, relations to nuclear cultures and 'tourism' more generally, as well as the more specific social effects of toxicity globally. What has been addressed most rigorously in practice and writing is the question of how contemporary art practice and theory changes the RK&M project, re-imagining the marker of nuclear waste as entangled within the materiality of radiological deep time. This involves a shift from focusing on the contained site to a more intra-active ontology of connected sites, performed through a distributed artwork. Against positing a local community as saved, other localities erupt where toxicity remains, so radiological deep time is necessary as planetary scale to start conceptualising these relations. The corollary question of how art itself is changed has also started to be addressed, through the aesthetics of the future relic proposed in the final chapter. How this could then relate to current ongoing thinking around, for example, relations of contemporary art to theories of material agency excluded from it, can now be taken further. In the rest of this submission I now go on to present documentation of my practice.

PRACTICE-BASED RESEARCH

1. Addressing Radiological Deep Time Through Practice

In the previous section, I discussed how this thesis has developed through art practice, alongside methods of theoretical writing. The practice-based research is included in the form of a portfolio of documentation, which follows this section. Throughout the written dissertation, I have highlighted relations between the writing and the practice through footnotes. In this section, I explain these relations further, describing my process of practice-based research, as well as its key claims. This includes the entry points and negotiations specific to its field.

In Chapter Three, I focused my argument on the Documenta 13 exhibition in Kassel in 2012. This was based on my experience of the exhibition where analysis of works such as Pierre Huyghe's *Untilled* (2012)[86] led me to consider the role of the viewer within the context of an artwork and curatorial framework that claimed to challenge an anthropocentric view. Writing on Huyghe's work at Documenta, alongside the more general curatorial claims of the exhibition led to developing my argument for the alreadymade in Chapter Three of the dissertation. Identifying how artists at the time were claiming to address times beyond human existence also led to my argument for the deep time sublime in Chapter Two.[87] In parallel with this, I was in Kassel exhibiting artwork as part of a residency project. The work I showed was called *Deep Time Contagion* (2012), proposed as a web-based archive of audio field recordings from deep geological repository sites. This was activated in various ways, I had exhibited it for example as a radio broadcast, and, in this case, as live broadcast from the gallery into the surrounding streets. This was my first approach to considering some of the theoretical questions opened up by radiological deep time through art practice. Here I

[86] An installation 'framing' non-human centred processes such as pollination and composting for a viewing subject.
[87] Trevor Paglen's *The Last Pictures* (2012), for example, a work which sent images to orbit the Earth for as long as the planet lasts.

focused on a fiction of contagion through sound, or through digital file sharing, starting to test relations between experience and a non-experienceable time. Without access to the repository sites, however, this was based on fictional recordings, meaning that in spite of my interest in the deep time of radioactive materials, the work was only activated through the imagination of its listener, so remained completely subject-dependent. Taken together, this writing and practice identified the question of how to make artwork that could address the materiality of deep time while resisting the sublime or alreadymade structures, and a focus on long half-lives of radioactive waste to approach this.

It was following discussions around the *Deep Time Contagion* work, including presentations at Arts Catalyst and at Goldsmiths, that I was able to take my research further and develop the ideas driving this thesis. I was invited to make my first site visit to the ONDRAF/NIRAS (Belgian National Agency for Radioactive Waste Storage and Management) underground laboratory (HADES) by curator Ele Carpenter. Carpenter has been a vital contact in terms of facilitating and managing relations between artists and nuclear sites, part of her establishing of Nuclear Cultures as a research field, developed, for example, through exhibitions, a book and research group,[88] and I have at times worked closely with her on the development of this practice. This emerging Nuclear Cultures research area has provided an important framework for my research in terms of developing networks and access necessary for the practice, as well as theoretical and practical discussions across disciplinary boundaries, which I discuss further later in this section. During my first visit to HADES, I discussed the repository project with the long-term safety management experts, Maarten Van Geet and Christoph Depaus, and Sigrid Eeckhout, who's role is to manage the 'societal dimension' of geological disposal for ONDRAF/NIRAS.[89] I met curator Ils Huygens from Z33 House of Contemporary Art in Hasselt, near to the HADES site, and other artists interested in nuclear-related issues.[90] Maintaining such links has been important in coming to gradually develop communities of collaboration in this context, supported through Carpenter's work.

[88] https://nuclear.artscatalyst.org/

[89] Van Geet is a geologist, Depaus comes from a background of the philosophy of science and international nuclear law, Eeckout from sociology, reflecting the range of expertise involved in the project.

[90] Including some of the artists discussed and involved in this project such as Robert Williams and Thompson & Craighead.

Developing these networks through further visits, discussion events (Documentation of Practice: Section 10) and a residency project (Section 14) has been key to the development of the practice, involving sometimes long processes, of the duration of this project.

On my first research visit to HADES, I observed how the Romantic register of deep time as overawing immensity, which I had identified in relation to artwork, was not present in this context. Deep time, understood through half-lives of Uranium, computational and predicted scales of testing, was presented on another register, through graphs and data, as something, to an extent, never completely known, but at the same time, managed and contained. This informed my discussions of the 'planetary image' in Chapter Two. At the same time, there existed a (less foregrounded) culture of ritual, myth and religious iconography, embodied by the twin vitrines containing a safety helmet and Santa Barbara figure placed at the entrance to the mine shaft, touched to offer protection to workers going deep underground. The collision of these registers, shaping fears of the unknown into culturally shared forms, led to my developing of an aesthetic combining the mythic with speculative modelling. This first visit and early discussions also drove my research in other ways. The national level of regulation and scope became evident, for example, where the remit to design storage for 'Belgium's nuclear waste' was very clear, and differentiated from other national projects. Alongside this, I gained insight into complexities of organisational structures, where local 'stakeholder' groups are involved in the management and development of sites, including planned museum projects. Scales of time and space with competing interests started to overlap, informing later work. I was also interested in these discussions to gauge expectations around what art could contribute in this collaborative context. This seemed initially to be directed into a form of marketing, making monitored visual images of work done at the site to communicate that work positively to a wider public. This opened further questions then around instrumentalization. What role could the artist play in this context, in other words, beyond making publicity images or adding a dash of creative critical currency to radioactive waste storage and so the Nuclear Industry itself?

Following this visit, I was interested in how specific methods were used to speculatively model long-term futures, and how these existed alongside other knowledge methods such as the mythic. I made the video work *The Plureal Deal* (2016) (Documentation of Practice:

Section 2). The work used the materiality of Uranium as a structuring fiction for a video tracing its planetary origins, mining, transportation, processing, use, waste and future storage, necessitating imagining a timescale from 4.46 billion years ago to 4.5 billion years in the future. It drew first of all on found internet material, and then on footage and interviews from HADES. In one sense, it deployed a playful tone to suggest the absurdity of capturing this timescale in images and claims to represent 'the real'. At the same time, it was useful in opening up a thinking of nuclear waste beyond either the unknown immensity of the sublime or the controlled narrative of the deep geological repository. Through opening up timescale in this way, the work questioned the centrality of 'the human' to a longer narrative. While geological deep time focused on the past, radiological deep time as it was modelled at the laboratory, focused only on the future. Connecting these through a narrative of Uranium, led to examining the planetarily dispersed journeys of Uranium, drawing attention to the specific human encounters with toxicity absent from the sublime and repository narratives. The fiction device produced real effects.

I started the Introduction of my dissertation with the political question of how to think of deep time not as always elsewhere – 'over there' – but as something we are implicated in today. Opening up deep time through the materiality of the nuclear in this way led to connections between spaces such as HADES and other planetary sites. As I argued in Chapter Three, the focus on relations between the in-itself, the without-us and the for-us evident in some realist philosophies lacks a questioning of who constitutes this 'us' and its implications in the real. Practice became a more effective way to address such questions. In this case using video to make these connections that had remained hidden. Through this work and first visits and meetings I developed my initial thoughts on where a critical art practice could sit within this framework against the imaginary of what I came to identify as the 'marker subject' (see Chapter One of the dissertation).

2. Developing the *Pazugoo* project

The Plureal Deal ends with the screen splitting into four sections to speculate on four futures of stored radioactive waste. One of these draws on how performative scenarios have been used to imagine future disruptions to storage sites, a method I have drawn upon my practice, basing this on the restaging of official scenarios (Documentation of Practice: Section 11); one draws directly on my HADES site visit showing computer modelling of radionuclides as they slowly diffuse through the Boom clay local to the site; a third is based on a real time observation of radioactive waste material, drawing attention back to the time of the video's viewing. A fourth screen proposes a different method of future speculation, capturing the fictional process of designing a plastic demon to bury with the waste as a kind of underground marker or 'anti-marker' (challenging the monumental marker tradition) imagining what would happen to the plastic as it slowly degrades over time. It is this fourth screen, proposing a use of 'the marker' very different to anything else in current discussions, which has developed into the *Pazugoo* project. This went on to become the main focus of my research in this thesis, shifting from this imaginary projection into the kind of negotiations and experimentations necessary to make it a real intervention.

Developing this practice, then, my aim was to make a different kind of 'marker'. Specific features of this emerged through practical experimentation, and can be understood in relation to my arguments for attuning to the hyperobject – i.e. art that evokes radiological deep time in its format, rather than claims to represent it from a transcendent position, and that aims to shape sensation and experience according to the hyperobject of deep time (Chapter Two). Firstly, this marker is designed to be buried underground with radioactive waste. Focusing on the waste itself rather than a monument above-ground draws attention to its materiality as already a kind of marker, through becoming part of it. This challenges the narrative of invisibility around the waste. Rather than it becoming forgotten as it merges into surrounding 'nature', in other words, agencies of underground processes are drawn attention to. Research into geologic disposal has opened up different and overlapping timescales, including for example different procedures for high-level waste, which must be stored for longer periods and further underground than intermediate- and low-level

waste.[91] This has led to the production of 3D-printed objects in specific materials, in discussion with engineers - plastic prototypes from group workshops, resin casts designed for deep burial, small bronze casts designed as perimeter markers for low-level waste sites. In order for the work to be accessed, I have made gold-plated 'index' figures designed for museum archive collection, referencing the buried objects (Documentation of Practice: Section 9). The development of index figures has led to my discussions in Chapter Four on using the exhibition as site to encounter a sample of something not directly accessible to experience. The buried artwork as future relic, is accessed through its sample in the museum.

Secondly, the work has a distributed format, not just buried at one place but in multiple sites, becoming part of the material network of toxicity distributed at a planetary scale (Section 6, 7, 10). This develops a practice-based way of thinking the complexity of deep time at multiple scales (Chapter One). *Pazugoo* is proposed as method to draw connections between multiple scales, as a kind of diagram through the earth and through time (as an interscalar vehicle, discussed in Chapter Four). This includes for example different localities on the planet, the 'localised' experience of encountering the artwork and the speculated future times evoked by half-life measurements, which are brought together through installation (Documentation of Practice: Sections 4, 9. 13). Thirdly, the practice develops mythic fiction as a method to navigate these scales. This emerged through my interest in philosopher Reza Negarestani's description of the demon Pazuzu through 'double flight', scavenging the dust of the Earth to uplift it to alien currents of the universe. Pazuzu, through its mutating reformulation via printing technologies as *Pazugoo*, is proposed as a figure for this mythic flight to universal deep time horizons and back to thought in the present, connecting sites of toxicity through a topography of pestilence. *Pazugoo*'s form is multiple and mutating, embodying these flights through culture and time, informing an initial demonic morphology as list of characteristics to guide re-combinations of features. Demon designs are then based on collecting freely available online 3D digital scans of museum artefacts, and recombining them according to this morphology. Through making

[91] Discussed in Chapter One of the dissertation, this led to further complexities around exactly what is being marked and for when.

shareable downloadable digital files, I have been able to develop collaborations with other researchers who have printed and made their own *Pazugoo* figures based on shared morphologies. This has led, for example, to burial rituals (Section 7) and working collaboratively in using *Pazugoo* to mark sites of toxicity in Australia (Section 6). This has necessitated initiating further relationships with communities affected by the nuclear in different ways, including guides from the Maralinga Tjarutja people in Australia who are creating an archive site of nuclear toxicity in their land.

The work has also developed through workshop methods. I made my first workshops in relation to gallery exhibitions (Documentation of Practice: Section 1), where we downloaded designs and made *Pazugoo* figures according to an initial morphology, through this process discussing the radioactive waste marking context. These included volunteer participants local to the workshop site, mainly drawn from the exhibition audience. As workshops have evolved, they have involved more specific invited participants, including, for example, working with the local groups MONA and STORA in Mol-Dessel at the HADES site, in drawing on local myths and histories to design new figure for burial at the site. Over the project I have gradually moved away from the use of the Pazuzu myth (as specific to another culture) and devised formats where, through workshops, local knowledges are drawn on to create combinatory myths of the land, of flight and the hidden, leading to new morphologies of figures. This has included, for example a winged rock demon, drawn from journeys into the land surrounding HADES, unearthing stories with local historians (part of work in section 14). The artwork *Pazugoo,* then, also includes the development of this narrative and performative ritualistic figure for this. The workshop format is used as a collective production method as well as site for discussion, forming collectives of participants within the now of deep time (Documentation of Practice: Sections 1, 3, 13), as art historian Anna Volkmar has argued, “where traditional marker designs envision members of the public as bystanders, *Pazugoo* redefines them as accomplices” (2018: p.4). Workshops are understood as focal points for participants to enter into this more-than-human ecological distribution, lured by the myth of *Pazugoo* to reformulate and distribute its host bodies, or become its pest seeding machines.

Presenting and proposing this work has also become a way for me to enter into broader discussions shaping Nuclear Cultures. This has included discussing the role of art within predominantly Nuclear Industry events (Documentation of Practice: Section 10), and gallery or museum based events aiming to bring together artists, nuclear waste management industry representatives, and knowledge from other fields, including archaeology, architecture, geography, sociology and design. Such events have, for example, opened up cultural implications of long-term communication procedures through insights from different disciplines (Section 5), or drawn attention to tensions between narratives of the future (Section 13). Academic events, including presentations and research exhibitions, such as the Nuclear Cultures Research Symposium at Goldsmiths have helped focus a more critical perspective, for example in relations of nuclear waste storage to military histories of atomic weapons, or postcolonial questions relating to extraction of resources, and ongoing damage to environments. Other more specific events have considered how the work contributes to conceptualising the role of art in relation to discourses of the Anthropocene, or in uses of fiction to approach the planetary scale.[92] Through such events, the role of the artist in this context has become reimagined since my first site visit. Against a focus on communication, and disseminating a controlled image, I have formed a collaborative research context within which to develop art practice as autonomous knowledge production in relation to geologic disposal and nuclear waste. Art becomes method for understanding deep time, critical perspective on disposal processes, and becomes itself changed in this process, contributing to debates around the contemporary and the historical condition of contemporary art itself, as I outline at the end of this section (Section 8).

These processes and negotiations have led to my current work, where I have returned to the HADES site to take work further. Here I am working with materials scientists to trace histories of the stored waste, tracing Belgian implications in Uranium mines in the Congo, for example (Section 14). I propose three new figures here – one buried as underground marker of the waste repository site, one buried at a site representing an earlier stage of the waste life-cycle, and one exhibited in a museum being built at the site. This aims to

[92] Through presentations at 'Art and The Anthropocene' at Trinity College Dublin (2019), and 'Fiction Machines' at Bath Spa University (2019).

represent past, present and long-term futures of radiological deep time, embedding objects as part of long-term decay, while bringing debates into the present.

3. Conclusion

To summarise, *Pazugoo* has developed as a body of research, constellation of objects, workshops, discussions and installations, focused on a process of printing and burying 3D-printed demons. These are produced through group workshops, modifying museum artefact digital scans according to a morphology of the Babylonian-Assyrian demon of dust and contagion Pazuzu. This leads to the production of composite figures, defined by mutable 'gooey' characteristics such as an excess of wings, and pest-seeding machine. These figures are proposed as distributed 'markers' of sites of nuclear waste, through their burial in contaminated earth. These objects are then referenced through 'index' figures in exhibitions and museum collections. The figures take the form of SLS plastic prints, bronze and resin casts. The plastic objects, I describe as part of a process of 'prototyping', the bronze figures as designs for burial close to the surface (perhaps to be unearthed), and the resin casts as designs to occupy sites deep in the earth, becoming future 'radioglomerate' (see Section 4:3 of the dissertation). 'Index' figures draw on languages of museum collections, referencing (or sampling) the buried objects. The *Pazugoo* title refers not only to these sculptural objects but also related work including videos and diagrams that play the role of speculative imagining of deep time futures, workshops that develop the work materially, and a range of events where the artwork enters into more interdisciplinary discussions and projects of nuclear waste storage, marking and memory. This portfolio of work shows how the project has evolved, both responding to and informing the arguments in my written thesis. Originally planned as an underground marker for deep geological repository waste sites, *Pazugoo* has taken on a more distributed format, aiming to make the kinds of connections from within ecologies of toxicity that is lacking in RK&M debates, as discussed in the written thesis. This has been enabled through collaborations such as the Taranaki marker presented here, and is being developed in my current commission where I propose to deploy the work as a mythic and material connection between waste at HADES, Belgium, its planetary origins and legacies. Its morphology has also evolved through contact with myths local to workshops, leading to a process of continual transformation, and the enfolding of deep timescales through other scales and traditions. The documentation also included related performance-based work. The *Human Interference Scenarios* work, taking the format of a

group workshop re-staging industry scenarios, is part of ongoing research on using fiction and performance as critical approach to future modelling in a nuclear context. Recent work has also considered improvisation and personification in relation to climate change data more generally, including the *Specificities of the Planetary Room* performance, opening to questions of ecologies, toxicity and care understood more broadly.

Looking back on this thesis now, as practice-based research alongside the accompanying written dissertation, its central claims as new knowledge can be rearticulated. This includes, firstly, through *Pazugoo*, the use of art practice to make a specific critical intervention into the existing RK&M framework of nuclear waste storage, management and communication, challenging the problematic imaginary and politics of the 'marker subject' through work that instead attunes to the complex hyperobject of radiological deep time. Produced in parallel to the arguments in the written thesis (mainly Chapter One, and the first half of Chapter Two), this has developed specifically through practice, using the methods and developing the interdisciplinary context discussed above. This proposes both that the nuclear RK&M Project is an important site for addressing questions of humanity's relationship to its environment,[93] and that my work is important in opening this project up to a more critical perspective. This practice has contributed to debates relevant to shaping the emerging research field of Nuclear Cultures. Its broader theoretical consequences have also been explored through writing, leading to a changed understanding of 'the human' within the context of radiological deep time.

Secondly, the work makes more general claims, outside of the RK&M context, through its challenging of identified problematic tendencies for art practice within the context of deep time. Through its rejection of the sublime, it contributes to debates on how art practice can respond to environmental catastrophe beyond the inertia of stunning scales. It does this through its focus on the materiality of radioactive waste as method to explore specific relations between human and non-human worlds, tracing long-term toxicity of nuclear waste as planetary post-colonial problem. Through remaking collective myths and personifications, it explores the ethics and aesthetics of imagining deep futures, which can

[93] Relevant for example to broader critical discussions around art and the Anthropocene.

be understood within a nuclear context or more broadly. Through its rejection of the 'alreadymade' it draws attention to and challenges fundamental conditions of contemporary art itself, which make this historically subject-dependent condition for art inadequate for the materiality of deep time, and so for engaging with realities and scales of environmental destruction beyond individuals (Chapter Three). Expanding art through scientific collaboration, away from its status as metaphor, it moves focus away from the viewing subject as determinant of the work's meaning. Through its format of work as future relic, it transforms the relation of materiality to contemporary art. Rather than deep time being subsumed by contemporary art, the concept of deep time enacted through work is something that transforms art's conditions and subject-positions. In practical terms, half-life durations and planetary distribution are used to rethink exhibition formats and conventions. The temporality of the work as buried object to outlive its viewers, speculating a future vantage point on the present, have developed through this process of practice. This is further developed theoretically through discussion of the radioglomerate object as future relic, and of the art encounter as speculative ethical call in Chapter Four of the dissertation.

DOCUMENTATION OF PRACTICE

Overall Description of Practice

Documentation of Practice:

1. *Speculative Demonology as Deep Geological Repository Marking Strategy* (2016)

2. Installation of work at Umea Bildmuseet, Sweden, 2016:
    The Plureal Deal (2016)
    Pazugoo Trailer Announcement w/Glo-sticks (2016)
    Design for a Deep Future Paleo-Archeologist (2016)
    Pazugoo Prototypes 1 (2016)

3. *Pazugoo Workshop Will Eat Itself* (2017)

4. Installation of work at Z33 House for Contemporary Art, Hasselt, Belgium, 2017:
    Pazugoo Prototypes 2 + Threshold Niche Prototypes (2017)
    Pazugoo Research Material (2017)
    Upflush Operation (2017)
    Double Flight Collage (2017)
    Double Flight as Navigational Procedure for Deep Time (2017)

5. *Underground / Overground*, Z33 House for Contemporary Art, Hasselt, Belgium, 2017.

6. *Pazugoo Taranaki Marker*, with Jacob Warren (2017)

7. *Clay Burial Ritual*, with Anna Volkmar & Jacob Warren (2017)

8. *Contemporary Research Intensive*, collaboration (2017)

9. Installation of work at Malmo Art Museum, Sweden 2018:
    Museum Index (Malmo) (2018)
    Pazugoo Prototypes 3 (2018)
    Pazugoo Perimeter Markers (2018)
    Pazugoo Burial Objects (2018)
    Glo-stick Trailer (2018)

10. Work at Modern 2020, Paris, 2019:
    Stakeholders Roundtable (2019)
    Nuclear Cultures Poster: Networked and Distributed Art, with Ele Carpenter (2019)

11. *Human Interference Scenarios 1991 -101,991* (2019)

12. *Specificities of the Planetary Room*, with Harry Meadows (2019)

13. Installation of work at Het Nieuwe Instituut, Rotterdam, Netherlands, 2019:
    Mythic Personification of Nuclear Waste for COVRA (2019)
    An Excess of Wings (You are Binders for my Granular Polymers) (2019)
    Goo-Goo (2019)
    Design for the Deep Future (2019)

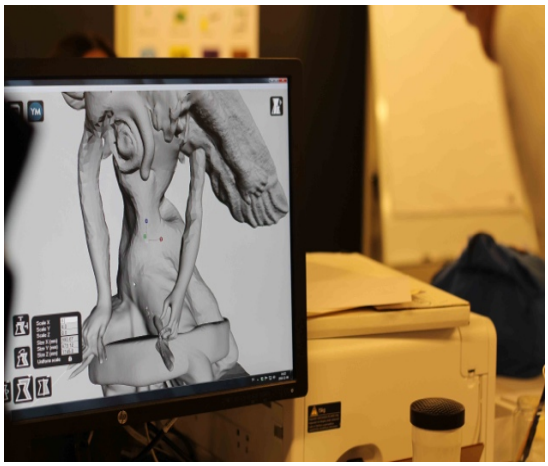
14. HADES / Z33 Commission, work in progress, 2019-20.

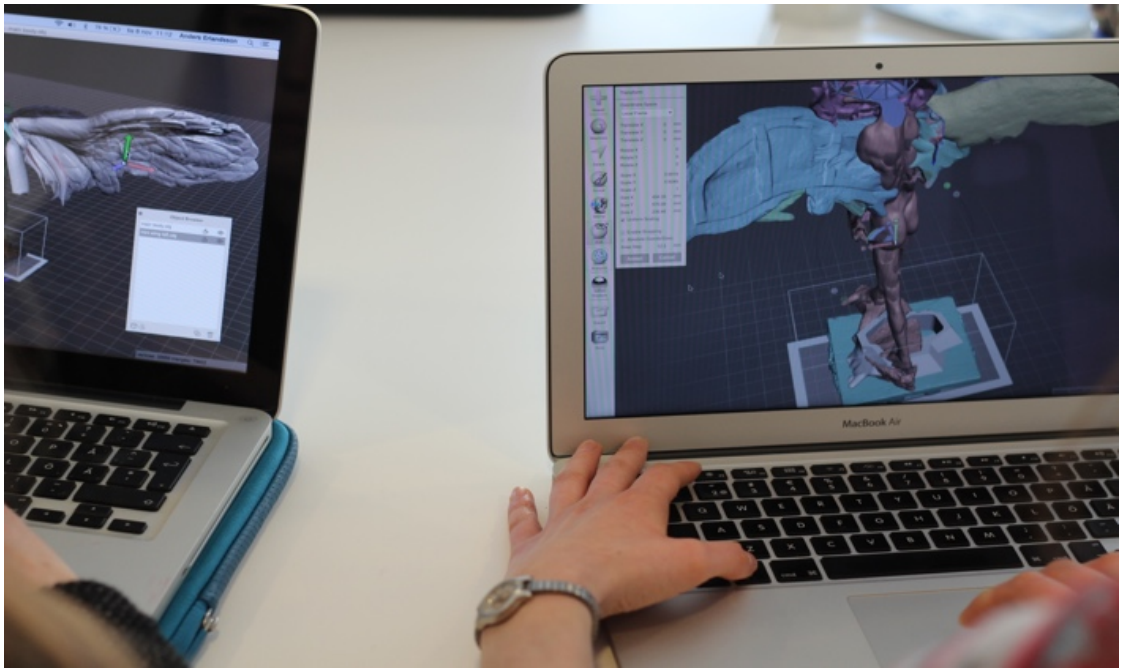
1. *Speculative Demonology as Deep Geological Repository Marking Strategy* (2016), workshop with invited participants, UMEA Bildmuseet, Sweden.

This was the first workshop I ran, forming the basis of later work, developed throughout this project. Participants collected files of scanned museum artefacts from online databases, and remodelled them into new figures according to this morphology:

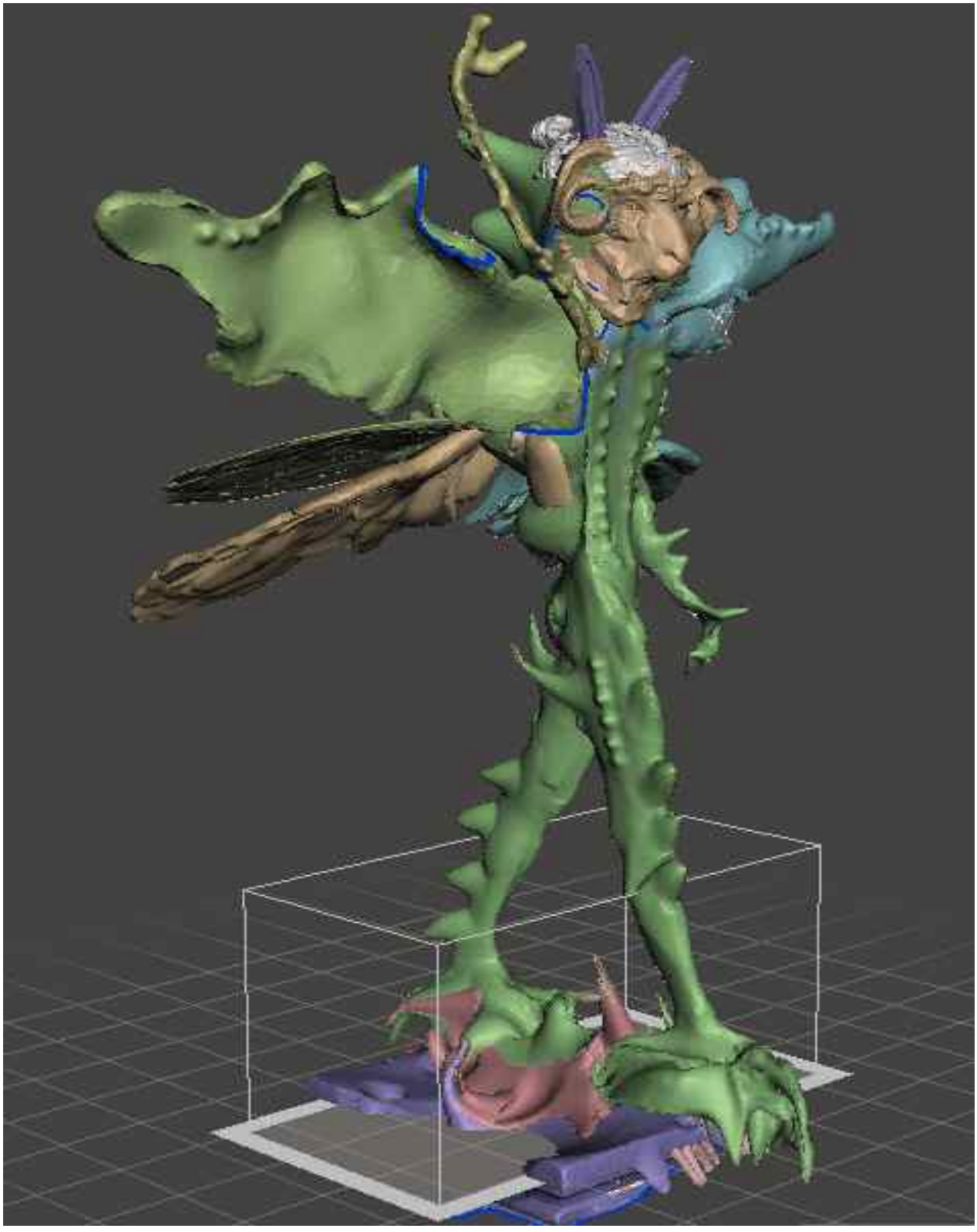
- 2 legs, wings, human-like beast with talons instead of feet
- Almost fleshless head that cannot be distinguished clearly
- Pest-seeding machine
- An excess of wings
- Right-hand downward / left –hand upward, outstretched hands
- A dignatory's beard
- Curves, spirals or circles connecting parts
- Mutation of gendered characteristics
- Contagion, drift, glitch
- Occupying threshold sites


lenovo





Figures 1.1 – 1.5: Participants making designs during the workshop.



Figures 1.6 – 1.7: Composite *Pazugoo* designs from the workshop.

Figure 1.8: Printed plastic figures from the workshop.

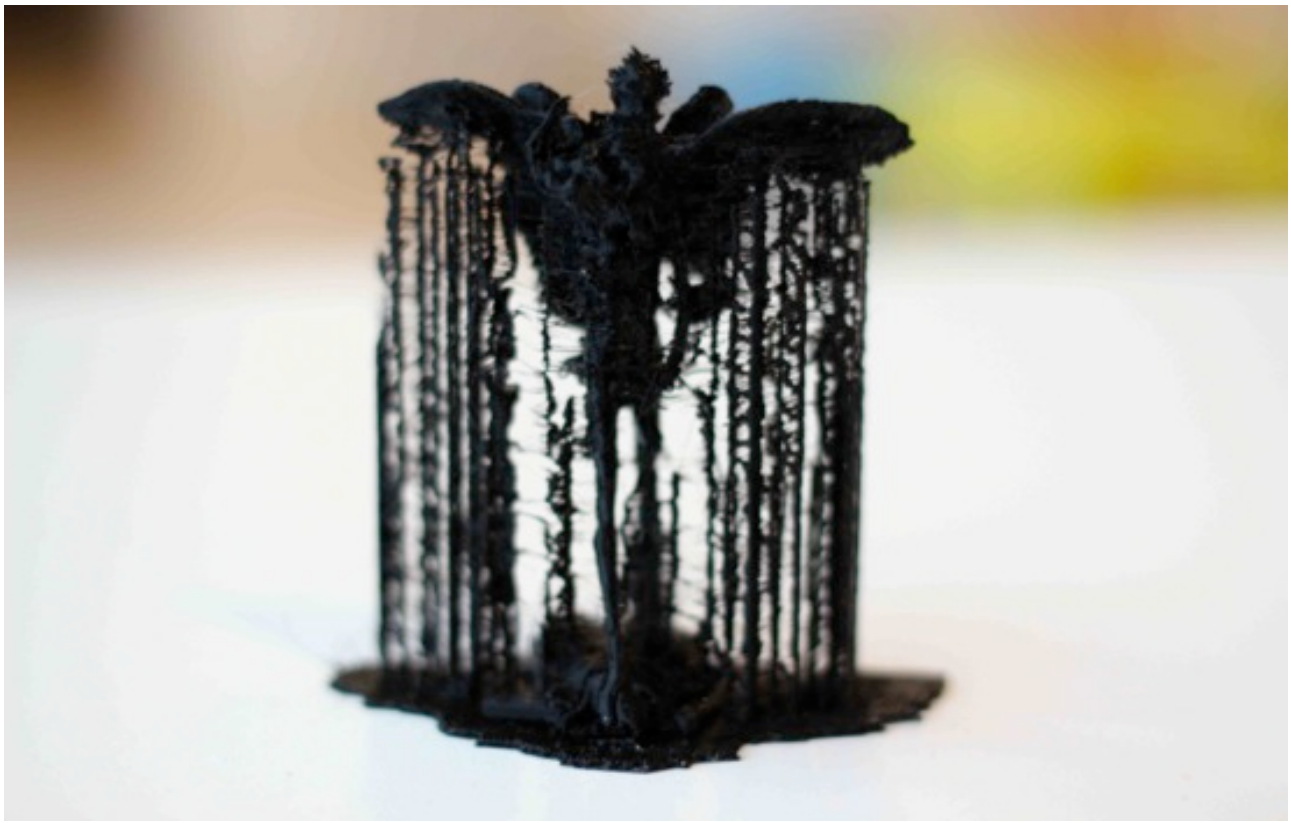


Figure 1.9: *Pazugoo Prototype S1N1* (2016), 3D-printed SLS plastic, 14cm x 10cm x 6cm.

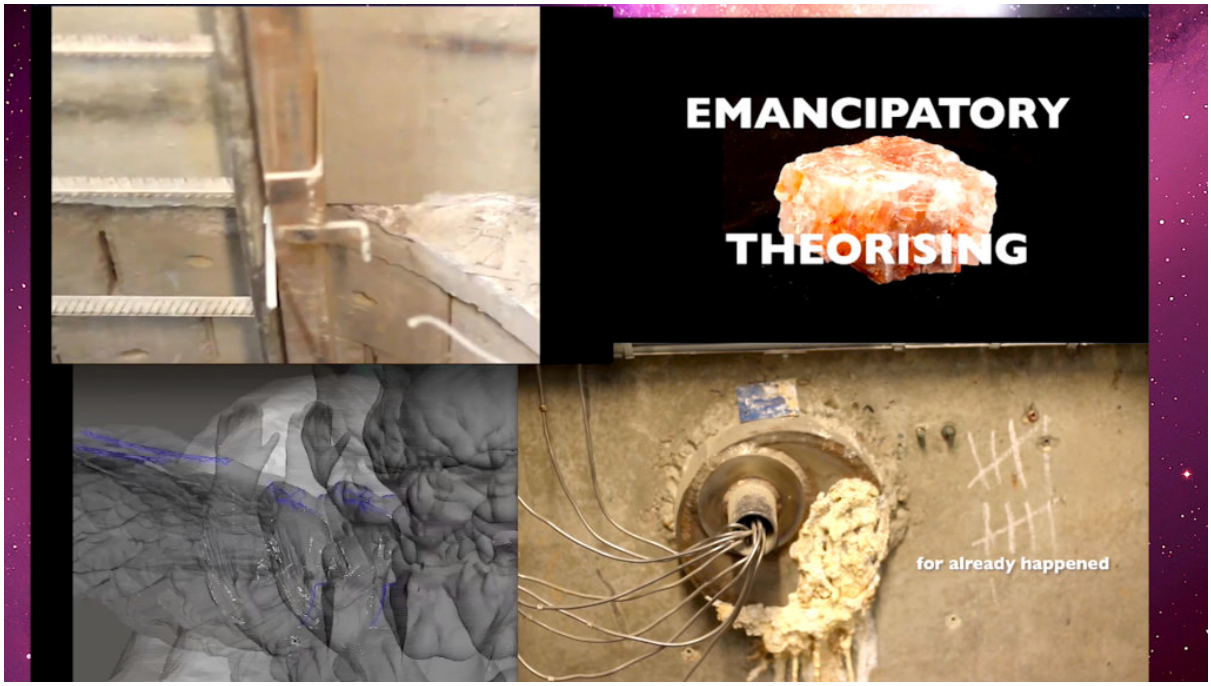
Figure 1.10: *Pazugoo Prototype S1N3,* (2016), 3D-printed SLS plastic, 12cm x 11cm x 8cm.

2. Installation of work at *Perpetual Uncertainty: Contemporary Art in the Nuclear Anthropocene*, Umea Bildmuseet, Sweden, 2016

The Plureal Deal (2016)
Pazugoo Trailer Announcement w/Glo-sticks (2016)
Design for a Deep Future Paleo-Archeologist (2016)
Pazugoo Prototypes 1 (2016)

The video *The Plureal Deal* (2016) assembled found footage in an attempt to narrate a material history of Plutonium from planetary origins to speculated deep time futures. Events unfold on overlapping screens against an Apple Mac cosmic screensaver background, emerging from narration from a Toyota car ad for 'the real deal'.

I showed it here on a monitor alongside a vinyl print poster *Pazugoo Trailer 1* (2016) announcing Pazugoo as Coming Soon, further playing with looping temporalities of the work. Referencing a myth of Uranium glo-sticks being sold in the 1990s northern UK rave scene, glo-sticks adorning the poster were taken away by visitors, worn by invigilators and sold in the museum shop. 3-D printed figures from the workshop later also became part of the installation.



Figures 2.1-2.3: Stills from *The Plureal Deal*, where future narratives of Plutonium unfold on four simultaneous screens.

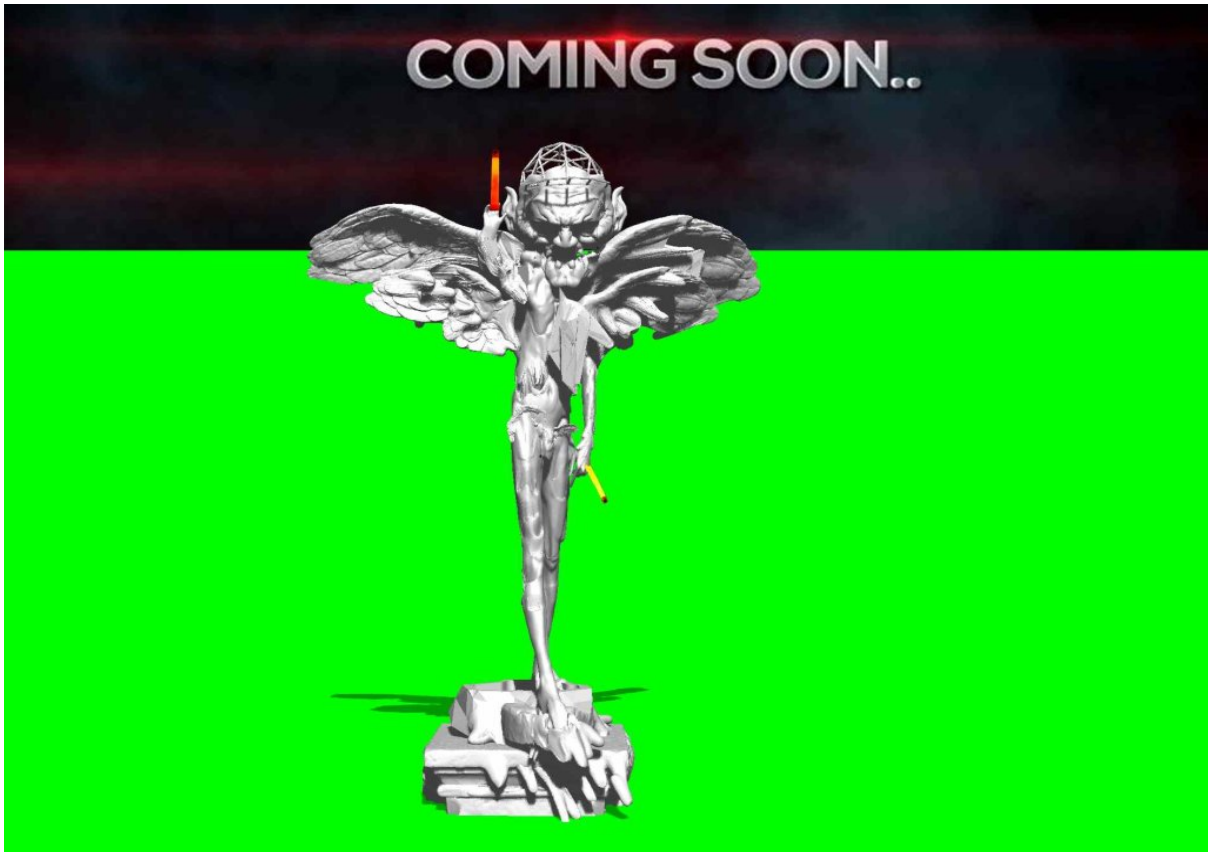


Figure 2.4: Design for Trailer poster.


COMING SOON..
SAFETY CASE
RISK ASSESSMENT
SCENARIO
1563

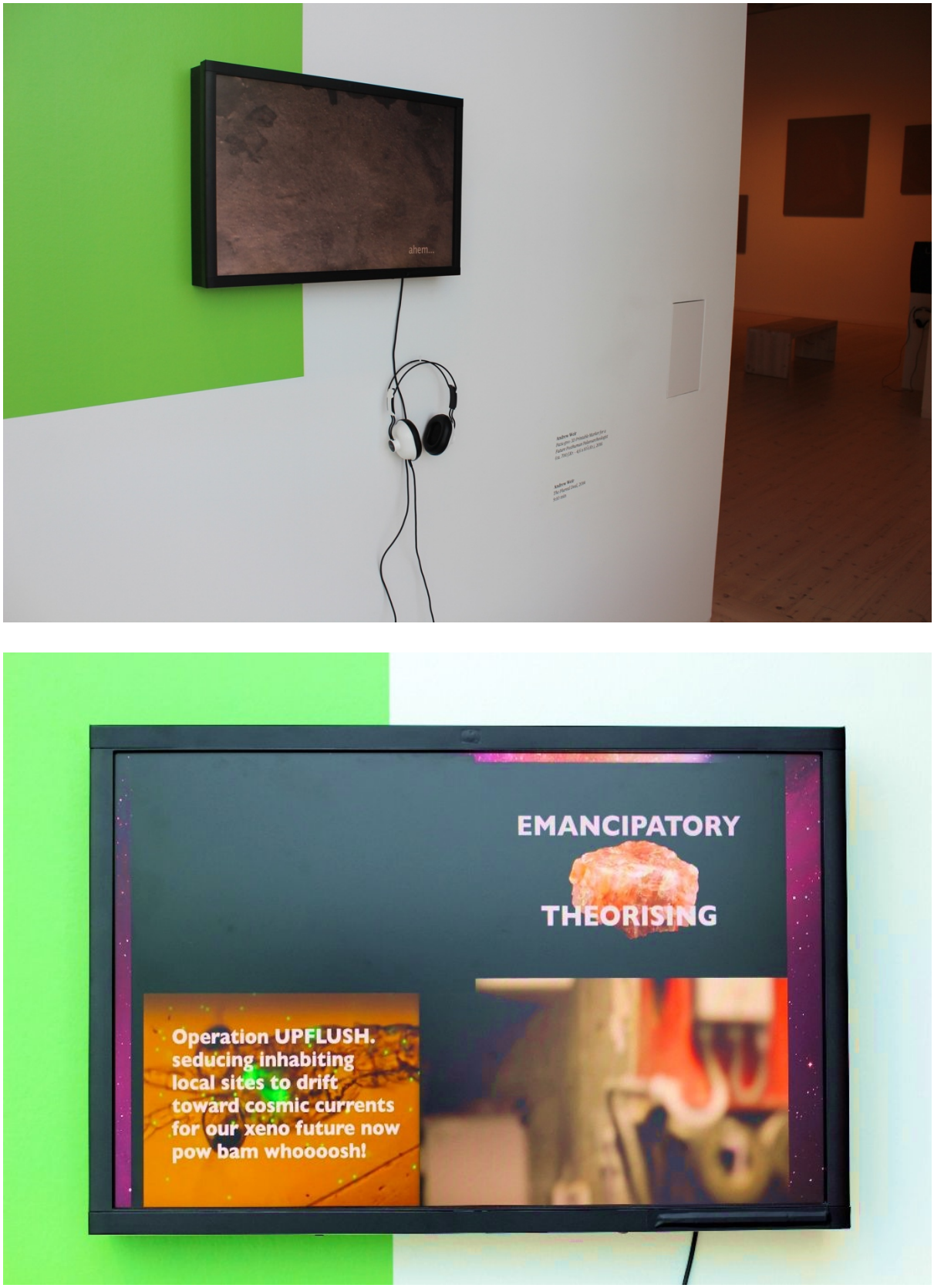


Figure 2.5-2.8: Installation view.

Figure 2.9-2.10: Poster viewed from outside (in 3rd floor window)

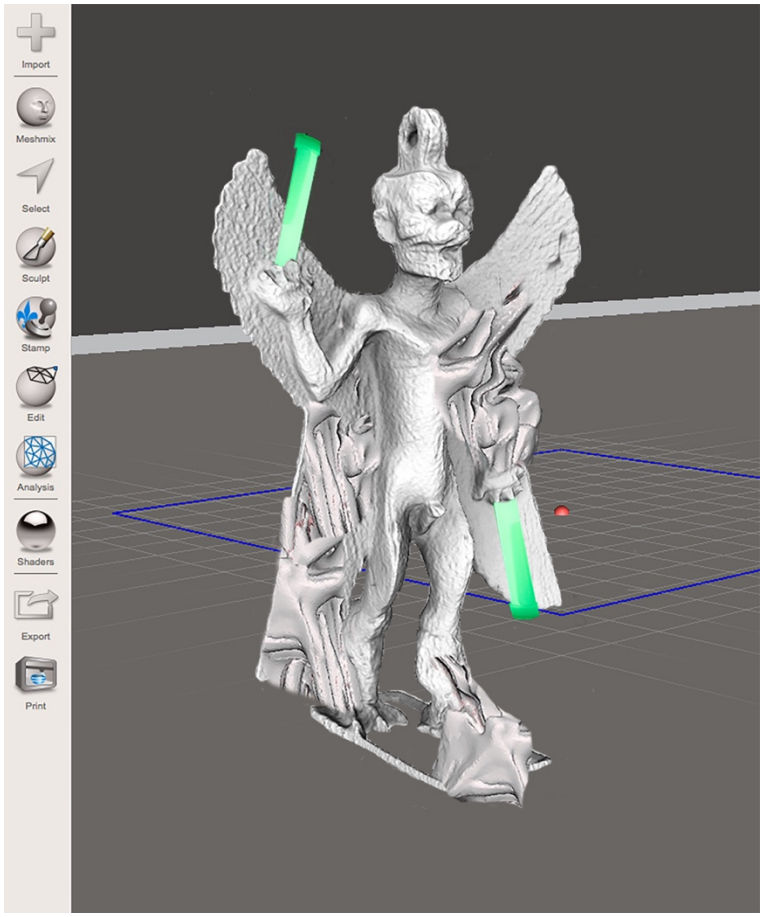
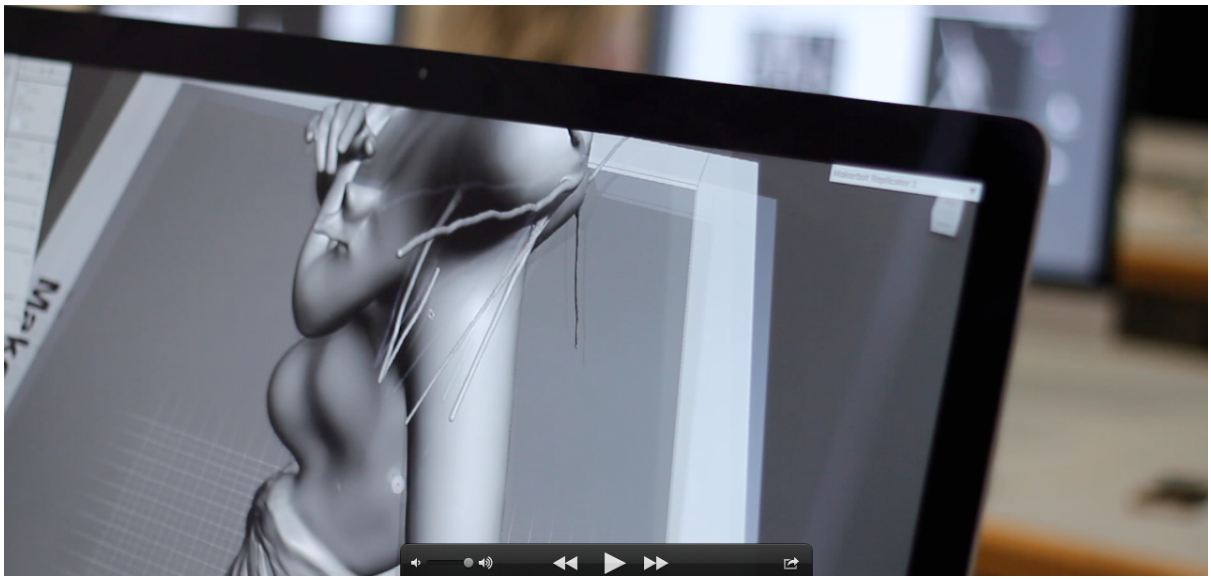


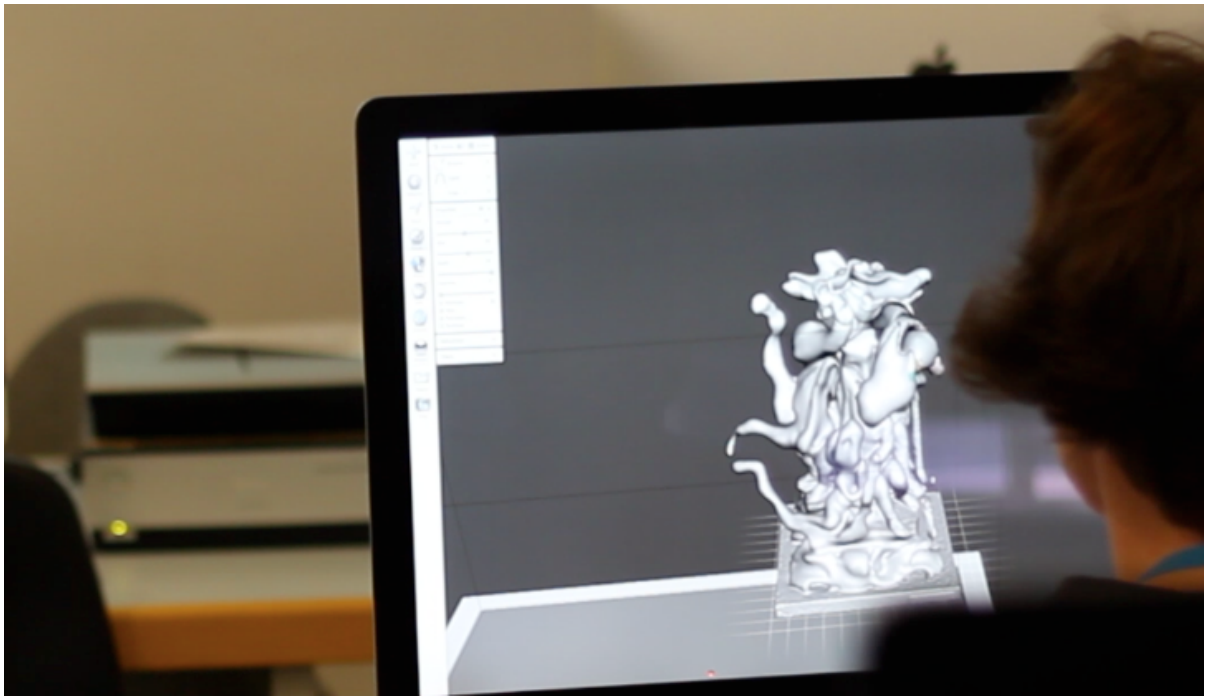
Figure 2.11: Design for *Nuclear Sourcebook* (2016)

Figure 2.12: Trailer image for digital circulation (2016)

3. *Pazugoo Workshop Will Eat Itself* (2017), workshop for *Artistic Research Will Eat Itself* Event, Plymouth Uni / Karst

Designs developed over a further workshop. Responding to its context, this work drew on a motif of self-cannibalism. Designs were downloaded, modified and re-uploaded for internet circulation, creating a loop - chewing, regurgitating and spitting out at increasing velocity.





Figures 3.1-3.3: Images from workshop.

4. Installation of work at Z33 House for Contemporary Art, Hasselt, Belgium (2017)

Pazugoo Prototypes 2 + Threshold Niche Prototypes (2017)
Pazugoo Research Material (2017)
Upflush Operation (2017)
Double Flight Collage (2017)
Double Flight as Navigational Procedure for Deep Time (2017)

For this exhibition, I made two new 40cm-high PLA 3D-printed *Pazugoo* figures, based on workshop designs. Drawing on the architecture and radical history of the *beguinage* these are installed in exterior arched niches (for religious statues) above the inner-courtyard entrance gates. Associated with thresholds (Pazuzu statuettes were found buried under doorways), they here becomes ritual guardians of the exhibition, occupying the passage between its inside and outside. This echoes the ritualistic function of Santa Barbara at the nearby HADES underground laboratory, marking the transition from above ground to underground, touched for protection by those taking the journey. Networks of mythic nuclearity resonate from the exhibition to the depths of its outside

Inside the exhibition, I presented *Pazugoo* as a prototyping process with accompanying research material. Mounted on the tiled fireplace, a series of SLS plastic *Pazugoo Prototypes* (2016) reference ongoing workshop production (approx. 15cm high). These are shown alongside another new 30cm high black PLA figure, and a lump of local boom clay, sourced from the nearby HADES (High Activity Disposal Experimental Site) underground laboratory. On a wall-mounted monitor w/headphones, a loop of *Pazugoo Upflush Operation* (2017), imagines future life of plastic alongside sound recorded from the HADES lab. On the adjacent wall is presented a diagram *Double Flight as Navigational Procedure for Deep Time* (2017); the A3 *Double Flight Collage* (2017), and a map as diagrammatic proposal for perimeter burial of Pazugoo objects at a low-level waste repository. The installation becomes a ‘geo-fictional’ strategy for combining the plastic materiality of Pazugoo with its mythic dimension.

Figure 4.1: Z33 House for Contemporary Art, exterior with exhibition poster.


OPEN
PERPETUAL
UNCERTAINTY


OPEN

Figures 4.2-4.7: *Pazugoo* figures in threshold niches.

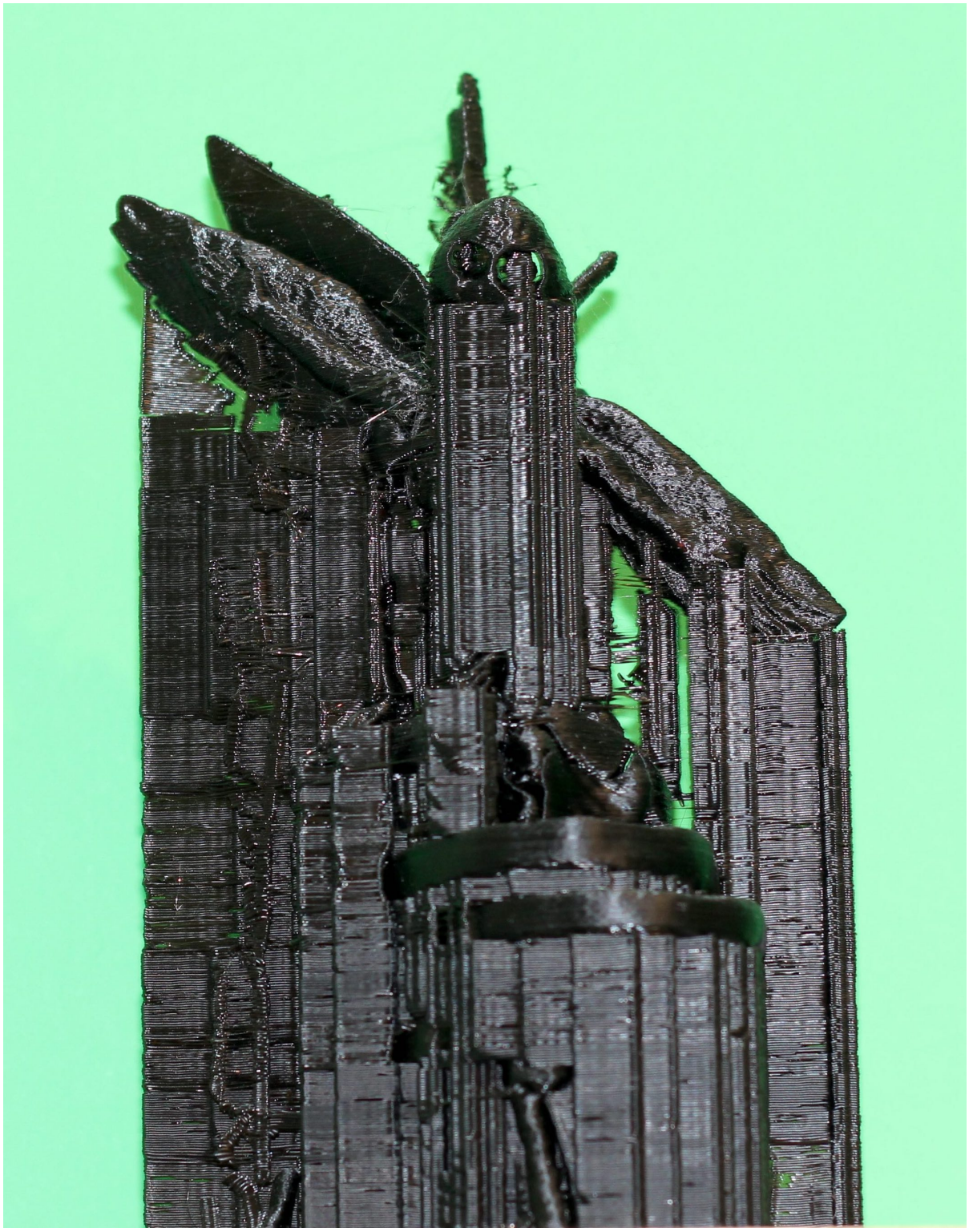
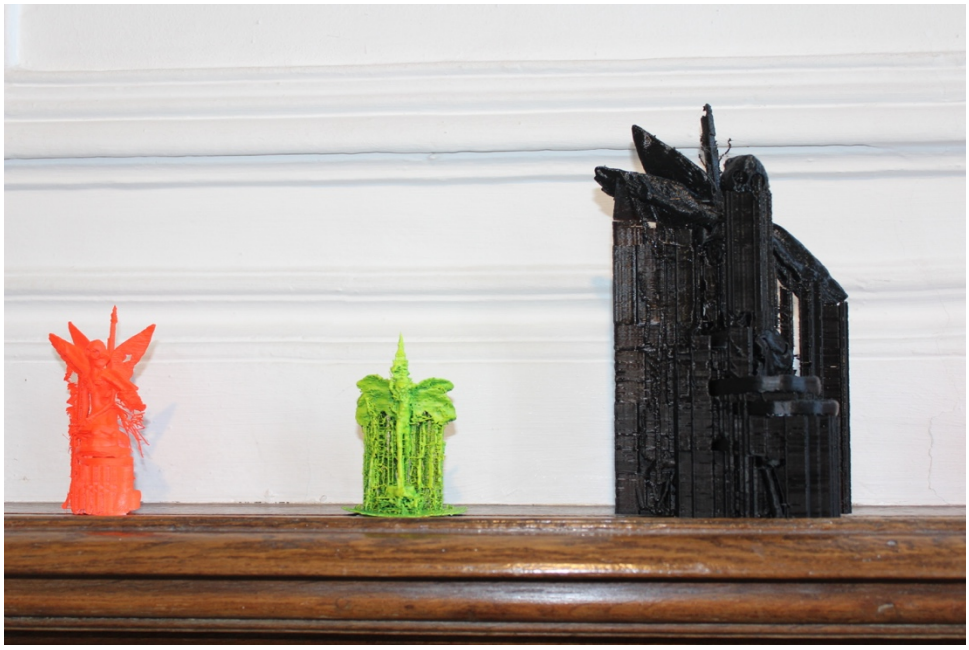


Figure 4.8: *Pazugoo Prototype 2.3* (2017), SLS-plastic, 32cm x 10cm x 8 cm.

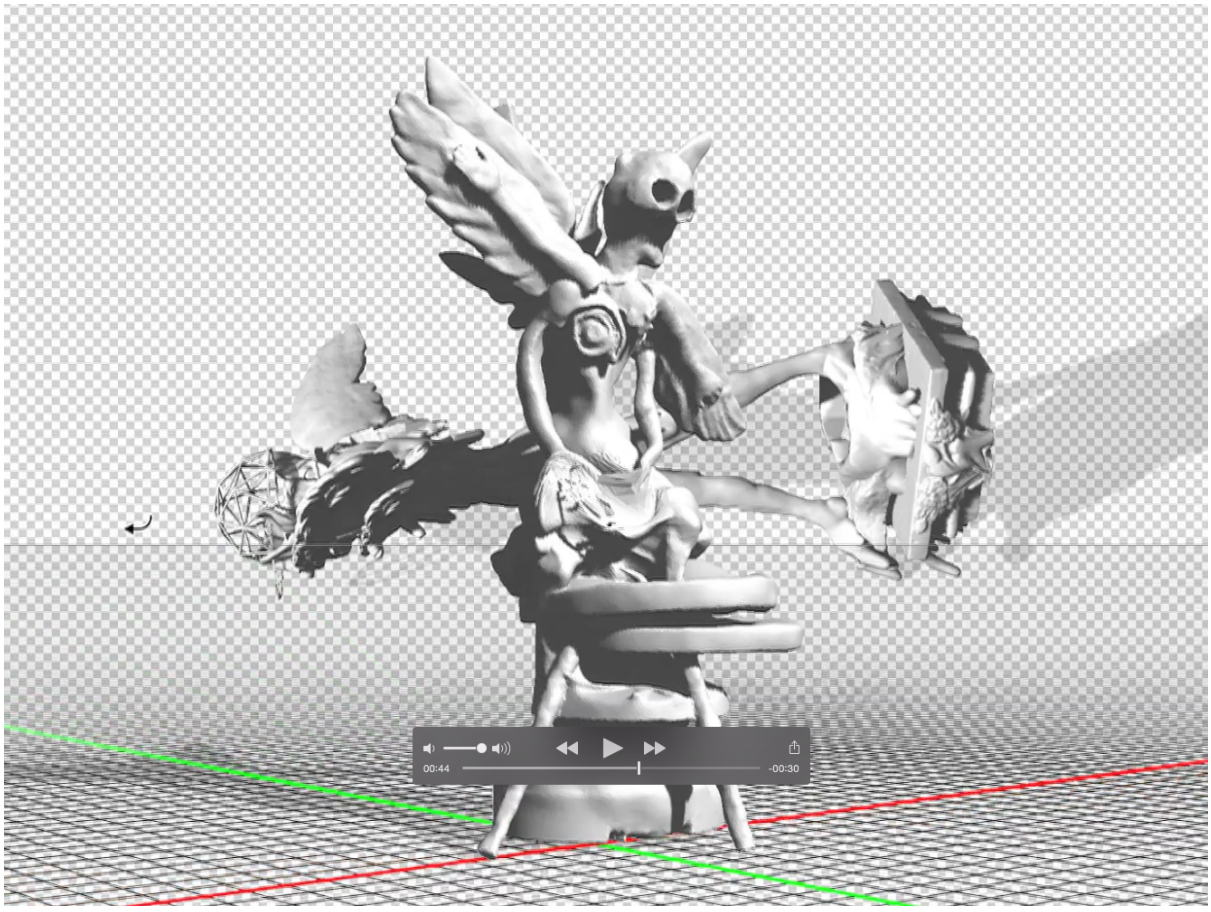
Figure 4.9: *Pazugoo Prototype* S2N2 (2017), polylactic acid 3D-print, 41cm x 23cm x 11cm.

Figure 4.10: *Pazugoo Prototype S2N3* (2017), polylactic acid 3D-print, 44cm x 21cm x 11cm.

Figure 4.11: Installation view, *Pazugoo Research Material* (2017), 3D-printed SLS plastic prototype figures from workshop; lump of local boom clay from HADES; video of morphing Pazugoo w/sound from HADES on monitor; diagram of Pazugoo temporalities; map of proposed low-level waste perimeter marking burial; double flight collage; morphology list.



Figures 4.11-4.15: Installation details.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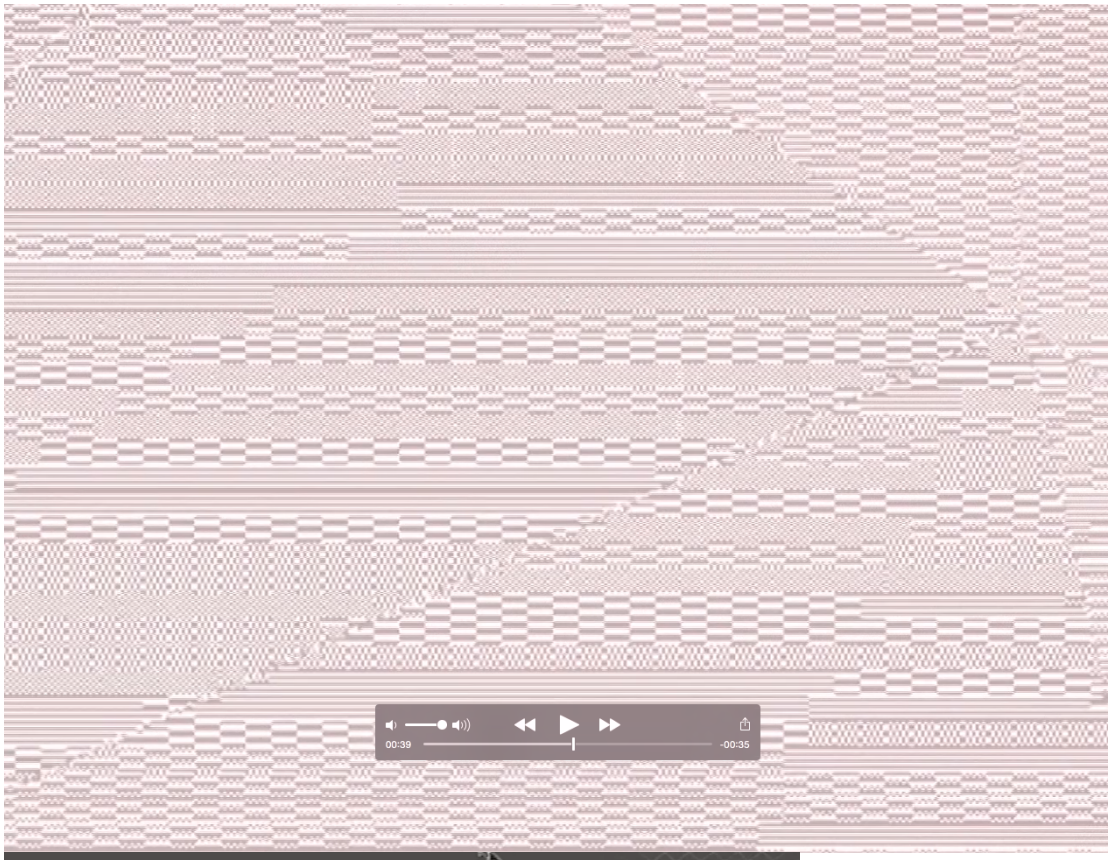
-00:30


00:39
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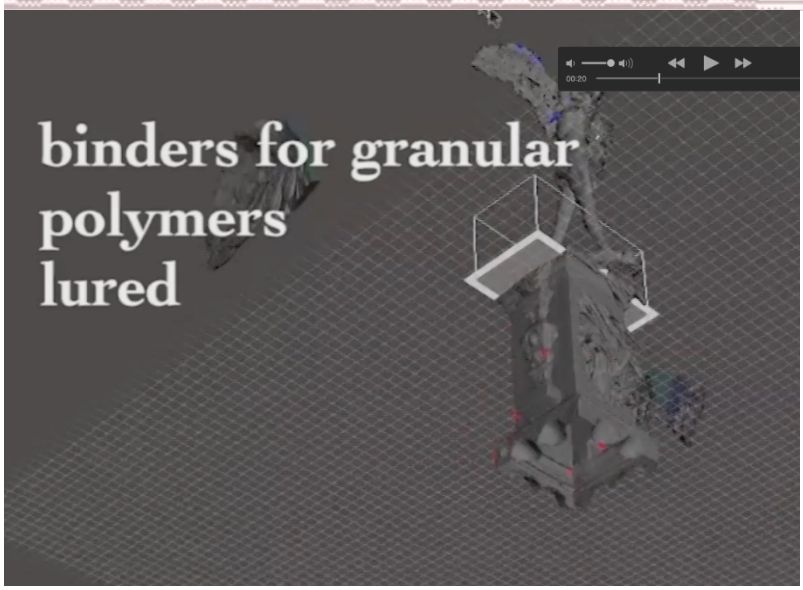
binders for granular
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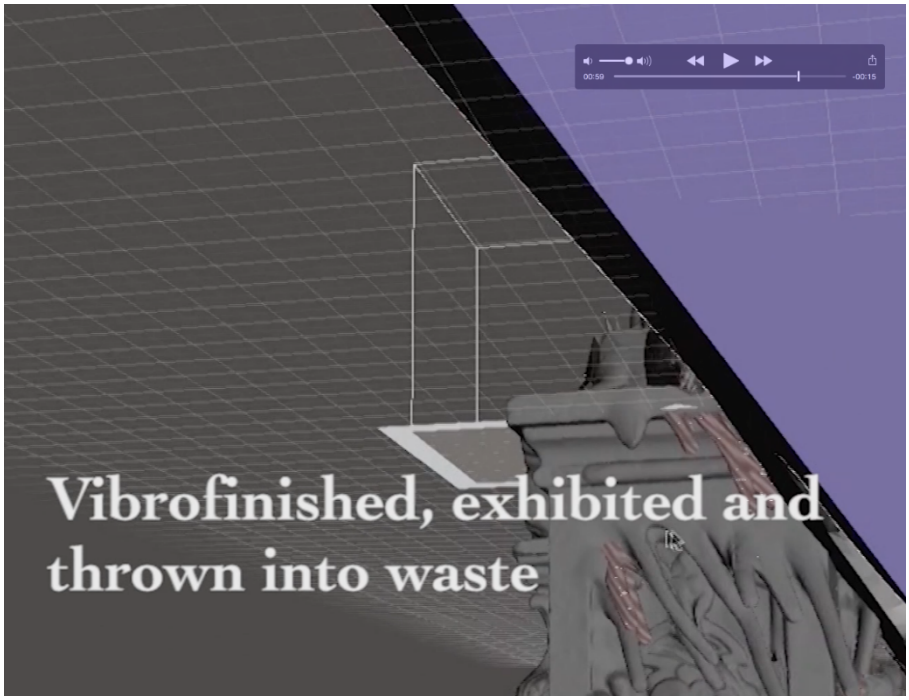


Figure 4.16-4.20: *Pazugoo Upflush Operation* (2017); installation view and stills.

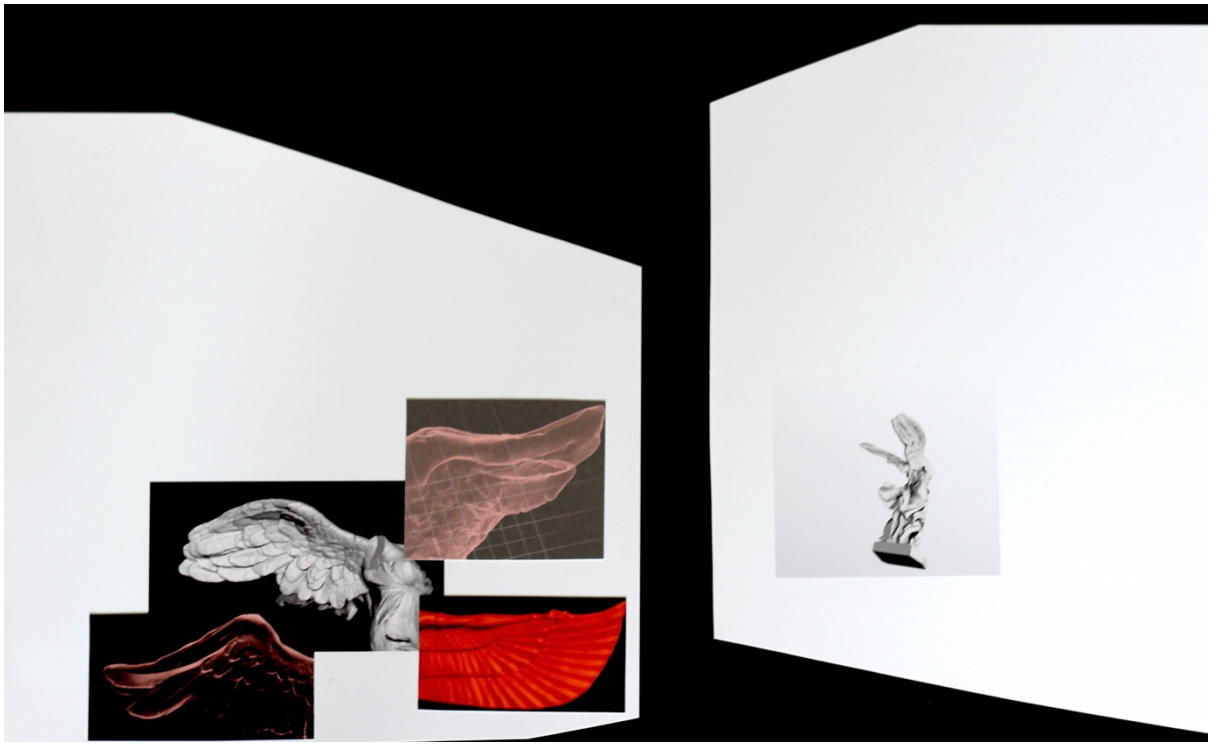


Figure 4.21: *Double Flight Collage* (2017), A2 print.

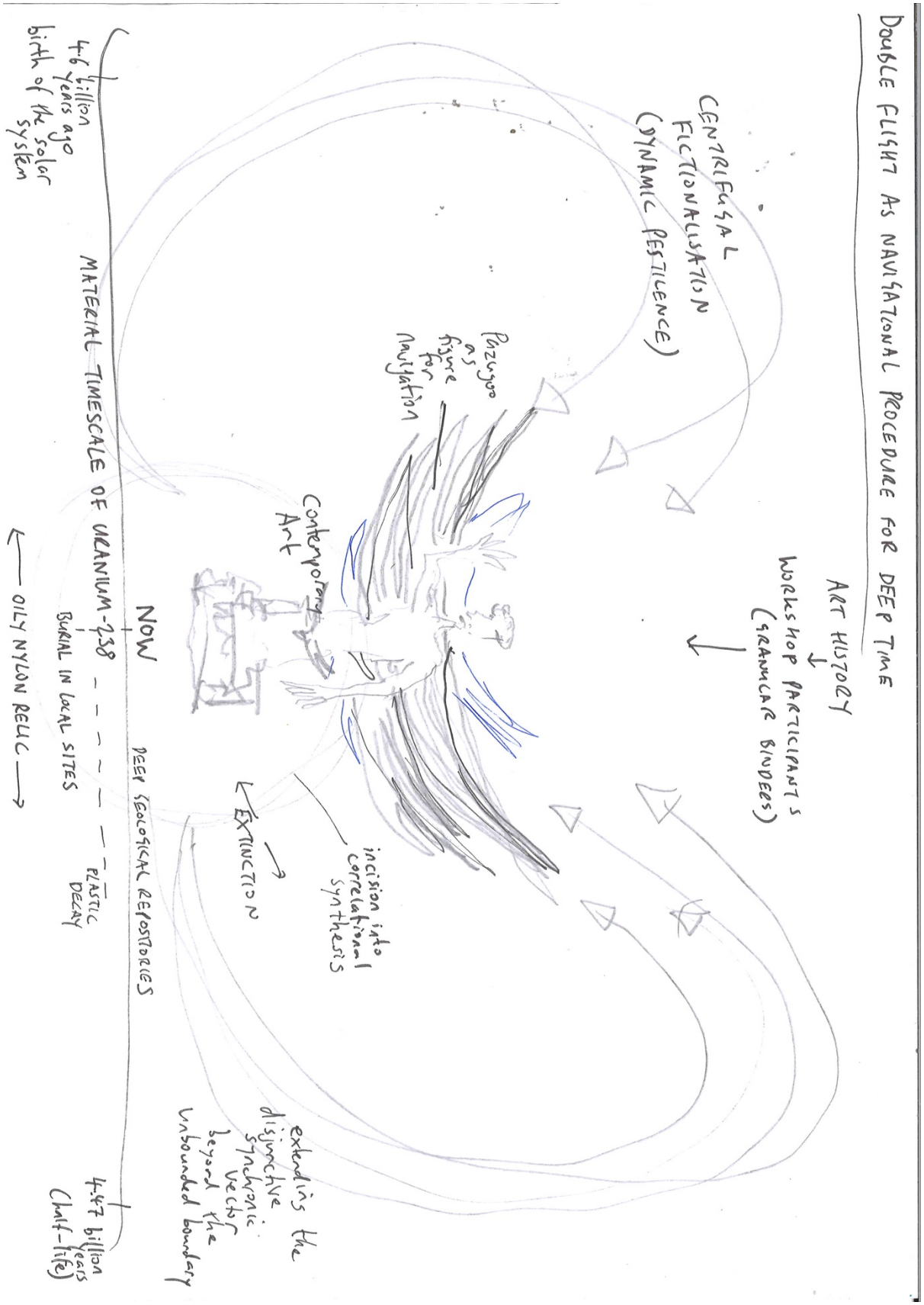


Figure 4.22: *Double Flight as Navigational Procedure for Deep Time* (2017), A3 drawing.

5. *Underground / Overground* , Z33 House for Contemporary Art, Hasselt, Belgium

For this event, I presented my work as a way to participate in cross-disciplinary discussions around intergenerational communication and long-term future projection in relation to this and other projects. The event involved artists, science and technology experts, architects, local community groups, waste management strategists, geologists and writers to critically discuss legacies, temporalities, problems and effects of nuclear waste in Belgium.
Working in this context offered potential for the work to have some agency outside of an exhibiton format.


"I find this insistence on veering away from the 'sublime' fascinating"
"I was looking for a sort of CAR CRASH of ideas"
"it's about humans taking themselves as norm"
"What EARTH art d in thi situa
ALEXIS
ANDY WEIR
STEFAN
ANNE REENBERG
Professor Robert Williams
MARTEN VANGEET
AYELLE MEYERMANS
Kyoko Tachibana
17.11.17


GET AWAY FROM THE SUBLIME
the plastic demon PAZUGU
based on PAZUZU, Babylonian deity of [redacted] DUST and CONTAGION
Andy Weir
fiction as a STRATEGY to MAKE THINGS HAPPEN
17.11.17

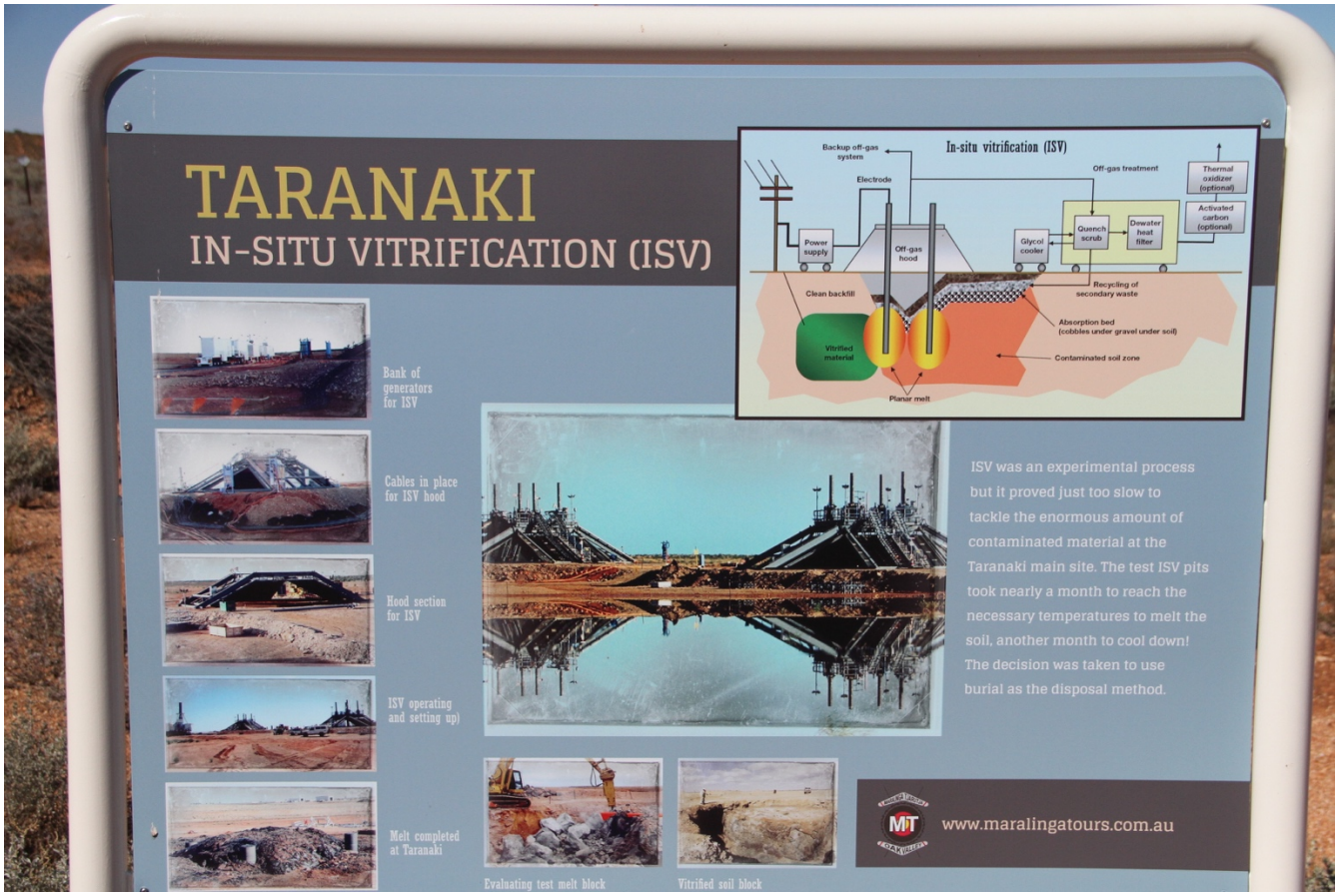
Figures 5.1-5.7: photographs from discussions, and illustration documentation by Pieter Fannes.

https://we-make-money-not-art.com/pazugoo-the-3d-printed-evil-spirits-of-nuclear-waste-storage/

5.8: Link to interview on the work following the event.

6. *Pazugoo Taranaki Marker*, with Jacob Warren (2017)

In collaboration with Jacob Warren, a SLS plastic Pazugoo figure is buried and indexed at the Taranaki Burial pits, Maralinga, site of 1950's UK nuclear testing in Australia, under the custodianship of guides from the Maralinga Tjarutja people, forming part of their local musuem of the site. I'm interested in how the work comes to function as a marker, against the RK&M narrative, not restricted to deep geological repository sites but as drawing connections between expanded networks of toxicity, through mythic burials and other procedures.


TARANAKI
IN-SITU VITRIFICATION (ISV)
In-situ vitrification (ISV)
Backup off-gas system
Electrode
Off-gas treatment
Thermal oxidizer (optional)
Activated carbon (optional)
Power supply
Off-gas hood
Glycol cooler
Quench scrub
Dewater heat filter
Clean backfill
Recycling of secondary waste
Absorption bed (cobbles under gravel under soil)
Vitrified material
Contaminated soil zone
Planar melt
Bank of generators for ISV
Cables in place for ISV hood
Hood section for ISV
ISV operating and setting up)
Melt completed at Taranaki
ISV was an experimental process but it proved just too slow to tackle the enormous amount of contaminated material at the Taranaki main site. The test ISV pits took nearly a month to reach the necessary temperatures to melt the soil, another month to cool down! The decision was taken to use burial as the disposal method.
Evaluating test melt block
Vitrified soil block
www.maralingatours.com.au


TEST SITE
TARANAKI
A BRITISH ATOMIC
WEAPON WAS TEST
EXPLODED HERE ON
9 OCT 1957


CT
WARNING
BURIED RADIOACTIVE MATERIALS
1996–97
NO CAMPING / NGURA WIYA

7. *Clay Burial Ritual*, with Anna Volkmar & Jacob Warren (2017)

In this collaboration with art historians Anna Volkmar and Jacob Warren, a burial ritual for a Pazugoo anti-marker figure encased in clay tablet was devised as part of an event on (In)human time and toxicity in Amsterdam (2018). The work, flushed into the future, acts here as an anti-marker:

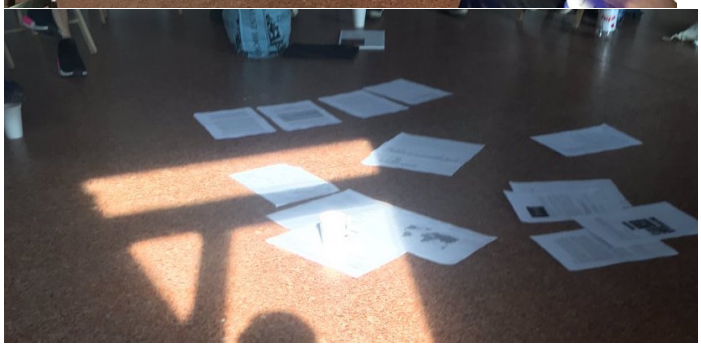
'Weir's experimental practice...addresses a present and not a future audience. By engaging the workshop participants in a collaborative effort to design a repository marker of their own, they become implicated in the problem of marking nuclear waste. Given the semiotic and material instability of the markers they design, they enter what can best be described as a relation of complicity that connects individual action to possible future encounters between the markers they dispose and the future organisms they will never meet in person. Importantly, this complicity is enacted not only on a discursive, but also on a material level. The workshop participants, as Weir puts it, become "operational binders" for the nylon particles that coalesce into Pazuzu figurines. This is a significant redefinition of the role that the public assumes in the process of developing feasible marking strategies. While traditional marker designs envision members of the public as bystanders (as I have shown in the case of Spike Field), Pazugoo redefines them as accomplices. A key moment in this linking is the disposal of the figurines which takes the form of a collective performance, linking determinate action to its indeterminate outcome.'

from Anna Volkmar, 'How to Deal Responsibly with Radioactive Waste', paper at *(In)Human Time: Artistic Responses to Radiotoxicity*, Vrije Universiteit Amsterdam, May 23, 2018, p.4

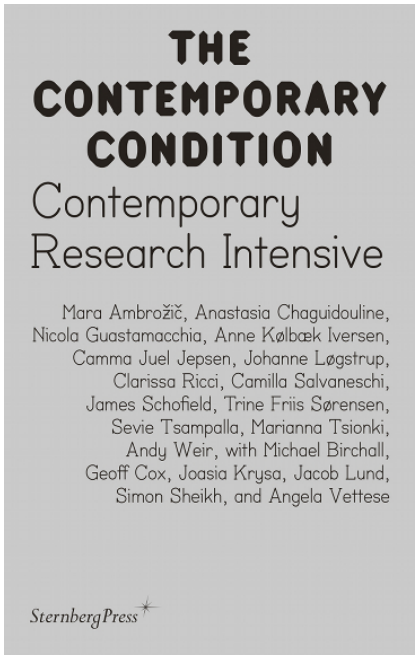

Figures 7.1-7.2: Clay Burial Ritual, Amsterdam

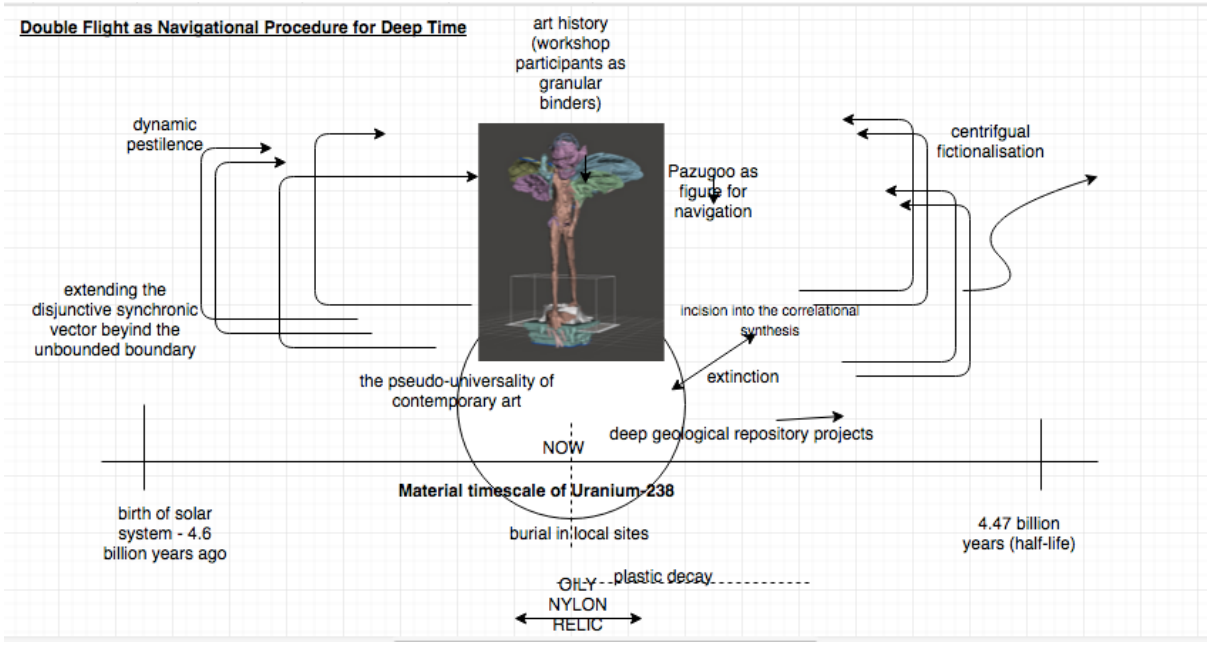
8. *Contemporary Research Intensive*, collaboration, Venice Biennale Research Pavilion (2017)

Group workshop on what constitutes 'the contemporary, leading to a collectively edited and authored publication including new Double Flight as Deep Time Navigation diagram.



Figures 8.1-8.2: images from workshop





Figures 8.3-8.4: Publication and printed diagram

9. Installation of work at Malmo Art Museum, Sweden 2018:

Museum Index (Malmo) (2018)
Pazugoo Prototypes 3 (2018)
Pazugoo Perimeter Markers (2018)
Pazugoo Burial Objects (2018)
Glo-stick Trailer (2018)

For this exhibition, I focused on a series of Pazugoo figures, designed as Museum Index, Prototypes, Perimeter Markers and Burial Objects. The Museum Index is part of the museum collection, referencing distributed buried Pazugoo objects; the objects for burial are resin casts designed for low-level burial at waste sites, and the perimeter markers are bronze casts, deisgned for lower level burial at edges of waste sites. These were shown alongside previous plastic prototypes, video and print work.

Figure 9.1-9.3: Installation views of *Museum Index (Malmo)*, 2018 (on plinth); Pazugoo Prototypes 1, 2016 (on long shelf in middle); *Pazugoo Prototypes 2*, 2017 (shelves on left); *Pazugoo Perimeter Markers* and *Pazugoo for Burial*, 2018 (shelves on right); *Glo-stick Trailer*, 2018 (vinyl print on wall) & Upflush Operation, 2018 (video on wall on left), at *Perpetual Uncertainty: Contemporary Art and the Nuclear Anthropocene*, Malmo Art Museum, Sweden (2018).

Figure 9.4: Installation view of *Upflush Operation* (2017), video loop w/sound, 2 mins.
A short video loop made for the installation, combining images of the 3d-modelling process, a text narrative on plastic, and sound recorded in the HADES underground lab.

Figure 9.5: *Pazugoo Perimeter Marker 1*, 2018, polished bronze, 18cm x 9cm x 6cm.
One of a series of works (from workshop designs) proposed to be buried at the perimeter of low-level waste repository sites. I have exhibited this alongside maps of sites as plan for burial.

Figure 9.6-9.7: *Museum Index (Malmo),* 2018, acrylic, SLS-plastic in Plexiglas container, 38cm x 16cm x 10cm. Work for the museum collection, to include the figure and archive material, referencing the distributed buried objects.

Figure 9.8: *Pazugoo Prototype 3.1*, 2018, acryclic resin, 22cm x 15cm x 8cm
A series of resin prints proposed to be buried with nuclear waste.

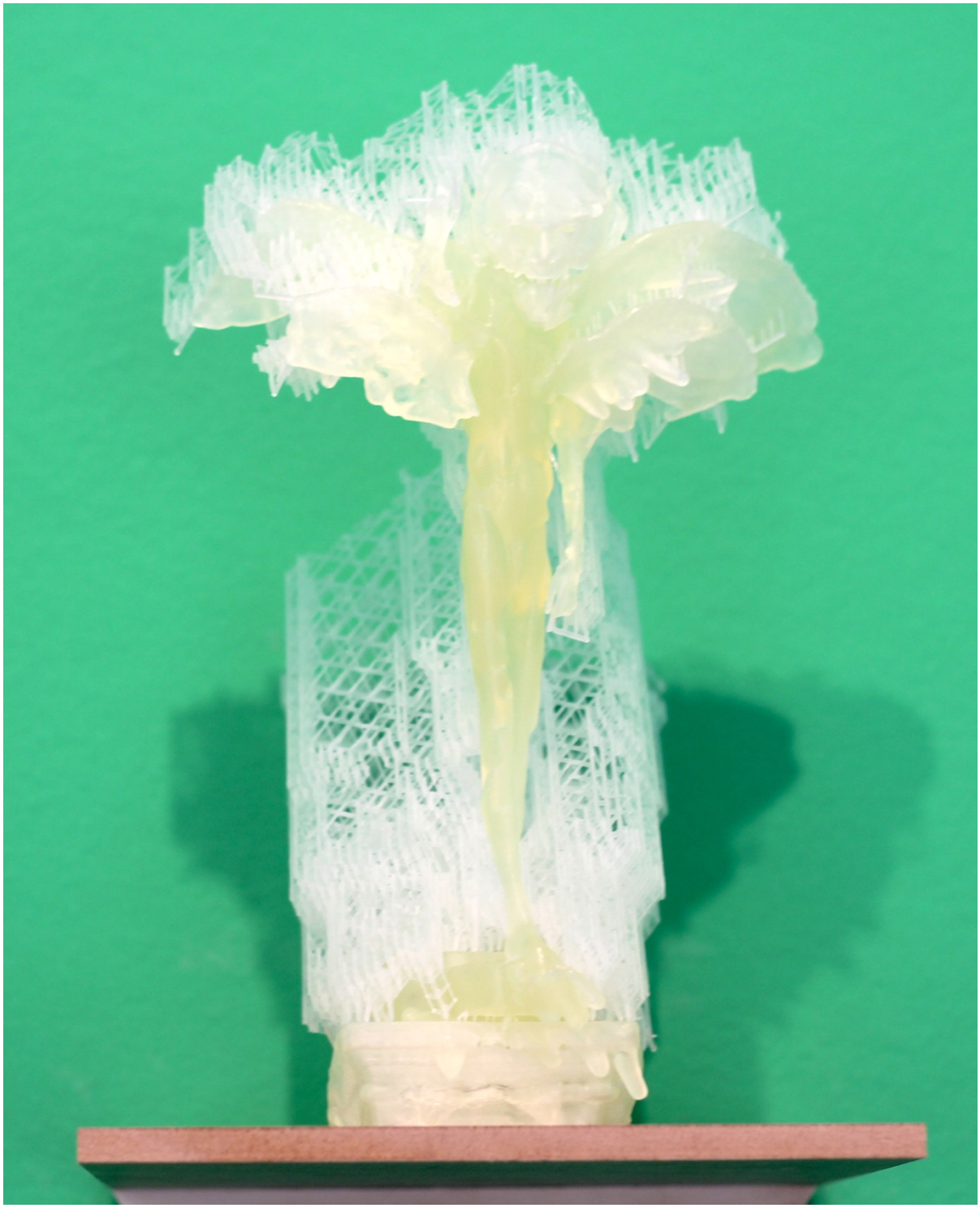


Figure 9.9: *Pazugoo Prototype 3.3*, 2018, epoxy resin, 28cm x 16cm x 12cm

Figure 9:10: *Glo-stick trailer Malmo (close-up detail),* 2018, vinyl print, 220cm x 160cm.

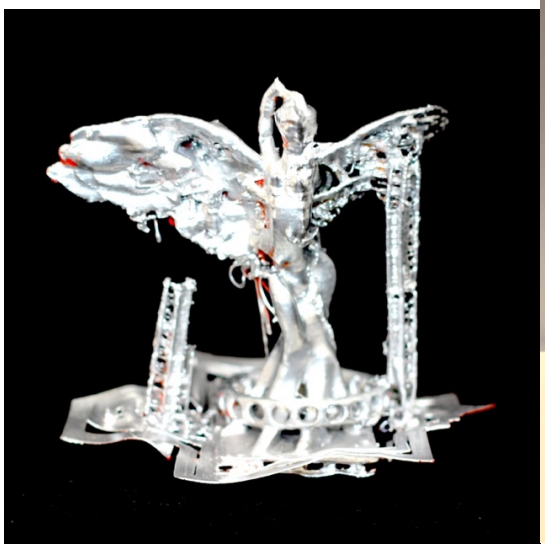


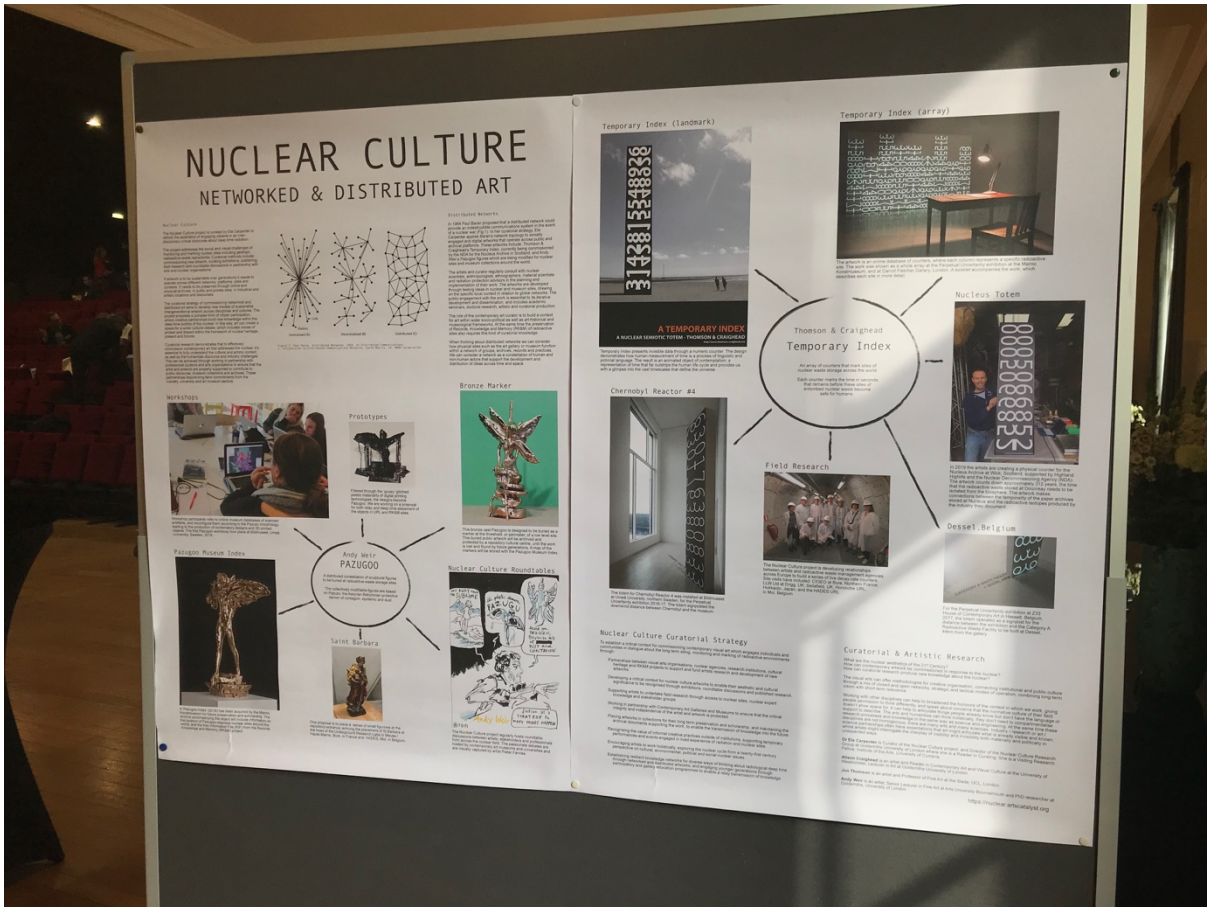
Figure 9.11-9.14: Pazugoo prototypes (2016-17)

10 Work at *Modern 2020*, Paris, 2019.

Nuclear Culture: Networked and Distributed Art, with Ele Carpenter (2019)
Stakeholders Roundtable (2019)

Developing conversations between art and nuclear waste industries, this included a poster presentation with Ele Carpenter, and a roundtable discussion with European-based nuclear technicians, representatives of local community groups and social scientists, focusing around questions such as what role art could play in marking radioactive waste for the future.

Figure 10.1: Presentation and discussion at 'Stakeholders Roundtable: How to Reveal the Underground through Data, over Time and in the Present', chaired by Ele Carpenter, at *Modern 2020, 2nd International Conference on Monitoring in Geological Disposal of Radioactive Waste*, April 2019.


NUCLEAR CULTURE
NETWORKED & DISTRIBUTED ART
Temporary Index (landmark)
A TEMPORARY INDEX
Temporary Index (array)
Thomson & Craighead
Temporary Index
Nucleus Totem
Chernobyl Reactor #4
Field Research
Dessel,Belgium
Bronze Marker
Prototypes
Workshops
Andy Weir
PAZUGOO
Patzugoo Museum Index
Saint Barbara
Nuclear Culture Roundtables
Nuclear Culture Curatorial Strategy
Curatorial & Artistic Research

NUCLEAR CULTURE

NETWORKED & DISTRIBUTED ART

Nuclear Culture

The Nuclear Culture project is curated by Ele Carpenter to rethink the aesthetics of engaging citizens in an inter-disciplinary critical discourse about deep time radiation.

The project addresses the social and visual challenges of monitoring and marking nuclear sites including geologic radioactive waste repositories. Curatorial methods include: commissioning new artwork, curating exhibitions, publishing, field research and roundtable discussions in partnership with arts and nuclear organisations.

If artwork is to be sustainable over generations it needs to operate across different networks, platforms, sites and contexts. It needs to be preserved through online and physical archives, in public and private sites, in industrial and artistic locations and discourses.

The curatorial strategy of commissioning networked and distributed art aims to develop new models of sustainable intergenerational artwork across disciplines and cultures. The project proposes a complex form of citizen participation, where creative partnerships build new knowledge within the deep-time politics of the nuclear. In this way, art can create a space for a wider cultural debate, which includes voices of protest and dissent within the framework of nuclear heritage, present and futures.

Curatorial research demonstrates that to effectively commission contemporary art that addresses the nuclear, it's essential to fully understand the cultural and artistic context, as well as the humanities discourse and industry challenges. This can be achieved through working in partnership with professional curators and arts organisations to ensure that the artist and artwork are properly supported to contribute to public discourse, museum collections and archives. These partnerships require long-term commitments from the industry, university and art museum sectors.

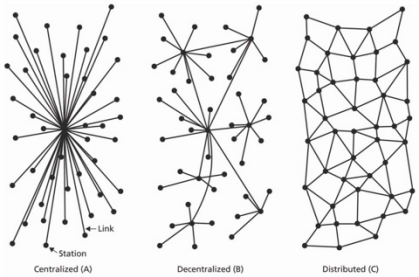


Figure 1: Paul Baran, Distributed Networks, 1964. On Distributed Communications: I. Introduction to Distributed Communications Networks. Santa Monica, CA: RAND Corporation.

Distributed Networks

In 1964 Paul Baran proposed that a distributed network could provide an indestructible communications system in the event of a nuclear war (Fig.1). In her curatorial strategy, Ele Carpenter applies Baran's network topology to socially engaged and digital artworks that operate across public and archival platforms. These artworks include: Thomson & Craighead's Temporary Index, currently being commissioned by the NDA for the Nucleus Archive in Scotland; and Andy Weir's Pazugoo figures which are being modified for nuclear sites and museum collections around the world.

The artists and curator regularly consult with nuclear scientists, anthropologists, ethnographers, material scientists and radiation protection advisors in the planning and implementation of their work. The artworks are developed through testing ideas in nuclear and museum sites, drawing on the specific local context in relation to global networks. The public engagement with the work is essential to its iterative development and dissemination, and includes academic seminars, doctoral research, artistic and curatorial production.

The role of the contemporary art curator is to build a context for art within wider socio-political as well as art-historical and museological frameworks. At the same time the preservation of Records, Knowledge and Memory (RK&M) of radioactive sites also requires this kind of curatorial knowledge.

When thinking about distributed networks we can consider how physical sites such as the art gallery or museum function within a network of groups, archives, records and practices. We can consider a network as a constellation of human and non-human actors that support the development and distribution of ideas across time and space.

Workshops

Workshop participants refer to online museum databases of scanned artefacts, and reconfigure them according to the Pazuzu morphology, leading to the production of combinatory designs and 3D printed objects. The first Pazugoo workshop took place at Bildmuseet, Umeå University, Sweden, 2016.

Prototypes

Filtered through the 'gooey' glitched plastic materiality of digital printing technologies, the designs become Pazugoo. We are working on a proposal for both relay and deep time placement of the objects in URL and RK&M sites.

Bronze Marker

This bronze cast Pazugoo is designed to be buried as a marker at the threshold, or perimeter, of a low level site. This buried public artwork will be archived and protected by a repository cultural centre, until the work is lost and found by future generations. A map of the markers will be stored with the Pazugoo Museum Index.

Andy Weir

PAZUGOO

A distributed constellation of sculptural figures to be buried at radioactive waste storage sites.

The collectively modifiable figures are based on Pazuzu, the Assyrian-Babylonian protective demon of contagion, epidemic and dust.

Pazugoo Museum Index

A 'Pazugoo Index' (2018) has been acquired by the Malmö Konstmuseum for future preservation and scholarship. The archive accompanying the object will include information on the location of Pazugoo objectsat nuclear sites around the world, and the Key Information File (KIF) from the Records Knowledge and Memory (RK&M) project.

Saint Barbara

One proposal is to place a series of small figurines at the repository entrance, echoing the placement of St Barbara at the head of the Underground Research Labs in Meuse / Haute-Marne, Bure, in France and HADES, Mol, in Belgium.

Nuclear Culture Roundtables

The Nuclear Culture project regularly hosts roundtable discussions between artists, stakeholders and professionals from across the nuclear field. The passionate debates are hosted by contemporary art museums and universities and are visually captured by artist Pieter Fannes.

Figures 10.2-10.3: Poster presentation supporting curator Ele Carpenter's argument for 'networked and distributed art' in a nuclear waste context, with *Pazugoo* and Thomson & Craighead's *Temporary Index* as examples.

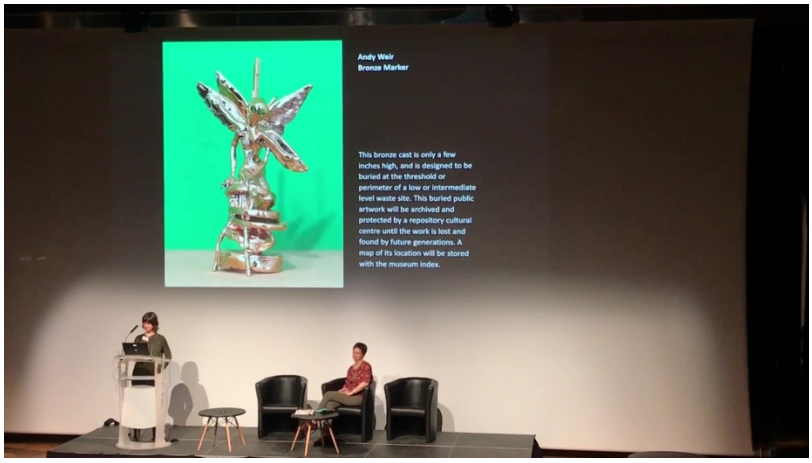
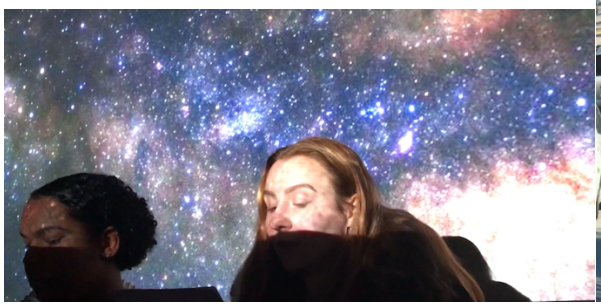


Figure 10.4: Ele Carpenter presenting Pazugoo

11. *Human Interference Scenarios* 1991 -101,991 (2019)

This was a workshop based on the 1991 SANDIA report of scenarios for interference in the proposed WIPP Repositoy. It took the form of planning and devising a play re-staging the scenarios, documented as video. I'm interested in drawing on the nuclear context to explore performance and group workshops as formats for modellng scenarios of unexpected events.

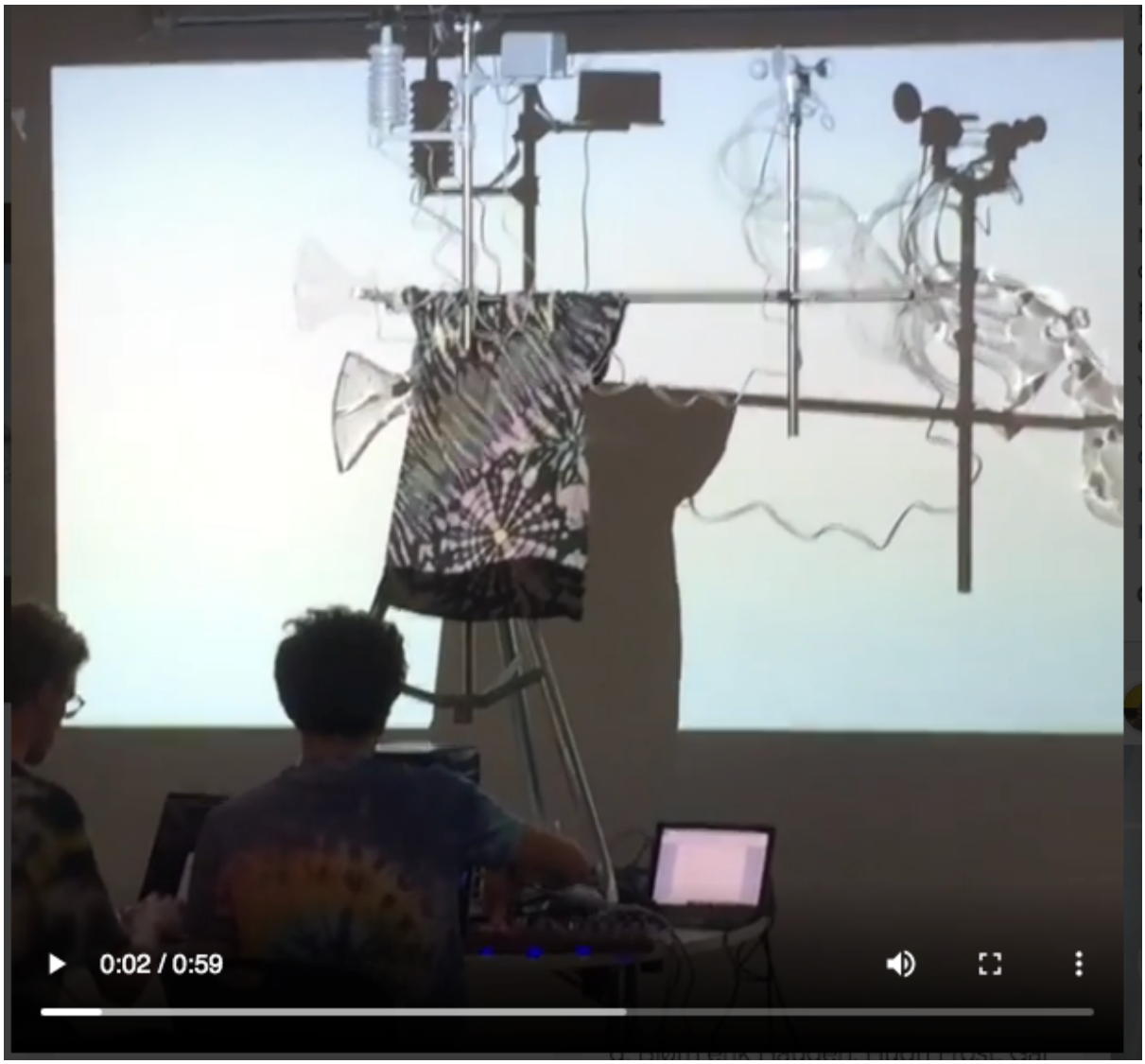


Figures 11.1-11.3: Stills from the video documentation.

12. *Specificities of the Planetary Room*, with Harry Meadows (2019)

This was presented as a live event with two performers facing a sculpture and making sound in response to its demands. It plays with fantasy of 'sonifying' climate date through the performers staging their own implications within the climate of the room, and the ritual personfication of the climate change sensor as voiced sculpture - anemometer, barometer and precipitation gauge intertwined with fetish idols and sea creatures.

It developed from a series of workshops on idiocy and improvisation drawing on the text *Idioms and Idiots* by Mattin, Ray Brassier, Jean-Luc Guionnet and Murayama Seijiro, where they discuss 'acknowledging the specificities of the room'. The 'specificities of the room' here include the physical setting of the performance; its institutional conditions; habits of performers and audience, and so on, as material for re-shaping. Extending this further, it asks what happens when the room extends to the planet? What is the capacity of the body-sound-audience machine in the face of incommunicably vast networks of data?



Figures 12.2-12.3: Still from video documentation of performance.

13 Work at *Neuhaus*, Het Niuuwe Instituut, Rotterdam, The Netherlands, 2019

Mythic Personification of Nuclear Waste for COVRA (2019-2020)
An Excess of Wings (You are Binders for my Granular Polymers) (2019)
Goo-Goo (2019)
Design for the Deep Future (2019)

This work developed through a project at Het Niuewe Instituut in Rotterdam as 'a temporary transdisciplinary academy for more-than-human knowledge', evoking the history of Bauhaus, in a re-imagined 'Neuhaus'. I have developed a new series of workshops which proposes to design a new figure as personification of the nuclear waste at COVRA, site for radioactive waste processing and storage in the Netherlands. So far, this has involved mutating Pazugoo from its origins in the Pazuzu demon through other cultural traditions local to the site of the waste. Work in progress is displayed in exhibition alongside an interactive work for visitors to make designs (*Goo-Goo*), which I am in the process of collecting as material. The first workshop focused on the context of relating to the overwhelming immensity of climate change data, through drawing on non-western traditions of representation through personification. This has also involved interviews and public discussion with COVRA representatives, artists and designers. The installation also collects recent prototype objects, and a new video work, documenting workshop processes alongside existing mythology and materiality of the HADES underground repository, re-imagining the demon as voice, which I aim to develop through further sound work.

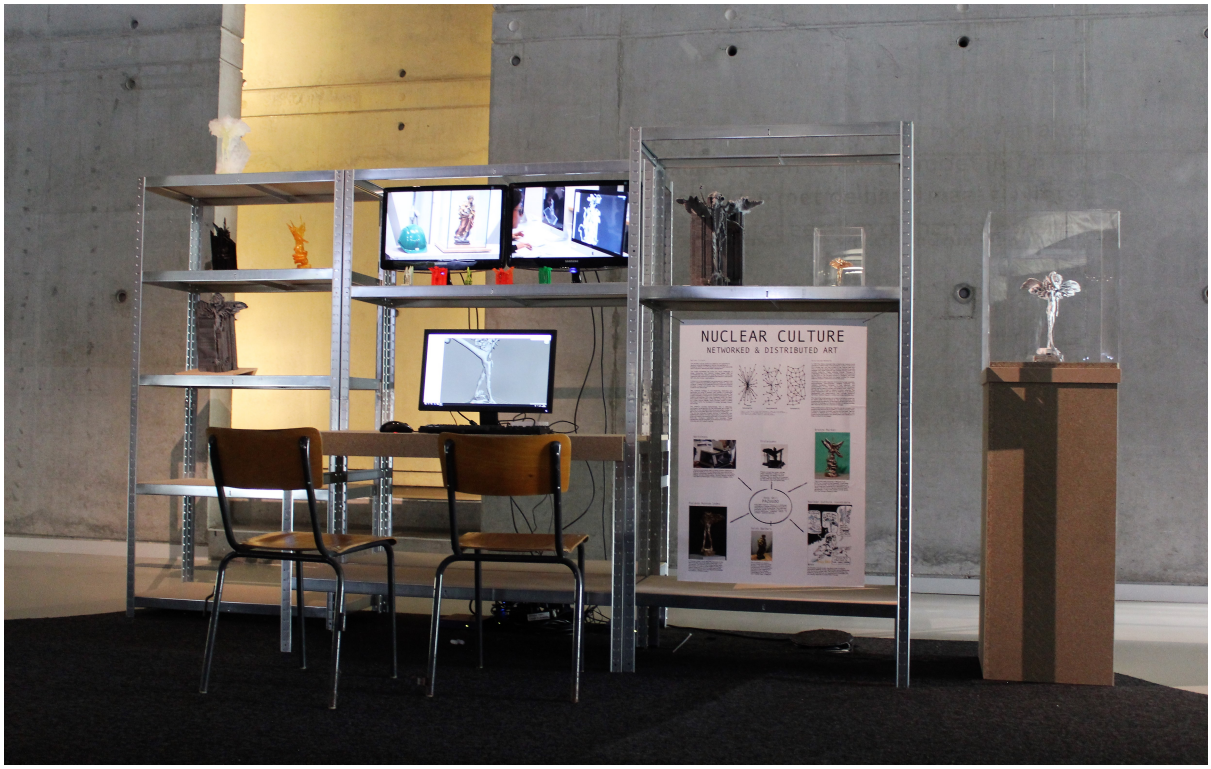
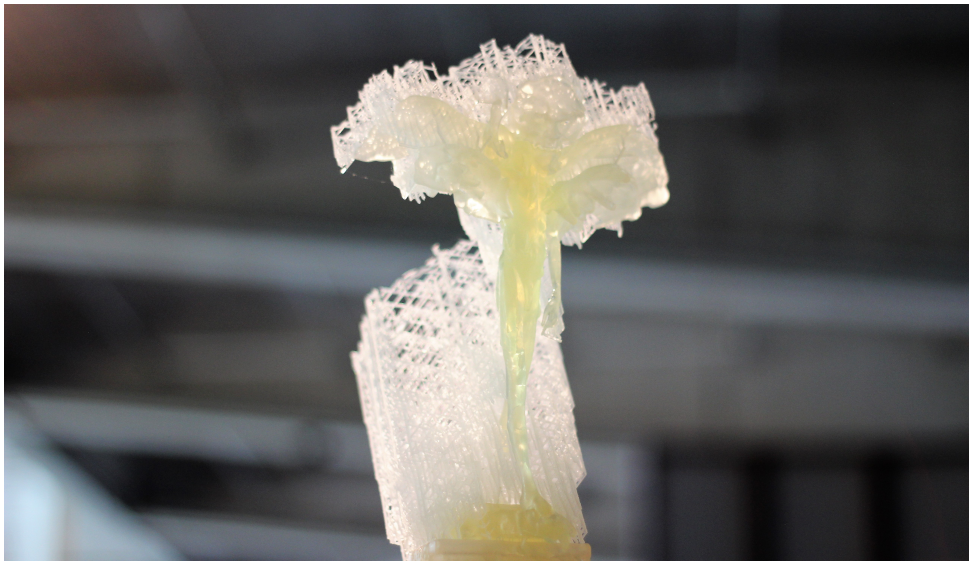


Figure 13.1: Installation View, Pazugoo Prototypes (2016-2018); Nuclear Culture poster (2018); An Excess of Wings (2019)

Figure 13.2: Video stills.



Figures 13.3-13.6: Installation details.

14 ONDRAF/ NIRAS & Z33 Commission, 2019-2020

This is my current work, developed from research over the project. Through commissioning by the Belgian National Agency of Nuclear Waste Management (ONDRAF/NIRAS), the work is able to intervene directly into the interdisciplinary context and specific sites of recording and remembering radioactive waste.

For the first part of the work I am working with local community groups in the area of HADES (the proposed site for long-term storage of Belgium's nuclear waste) to create a new composite demon that draws on mythologies of the area. This will lead to a new 3D-printed figure, copies of which will be sited as a ritualistic figure alongside the Santa Barbara statue at the entranceway to the HADES Underground Laboratory, be buried at the site, and remain as 'index' at the site museum, currently being built.

Alongside this I am working with material scientists at the laboratory to get information on the waste in storage, with the aim of tracing it to possible Uranium mine origins. Using this information, alongside other research and necessarily speculative connections, I will then travel to site of a possible mine source of the waste, and bury a further copy of the figure. A mythic connection is then made between the deep geological repository site in Belgium and the life cycle of the waste within its ongoing planetary toxic legacies.

For exhibition, I will present documentation of the new figure at these multiple sites, using this as a way to connect the sites, at the surface, for duration of the exhibition, where they remain connected underground afterwards.

Figure 14.1: image from research site visit to HADES underground laboratory

Figure 14.2: image from research site visit to HADES underground laboratory, miners hat and Santa Barbara figure (patron saint of miners), traditionally touched before going underground.

Figure 14.3: image from research site visit to HADES underground laboratory, close-up of the local Boom clay acting as protecting barrier absorbing radionuclides.

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