

The Geo_lo_gi_c Im_agi_na_ti_on

Edited by Arie Altena,
Mirna Belina,
Lucas van der Velden

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The Aral Sea was an endorheic lake between northern Kazakhstan and southern Uzbekistan. The lake - also known as the 'Sea of Islands' - once had 1100 islands and was one of the four largest lakes in the world (68,000 square kilometres), but it started shrinking in the 1960s after the rivers feeding it were diverted by Soviet irrigation projects. By 2007 it had reduced to 10 per cent of its original size and in August 2014 satellite pictures revealed that for the first time in modern history the Eastern basin had completely dried up. This part is now called Aralkum desert.



'(T)he lower reaches in the low and even in the middle stream of the rivers flowing into the Aral Sea are so dry that the existence of it in its present boundaries is evidence of our backwardness and inability to take sufficient advantage of the current water volume and fertile silt that the Amu and Syr bear. In a state capable of using the gifts of nature, the Aral would serve as a drain of water in winter (when it is not necessary for irrigation) and also of high-level waters in summer.'

- Russian climatologist and geographer A.I. Voeikov in his speech 'Rivers of Russia', 1882. (Igor J. Zonn, M. Glantz, Aleksey N. Korarev, Andrey G. Kortianov: *The Aral Sea Encyclopedia*, Berlin: Springer, 2009.)



The Water Ministry made the deliberate decision to sacrifice the Aral Sea for the sake of cotton production. Polad-Polad Zade, the First Deputy of the Ministry in the 1930s, stated: 'The Aral Sea must die, just as a soldier in battle!' (See Carol Crewdron, Joel Ziemann, Lee Blaney, 'The Death of a Sea', in *Lehigh Review*, vol. 13, paper 3, 2005.)

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The Geo_lo_gi_c Im_agi_na_ti_on

Lucas van der Velden
& Arie Altena

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We have been studying the sky and the stars since at least Sumerian times. When we look up into the sky, we are looking back in time. Our most advanced telescopes detect radiation from the birth of the universe – the birth of time. We have ventured far into outer space. Voyager 1, dispatched by NASA in 1977, has left our solar system, entered interstellar space, and at a distance of approximately 19.5 billion kilometres from the Sun, is still transmitting data to Earth. But how much do we actually know about the ground beneath our feet? We probably know more about the Moon than about the deep sea, more about the skies than about what is underground.

Inspired by geosciences, *The Geologic Imagination* zooms in on planet Earth. A fundamental starting point for this book is the thesis that we live in a new geological epoch: the Anthropocene. Human activity has irreversibly changed the composition of the atmosphere, the oceans, and even the Earth's crust. In the Anthropocene humans have become a force on a geologic scale. Scientists have estimated, for instance, that humans move more sediment, sand and rocks annually than rivers, erosion and other nonhuman processes. In this book, Matthew Coolidge of the Center for Land Use Interpretation even states that 'every molecule on the surface of the Earth has been affected by humans'.

Another powerful example of radical human influence is the Aral Sea on the border between Kazakhstan and Uzbekistan. Before 1989 this was one of the four largest lakes in the world. Since the 1960s the lake has been shrinking because the rivers that fed it were diverted for irrigation projects. It split into four smaller lakes, and since 2014 the complete south-eastern basin had dried up. Most of what was the Aral Sea just 30 years ago is now the Aralkum desert.

The electromagnetic footprint of human activity is also enormous. Suppose we were equipped with the right senses and sensors, and looked at Earth from outer space. What we would see would resemble a giant Christmas tree, a planet that is brightly 'lit-up' with not only enormous amounts of visible light, but also with electromagnetic radiation ranging from radio waves to wireless telecom frequencies.

The consequence of the thesis of the Anthropocene is that the emphasis is no longer on a world defined by human history. The perspective has shifted to forces that act on timescales beyond the perceivable. This shift is also marked by changes in the images

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of Earth. At the end of the 1960s the colour photos of Earth taken during the Apollo missions made such an impact that they are thought to have spawned a new ecological consciousness, simply because we could see Earth from outer space. Now we can look at Earth from space at any time of the day on our communication devices. We can log into the livestream of the International Space Station, travel around the Earth in 90 minutes and see the sun rise twice above the planet's curved edge.

All of this challenges us to rethink our attachments to the world, and our concepts of nature, culture and ecology. How do we conceive of the world? How do we understand the systems and processes of nature, and our intentions and interactions with the planet?

This book brings together different perspectives from the arts, philosophy, science and technology studies, geography, design, and other fields. Rather than presenting a single unified statement, it offers an overview of approaches and practices. Several contributions in *The Geologic Imagination* are the fruit of the first edition of the *Dark Ecology* project, initiated by Sonic Acts and Norwegian curator Hilde Methi. *Dark Ecology* is a three-year art, research and commissioning project in the Barents Region in Northern Norway and Northwest Russia. In October 2014 a group of artists and researchers travelled to the Norwegian border town Kirkenes and the Russian industrial towns Nickel and Zapolyarny, in Murmansk Oblast, for a week-long programme of lectures, presentations of commissioned works, workshops, concerts, and explorations of the area. The project is informed by Timothy Morton's idea that ecology does not privilege the human, and is not something beautiful, but rather something dark. It demands that we think about our intimate interconnections with, for instance, snowflakes and plankton, but also with radiation and iron ore. The effects of global warming and the need to rethink concepts of nature and ecology are relevant anywhere in the world, but they are especially pertinent in the Barents Region with its Arctic nature, industrial pollution and open-pit mining.

The book opens with photographs made by Marijn de Jong during his visit to Kirkenes, Nickel, Zapolyarny, and Prirechny in October 2014. In the first essay of the book Douglas Kahn reinterprets the Icarus myth in the light of global warming. Interviewed by Julian Ross, Kodwo Eshun discusses two of The

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Otolith Group's films, *The Radiant* about the Fukushima disaster, and *Medium Earth* about sensing earthquakes. The Center for Land Use Interpretation contributes a visual essay on nuclear landfills in the US, complemented by an interview with Matthew Coolidge explaining the Center's motivations. Historian Dipesh Chakrabarty discusses the moods of the Anthropocene with Liesbeth Koot. Jamie Kruse and Elizabeth Ellsworth contribute a visual reflection on living in the Anthropocene. In his essay 'Poetry and Bookkeeping', Michael Welland takes up the theme of the geologic imagination in science and poetry. Kurt Hentschläger discusses his recent work *Measure* with Mirna Belina. Carsten Seiffarth asked Mexican sound artist Mario de Vega about the use of electromagnetic radiation and infrasound in his installations.

The Geologic Imagination also includes Timothy Morton's keynote lecture for the *Dark Ecology* event, 'Human Thought at Earth Magnitude', in which he outlines what the consequences are when we think about events at the magnitude of the Earth. 'Robotic Arms, Crabs and Algos' by Femke Herregraven is about her commissioned *Dark Ecology* research into a possible landing point for a new undersea cable near Murmansk that will carry global financial data. Raviv Ganchrow's text is an investigation of infrasound, and reflects on his site-specific sound installation *Long-Wave Synthesis* that he is developing in Kirkenes. Sociologist Noortje Marres talks about how things are equipped to speak up. Tim Maughan had a conversation with Liam Young during their expedition on a container ship to key spots in our global economy. Paul Bogard's contribution is about light pollution and accepting darkness as something positive. Mirna Belina's piece looks at the redefinition of landscape in a selection of recent and classic experimental films. It is followed by a visual impression by Karl Lemieux and BJ Nilsen of their travels in the Barents Region. The USB device that comes with this book contains BJ Nilsen's new composition *unearthed*, based on field recordings made in Kirkenes and Bjørnevatt in Finnmark, Norway; and Nikel, Zapolyarny, Prirechny in Murmansk Oblast, Russia. We are extremely grateful to the authors and artists for their contributions.

This book explores a world of long timescales, slow shifts and dark ecology. It asks what happens in the ground beneath our feet, and looks at how unknown territories can be documented in meaningful ways. The contributions examine how the changes and transformations

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that occur at Earth magnitude and on a geological scale challenge our imagination and reshape our cultural conceptions. They ask how these transformations become something humans can feel, touch, experience and understand. What ways do artists develop to help us experience these transformations? How can we imagine the slow transformations that we are part of, how do they affect us culturally and emotionally? In that sense this book is an attempt to attune to a conception of the world that is implied by the Anthropocene, taking into account timescales far beyond human history.

Ultimately, both *Dark Ecology* and *The Geologic Imagination* are an attempt to imagine what it means to live in the Anthropocene, in a world where climate change – a catastrophe for humans – is irreversible.

G_{re}**y** **Z**_{one}

Marijn de Jong



Nikel, Russia. Lake Kuetryarvi and the Parvik River are beyond the hills in the distance. Norway is on the other side.

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Monochrome days. At night signs of life in the windows.

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It is difficult not to see the factory with its blackened smokestacks, which dominates the town like a cathedral.



Even if you don't see the smokestack, you still see the smoke.

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Children's paradise



Sunrise



Black sand from the smelter with dead trees.

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Prirechny, a small town near Nikel, built in 1961. Because the nearby mine is closed, hardly anybody lives here.



In 2010 Prirechny had 45 inhabitants, mostly elderly women. A once lively small community has disappeared.

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There are towers everywhere in Nikel. This one is about five metres tall, with iron stairs leading to a door. It's a waste depot of a type that is only found in Nikel. The hills of black sand in the background are from the smelter.



Hot water pipes for the town's heating system. They are above ground because of the permafrost.



Statue of Lenin on Nikel's central square.

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Outdoor public spaces in Kirkener are extremely well maintained. Trees are planted in exactly the right spots. Most houses in Kirkener are partly built of wood and surrounded by grass. This house is located on Preteveien.



Snow erases old traces, and lights up the city. Only what recently happened is betrayed by signs in the snow. Empty buildings are unsecured - no gates, no 'No Trespassing' signs. It feels as if you can wander freely through the whole town. There are stray dogs aplenty - they are wild, more wolves than dogs. They are unafraid and unfriendly and let you know where you cannot go. This is in Nikel.

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Rowan tree in Kirkener (night exposure)



Rowan tree in Kirkener



Re_{ve}rse
Ica_{ru}s

Douglas Kahn

The myth of Daedalus and Icarus has for many centuries been a foundation of Western ideas about technology. Douglas Kahn re-interprets it in the light of the Anthropocene, connecting global warming with the atomic bomb, both energetic phenomena on Earth magnitude, and both species of death that fall from the sky, like Icarus.

The myth of Icarus needs to be reversed. Icarus does not fly into the Sun; the Sun descends onto him. His waxwings do not melt under the Sun's heat, casting him into the sea where he drowns; glaciers and polar ice caps melt and seas rise to engulf him where he stands. He has not ignored the instructions of his father, Daedalus; it was his father who broke the bond with the Earth that brought the Sun down and sent the seas washing onto land. Daedalus too will drown or succumb to the ills of overheating before water fills his lungs. The Sun indiscriminately passes judgment on everyone and everything, sets on the species and claims its full dominion over Earth.¹

The most familiar version of the Icarus myth is found in Book VIII of Ovid's *Metamorphoses*. It describes Daedalus' attempt to escape from the island of Crete with his son Icarus. A renowned master craftsman, he embeds feathers in wax to form artificial wings, which he and his son will use to fly off the island. He instructs his son to moderate his course. Too close to the waves and his wings will become weighed down with water like sails capsizing a boat. Too close to the Sun and the feathers will burn and the wax holding them in place will melt. Once in flight Icarus becomes intoxicated with his brand new abilities and, ignoring his father's instructions, flies too close to the Sun. His wings disintegrate and he falls into the sea to his death.

Unlike the interruption of Daedalus' lineage, the myth has successfully passed from one generation to the next, adapting to each new location and time to temper a range of human conceits, follies, ambitions, and transgressions. Daedalus has been associated

1. The concept of a reverse Icarus, of a Sun-to-Earth, was introduced in *Earth Sound Earth Signal: Energies and Earth Magnitude in the Arts*, Berkeley: University of California Press, 2013.

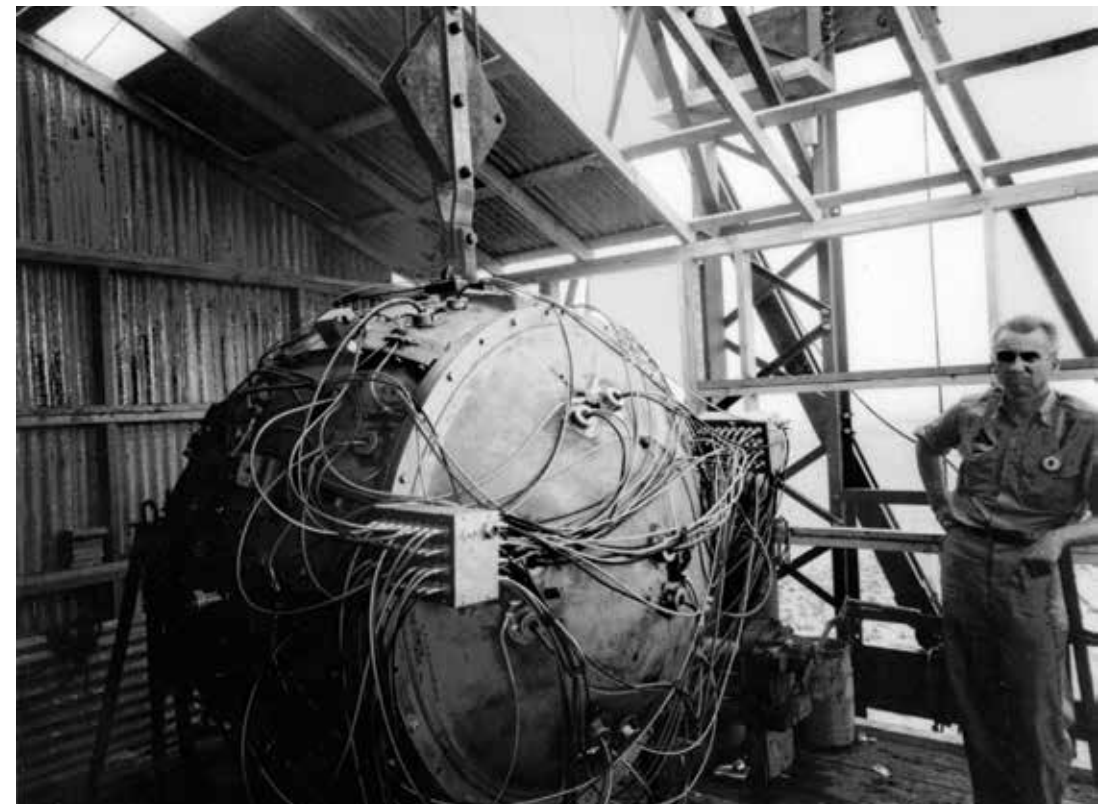


Joos de Momper, *The Fall of Icarus*, print, 1564.

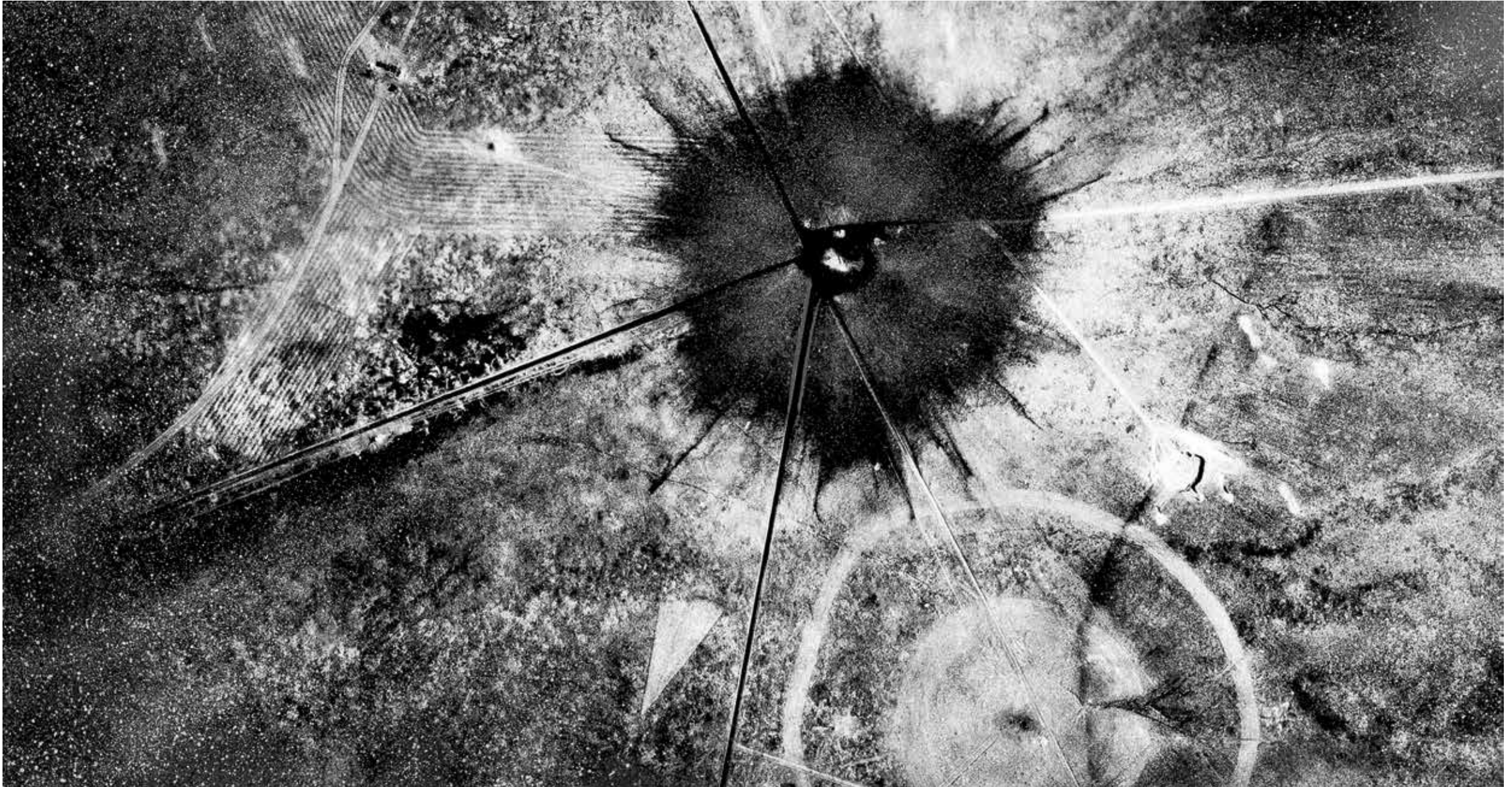
with tools and technologies, even scientific knowledge, and thus seems at first well suited to our present condition. One might imagine him as a knowledgeable, tech/sci-savvy climate scientist instructing everyone on the functioning of the Sun, its past energies pent up underground, the perilous time-warp use of fossils as accelerants that will rise and burn up the future. We could see climate modelling as fortune telling, an oracular prowess, a modern day augury – divination by birds, by their flight patterns, odd behaviours and entrails. But the fact that Daedalus had to fish his son's feathers from the sea is a bad omen.

To think that Daedalus will give us a useful set of operating instructions would be falling for the technological fix. He was a serial offender, after all. It was his earlier inventions that put him in the predicament from which he needed to escape. He was probably imprisoned on Crete by Minos because he constructed the wooden cow that Pasiphaë, Minos' wife, used to seduce the bull that sired the Minotaur. He built the labyrinth that imprisoned the Minotaur and then gave Minos' daughter Ariadne the simple means (a ball of thread) to defeat its false complexity to assist in the slaughter of her monstrous half-brother. What his inventions had wreaked upon Minos and his descendants necessitated yet another, the artificial wings, that lead to a break in his own family lineage. His practice of deception rebounded as self-deception in thinking that wax was adequate, given the proximity of the Sun, for his attempt to escape the conditions he helped to create. Rather than a moral fault of his son ignoring his instructions, the break in his family lineage unmasked the shortcomings of his craft.

If we pare this down further to a technological tale, Icarus exists not as a son at all but as a register of Daedalus' proficiency, the beta testing of a fledgling (new feathers) device. For Daedalus, Icarus was a dullard who was distracted instead of apprenticing himself to the construction of the wings. Carrying his obliviousness into flight, Icarus lacked cognisance of both the principles of the device and his own ineptitude. The sudden onset of artificial skills plummeted him immediately into reckless overconfidence. He had taken on the traits of a consumer whose death was merely an obsolescence in the generational iteration of a manufacturer. That inventions were Daedalus' true progeny was made clear when his first impulse upon seeing feathers floating on the sea was to curse his own skills.



Trinity Test, 15 July 1945. Norris Bradbury, the group leader for bomb assembly, stands next to the partially assembled Gadget atop the test tower. Later, after the departure of Robert Oppenheimer, he became the director of Los Alamos.



Trinity Test, 16 July 1945. An aerial view of the aftermath of the first atomic explosion at the Trinity Test Site, New Mexico. It left an 800-metre-wide crater, three metres deep in the vent. The sand in the crater was burned and boiled into a highly radioactive, jade-green, glassy crust.

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The contemporary problem with this tale is that it is limited to humans. In Greek and Roman mythology forces were often personified, so what of the Sun and the sea that defines the Mediterranean, that unite as judge, jury and executioner? From which rights, through which mechanisms of justice did they act? Humans feel free to grant agency to things now that they have surrounded themselves with weather of their own making and, as Michel Serres says in his book *The Natural Contract* (1990), they weigh down upon the Earth like tectonic plates. But while the oceans have been humanised through acidification, changing temperature and salinity, the Sun will always stay out of reach. Humans can change the weather but not space weather. So it makes sense to give the Sun the starring role.

The image of the Sun descending upon the Earth occurs in 1945 with the testing of atomic weaponry and its deployment on Japanese citizens. At the Trinity Test, a *New York Times* journalist wrote about night becoming day, illuminated by many suns at once. Sixteen hours after the bombing of Hiroshima, US President Harry Truman threatened to unleash the power of the Sun upon the Earth once again, which he did in Nagasaki. Hiroshima served as Serres' point of departure for understanding global warming, since it was the first rehearsal of a global self-awareness of tangible self-annihilation. The second instance of self-annihilation through global warming (as the prevailing emblem for a ubiquitous, multifaceted ecological catastrophe) has occurred on an historical timescale close on the heels of the first. Both achieved global self-awareness by stigmatising the sky. With the Cold War, the presence of satellites (also known as 'birds') signalled the capability of missile delivery systems to equip the sky with potential thermonuclear suns. As the Cold War has moved to the Warm War there are no longer just punctuated points of attack because the entire sky has become stigmatised; the Sun descends everywhere at once, both day and night.

Like Icarus, thermonuclear devices and global warming are species of death that fall from the sky. Both are energetic phenomena on an unprecedented scale: the first being an instant inferno and the second a slow, protracted burn. There were attempts to rationalise nuclear weaponry as an energy source after the fact, but its sudden bright appearance was betrayed by the longevity of radioactive fallout and waste. It was only by chance that Hiroshima

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arose first as a rehearsal of a self-awareness of self-annihilation, since the mad expenditure of old Sun locked up in fossil fuels had itself come before, albeit only since the Industrial Revolution. Nevertheless, if we accept that anthropogenic climate change was accepted in the 1960s or 1970s, then we are talking about a very brief time between 1945 and a self-awareness of a second irruption. Although discourses on the Anthropocene generally appeal to geological time scales, the socio-technological scales in operation are much shorter in orders of historical magnitude, and growing shorter still into personal ones, given that the effects of climate change can now be observed in much less than one generation. From a historical vantage point, their proximity presents an immense, spasmodic expenditure of energies, one pinned between Daedalus' false sense of control and Icarus' giddy infantilism.

In Ovid's *Metamorphoses* the story of Daedalus and Icarus is immediately followed by the story of Daedalus and Perdix. It is actually a back-story, a prequel to explain why Daedalus suffered his fate. He lost his own son as retribution for the murder of his nephew Perdix, the son of his sister Polycaste. She entrusted her twelve year-old son to her master craftsman brother, who would school him. Unlike his own son, Perdix was brilliant; too brilliant it seemed for Daedalus who, as the story goes, murdered him in a fit of professional jealousy.²

Perdix was a child prodigy in the technological arts. Seeing the backbone of a fish – some say the jawbone of a serpent – at the edge of the sea inspired him to design the saw; he invented a compass by drawing circles in the sand; and is credited with inventing the potter's wheel, spinning earth on an axis. He was a natural in two senses of the word: because he was precocious, and because his craft was developed from a knowledge already existing in the earth. He generated technologies that arose from rather than attempted to surpass nature. If he had developed a larger catalogue of devices, we might now be calling technological relationships that evolve from the Earth and remain close to it: 'Perdixian', a technature. But he was murdered before that could happen.

2. My reading of Perdix is influenced by Riemer Faber, 'Daedalus, Icarus, and the Fall of Perdix: Continuity and Allusion in *Metamorphoses* 8.183–259', in *Hermes*, vol. 126, no. 1 (1 January 1998), pp. 80–89.

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The way Perdix was acclaimed for his craftsmanship throughout Athens undermined Daedalus' authority, so he fixed the problem by eliminating the competition. He threw Perdix down the steps of the Acropolis and then invented a tale that the boy had fallen of his own accord. Minerva [Athena] the goddess, 'who rewards quick-witted creatures' for their wisdom rather than their lies, saw what was happening and intervened to cloak Perdix in feathers, transforming him into a partridge (*Perdix*). Much like the soul that takes flight upon death, Perdix lives on in the partridge, his quickness of mind transformed into an agility of wings and feet. Because it was a fall that killed him the first time, the partridge keeps close to the Earth and does not fly or nest too high. Here, of course, are the terms of retribution against Daedalus. Perdix was murdered as a consequence of a fall, unjustly thrown from the *high city* (Acropolis); therefore, it is the fate of Icarus to fall from a great height. Whereas Perdix was cloaked in real feathers and agile in wit and wing, Icarus was fitted with fake wings and then stripped of them. Whereas Perdix needed no instruction, Icarus ignored instructions. Perdix is the counter-Icarus.

But Daedalus kills twice when he murders Perdix. He was motivated by the prospect of Perdix's innate skills continuing to upstage him, and by the threat posed by a set of skills that represented a fundamentally different relationship to natural order. By killing Perdix he kills nature too; at least in this respect he is technologically efficient. One reading of 'he alters Nature' (*naturamque novat*) suggests that Daedalus does violence to Nature itself. Daedalus tried to deceive, transgress and literally rise above nature, or at least the natural order as described in Greco-Roman mythology. The artifice of waxwings melted away into the drowning death of his son; the wooden cow was a handmaiden to a half-bull half-human offspring; and both transgressed the boundaries of human and animal. Perdix is murdered again: monstrous industries that vivify fossils, half-plant half-rock, through a deceit that the Earth opens like the sky into infinity. Yet, even the Sun is finite; it will grow and engulf the Earth in its own time before it, too, dies. However, within a time frame of species survival it is a functionally infinite energy source, as close to a perpetual motion machine as one could devise. The species' self-sacrifice so far ahead of schedule is retribution for the murderousness of Daedalus, for his ecocides and homicides, because all ecopaths are by definition sociopaths.

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In the Latin, Daedalus' inventions were *ignotas*, i.e., unknown or novel. His cleverness always involved cunning and the novelty of his inventions did not degenerate to a benign superficiality, but were geared to deceit and violence where people were killed and generations wrenched apart. Perdix's inventions were *notas*, i.e., 'known', a knowledge already contained in the Earth and remaining close to the ground. In this way, Daedalus' violence against Perdix was consistent with the character of his technological efforts generally; it was not merely to jealously mask superior craftsmanship. By killing Perdix he was destroying nature. When he lied about it, he was merely fabricating a deceptive story in the same way he fabricated his technological deceptions. The failure of his fabrication to deceive Minerva became the failure of his waxwings.

It was specifically while flying near Kalimnos in the Aegean Sea, 'a place made famous for its wealth in honey', that Icarus felt the power in his wings and lifted towards the Sun. There were those (an angler, a shepherd, a ploughman) who witnessed Icarus' flight, but bees witnessed his fall. It was through his fall that the wax used to make his wings was returned. Like partridges, bees fly close to the earth where they collect the fruit of sunlight from flowers. They store the Sun in their honey and wax. Icarus' misdeed was not merely to fly too close to the Sun, too far away from where bees fly, but to approach the Sun with old Sun in his wings, elevating a corpse of the Sun into the sky. 'Dark honey of petroleum', the poet Michael McClure writes.³ When unleashed the massive energetic wealth of sunlight stored underground concentrates in the skyscrapers of major cities, at night the light inside glowing like embers. They ascend to the heavens like stands of trees denuded of their foliage by fire, what McClure calls a *cinderisation* brought about by the overheated fossil fuel economy.⁴ They aspire to a wealth that rises above all else but have risen instead as unwitting ritual effigies burnt by old Sun, doused and now, like New York City, flooded.

Daedalus retrieves his son from the sea. As he buries him, he sees a partridge mocking him with its simple presence. The remains

3. Michael McClure, 'Big Dumb Animal States', broadside, Oakland: Horwinski Printing Company, 2000.

4. Interview with the author, (San Francisco, April 1996), cited in Douglas Kahn, *Noise Water Meat: A History of Sound in the Arts*, Cambridge: MIT Press, 1999, p. 337.

of Icarus name the sea into which he fell and the island where he was buried, locations that serve as monuments to ignominy, humiliatingly resurrecting his demise whenever they are mentioned. Yet retribution provides little solace. In the new myth the island where he was buried will itself be buried by the sea into which he fell. The partridge that clings close to the island will also drown. Human dramas and knowing animals cede to a battle between Daedalian ecopaths and Perdixian technature that itself contends with a Sun that is already brightly setting.

G_{eo}**log**_{ic}
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Interview with Kodwo Eshun

Julian Ross

Julian Ross sat down with Kodwo Eshun of The Otolith Group to discuss their recent works *The Radiant* and *Medium Earth*, both of which deal with the geologic implications of seismic activity. *The Radiant* explores the aftermath of 11 March 2011, when the Tohoku Earthquake triggered a tsunami and caused the partial meltdown of the Fukushima Daiichi nuclear power plant on the east coast of Japan. *Medium Earth* is set in California, and investigates the psychological and geological effects of the San Andreas Fault, zooming in on the cultures of seismic prophecy and forecasting.

Julian Ross The Otolith Group's recent films, *The Radiant* (2012) and *Medium Earth* (2013), express a strong engagement with geology. What encouraged you to work with this subject?

Kodwo Eshun Let's start with *The Radiant*. We were frustrated with how the triple disaster of 3.11 was narrated in the UK. Hitting 9.0 on the Richter scale, the Great Tohoku Earthquake, the first disaster, was one of the strongest ever recorded. It was powerful enough to move Japan and tilt the Earth's axis to a slight degree. The second disaster was the tsunami, which was followed by the third, the partial meltdown of three nuclear reactors of the Fukushima Daiichi Nuclear Power Plant. This triple catastrophe was reported in England as a local accident and the survival of the brave Japanese people. It was framed as a humanitarian disaster. We were very frustrated by this because, for us, it seemed to be another example of a capitalist catastrophe. We compared it to the Chernobyl disaster in 1986, which was understood as a death sentence for state-sponsored communism. The idea that communism could expose its citizens to such dangers clearly meant that this system was, in some sense, bankrupt. At least this was how it was reported in England. But Fukushima wasn't analysed like this at all. Neither was the BP Deepwater Horizon oil spill in the Gulf of Mexico, the financial crisis of 2008, nor Hurricane Katrina. On the contrary, all of these were reported as humanitarian crises that had to be repaired with more capitalism.

The 16 Beaver Group held a one-day symposium and invited a number of theorists and activists from Japan to analyse 3.11 and connect it to previous crises. It was there in November 2011 where

we met Sabu Kohro, a Japanese theorist, activist and translator, and Jim Fleming of Autonomedia. Jim Fleming had published *Fukushima mon amour* (2011), a book of four essays, one of which was Sabu Kohro's 'Fangs Hiding in the Green'. The essay analysed 3.11 as a multi-scale catastrophe with dimensions that included the ecological, environmental, political and psychic. It was the first article that I read that made any sense concerning the complexity and the scale of this catastrophe. At the symposium, Sabu Kohro told me about the website *Fissures in the Planetary Apparatus*. With the book, website and encounters with these activists, we were able to find the beginnings of a vocabulary to help us understand what was going on in Fukushima and figure out its planetary implications. *The Radiant* comes out of a desire to research the entangled nature of this catastrophe and to understand Sabu Kohro's reading of it as part of the global nuclear regime.

JR Object-oriented ontologists speak of the need to put aside the privileging of the human as a central agent in relation to the planet. They advocate a decentering of the human position. I think *The Radiant*, and many other films by The Otolith Group, convey this notion of decentering and translate it through film language.

KE The decentering of the human sense and perspective – is crucial to a lot of our work, which often tries to reverse this perspective and take on the perspective of the material, and treat the material as having agency and subjectivity. We treated liquid crystals as an agent without a subject in *Anathema* (2011), and the Atlantic Ocean as an agent without a subject in *Hydra Decapita* (2010). For

The Radiant, the agent is radiation itself: it has a half-life, it decays, and it affects people. But, again, it doesn't have subjectivity. The implications this had for documenting it constrained us, as radiation is an agent that cannot be recorded with standard cameras. Because we can't see it, we had to work out strategies to make it tangible. Of course, it turned out that this very problem had also confounded artists since the discovery of X-rays in 1895, which was at the same time as the invention of cinema.

Wilhelm Conrad Röntgen, the Munich-based scientist and discoverer of X-rays, clearly faced the question of image-making. His first X-ray – of his wife's finger with a ring on it – shows the bone beneath the flesh. This is clearly an example of a certain kind of image that produces a non-image. It's a visual culture that shows an avisuality. The X-ray is a form of image that shows what is normally not visible to our naked eye, and this is radiation. When we reviewed historical attempts to visualise radiation, we saw animation films, which had become an important way to show the chain-reactions and nuclear fission involved in radiation. Animation was also used to educate people about the promise and power of nuclear energy. We started collecting these examples of visualising radiation.

The other aspect is that Fukushima is a picturesque prefecture. It's a rural area with outstanding natural beauty. When you visit nuclear power plants – whether they are in France, the US – they're always in rural and quite provincial areas. When we arrived in Fukushima, we didn't see much disaster. There wasn't much visible change in some of the villages such as Miyagi where all the people had been evacuated, except for

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The Otolith Group, film stills from *The Radiant*, 64'14", 2012. Commissioned as part of dOCUMENTA (13) in 2012, *The Radiant* explores the aftermath of 11 March 2011, when the Tohoku Earthquake triggered a tsunami that killed many thousands and caused the partial meltdown of the Fukushima Daiichi nuclear power plant on the east coast of Japan.

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the vegetation that was running wild. The disaster is actually quite banal. In *The Writing of Disaster* (1986), Maurice Blanchot writes of the disaster that leaves everything standing. If you go further up the coast to Kesennuma, everything is destroyed. But Fukushima isn't like that. There's something paradoxically reassuring about seeing a destroyed city. It means that it can be repaired. Of course, you can't bring back the people who died but the infrastructure can be restored. In Fukushima, the infrastructure is intact but repairing the radiation will take too long. Radiation is latent - it enters the soil, the wind and the rain.

In *The Radiant*, we tried to tackle two things: the history of visualising radiation and the banality of the radioactive landscape as an image. On the one hand, we tried to convey that radiation is a crime scene where there are no bodies and, on the other hand, we tried to show that the old ways of visualising radiation, although they may appear kitsch and old-fashioned, are actually quite powerful, pedagogic and propagandistic methods that can still function. When you have a catastrophe, they no longer appear kitsch. This is the nature of the catastrophe - it makes the past seem very present. It reconnected us to the history that we all thought had been shut down with the Cold War. Instead of laughing at them or feeling superior to these images, we came to associate them with premonitory horror and dread, and we even came to respect them.

The Radiant is chronological until the hydrogen explosions break the sequence and the film moves around in time and space. 1954 comes back as if it has returned from the future. The past and the future are reassembled by a catastrophe without end. We drew

the idea from the philosopher Peter Sloterdijk and his book *Terror from the Air* (2009), where he writes about latency - the latency that makes radiation apparent. *The Radiant* is a film that studies these two principles. I think it's what separates *The Radiant* from regular documentaries, which are based on access. Online or news documentaries are about getting to the right people or getting the right footage. But I don't think art is good at these things. We had to decide how much we could do compared to what other works wouldn't do. We decided to make *The Radiant* a study of what images can or cannot do with regards to the forces of radiation that hide inside environmental psychic forces.

JR What you just spoke of reminds me of the scene in the film where the Japanese photographer Chiharu Minato talks about the Japanese word for landscape meaning 'scenery of wind', which is something more active compared to the static connotations of the English word. We've talked a lot about images, but radiation is also soundless. How did you approach this?

KE We realised that a Geiger counter is a better indicator of radiation than a camera. The Geiger counter converts the rate of radioactive decay into numbers, and these numbers are indexed to sound. In a sense, we filmed what the Geiger counter told us. At the same time, we were very much aware of the millennial sonic as the nuclear psychic dimension that we didn't fully comprehend. Onkalo in Finland is a nuclear waste bunker that is expected to last at least 100,000 years. What sort of music and sound could register that kind of time span? When we thought of this, we arrived at compositions like Jem Finer's

Longplayer or John Cage's *As Slow As Possible*. There are also other attempts by people like Jacob Kirkegaard and Peter Curack, who made field recordings in Chernobyl.

We wanted to document how people cope with the scientific uncertainty of living with low-level radiation, like in Fukushima, Tokyo, Japan itself and, in fact, everywhere else in the world. Many times in the film you also hear bird sounds and we created a sonic motif where bird sounds and Geiger counters match. It's a simple modulation between Geiger counters and recordings of birds, in which the two are linked. We repeat certain bird sounds so they appear to be performing a similar role to the Geiger counter. In some way, birds are a good indicator of radiation. Insects and birds have tactile and aural senses far more sensitive than humans. Just as many birds and insects can detect earthquakes, they can also detect certain kinds of radioactivity.

In the closing credits, there's a contrast between the natural, green idyllic environment and the animations. In the section with the images of nature, we added amplified natural sounds of birds and crickets. But for the animation we added four voices: the character Atom Boy; a TEPCO engineer talking about the damage to one of the reactors; the translation of his words into English; and a US General defending the Bikini Atoll detonations in 1954. The four voices are punctuated with exaggerated natural sounds. This kind of sonic design was a way to encapsulate an experience of what Fukushima is like.

When we arrived in Japan a year after 3.11, there still wasn't a consensus about what happened. Some people didn't talk about it at all in an attempt to resume their lives and others were so disillusioned and

sceptical about official government and media discourse that they formed online citizen science groups. Their distrust of the official optimism of the newspapers, television, radio and the government meant that they always looked for the most pessimistic explanations. And they're quite right not to trust such discourse. TEPCO is not just Tokyo Electric Company, but is a powerful monopoly that is linked to television programming, advertising, and game shows. TEPCO is able to create a powerful normalising effect through the media. In a sense, we wanted to arrive at place where normalisation processes exist at the same time as paranoid interpretations, but don't communicate with each other. There are two separate Japans. In the closing credits, we tried to suggest both of these.

This film is not for Japanese people. We made it for complacent non-Japanese people. It's for the complacent British people, who don't even realise that there's a branch of TEPCO in London. TEPCO also has offices in Tokyo and Washington. This is what the global regime means. It's not something 'over there' in Japan. Many countries have nuclear reactors. We're not lecturing Japanese people - that would be grotesque - but we're trying to share our fear. As non-Japanese people, we should be more afraid. We should reflect on fear. The final scene is semi-autobiographical in that way.

JR The film *Medium Earth* seems to be an attempt to find a language to communicate geologic time...

KE On the one hand, *Medium Earth* came out of visiting Los Angeles and spending time in the desert, and on the other, it also came out of attending the first Anthropocene conference at the Haus der Kulturen

der Welt in Berlin. Visiting the desert was a way to get in touch with the timescale of stones and seismic forces. Although it's not as strong as in Japan, Turkey, Iran or China, the state of California has seismic activity because of the San Andreas Fault that extends 1300 kilometres down the length of the state. Due to this, there is a general awareness of tectonic forces. When we were in the US we discovered earthquake sensitive, who seemed to be exaggerated versions of everybody in the state of California, who live in a world where stability is a myth. Solid ground is a myth for all humans, but people who live in sensitive zones really understand that the Earth is moving. Because it moves at the same rate that our hair grows, it's too slow for us to perceive. Earthquake sensitive claim they're in touch with the timescale of seismic forces, which makes them a grotesque, literalised version of the Anthropocene.

In her keynote speech at the Anthropocene conference, Lorraine Daston said that there has always been a difference between geologic time, technological time and human time. Geologic time is a nonhuman time, in which the Earth's history is measured using fossil records. Fossil records have nothing to do with humans as such. Fossils are records of the history of the development of an epoch. According to Daston, however, these distinctions between the geological, human and the technological are collapsing in the Anthropocene. Humanity as a species now takes on a geological capacity and agency that is experienced at all levels if the Earth is considered a system. We now have agency that is felt in the cryptosphere, cryosphere, atmosphere and the biosphere. What Daston didn't discuss, however, was the confusion that emerges

when non-scientists try to make sense of this. The Anthropocene is a scientific hypothesis - geologists and scientists are trying to understand where to locate it and how to measure it. But we are curious about what happens when non-scientists struggle to make sense of this collapsing of geologic, human and technological time, which is where the earthquake sensitive come in. They're a Pop version of this clash between geologic and human time. They claim to physically feel the timescale of the planet, of tectonic plates and of seismic forces. In that sense, they're quite medieval in their thinking, as they think of their bodies as a map of the world. For them, a pain in an arm means earthquake activity in Mexico.

If you listen to Bruno Latour's Gifford Lectures at the University of Edinburgh in 2013, all six lectures are about attempting to understand Gaia as a techno-social assemblage. At some point in one of the lectures, he speaks about the need for a new kind of sensitivity among cultural practitioners to understand the Anthropocene. Although he didn't mean earthquake sensitive when he said that, we took his call for sensitivity and juxtaposed the earthquake sensitive with Daston's thinking. Instead of dismissing their claims, we listened to how they heard the Earth and tried to understand what the Earth is saying to them through their bodies. Once we did that, it became a question of slowing down the camera enough to pay attention to what the Earth is saying.

We were fascinated by Roger Caillois' book *The Writing of Stones* (1970). He uses inorganic materials in his attempt to restage the entire history of art. When he polished sections of certain minerals from the eighteenth century he saw images (forests and landscapes) and in

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minerals found in the twentieth century he saw Cubist paintings or Malevich. We applied this approach to Los Angeles itself and looked at the fault lines in the city. A fault line is the visible sign of a hidden volume - it's all the camera can show of what is happening beneath the surface. If you follow the cracks, they tell you about the lines of force. So we followed the cracks in the concrete in underground garages. We followed them out into Joshua Tree National Park, which was where we looked at the boulders themselves. We saw the mountains as colossal youth - children of the Earth. We started working with this geopoetic imagination.

The key was to slow down the camera enough so that we could record some of these forces. Because they provide a sense of scale, there are no humans in the image. Although you can't tell how large the boulders actually are, you're already aware of their size. We wanted an optical disorientation where you can't quite measure height or even proximity. You can't tell how close you are to the boulders in the film - except for a shot halfway through when the camera starts on one side of the road, crosses the motorway, and travels along the Palmdale Road Cut, the only place in California where you can see the San Andreas Fault, showing the strata, before it comes to rest on the other side. You have a comparison between geologic time, technological time and human time.

Human time is the time it takes for the camera to move. Geologic time is the time revealed by the Palmdale Road Cut. Technological time is both the time of the camera and the time of the cars. In this shot, they're all laid out in the most diagrammatic way. This scene has the same role as the scene in

The Radiant where the camera is disassembled, where Minato talks about the landscape being doubly invisible and populated by radiation and Gods. Both scenes are halfway through their films and both are keys or diagrams to the films in their totality. Although there doesn't appear to be much happening in *Medium Earth*, a lot did happen that we had to convey through simple means.

JR The voiceover halfway through the film quotes the earthquake sensitive Charlotte King speaking of her body as the land and discussing her premonitions and predictions of earthquakes. As we've discussed, this is taken seriously in the film despite its apparent absurdity. It reminded me of your treatment of science fiction in your previous films where it is portrayed not as a distant Other but something among us and very present.

KE Our notion of the science fiction of the present is inspired by the work of J.G. Ballard. His science fiction is a speculative theory of the present. It's a prop in which he takes real-world existing architectural and technological features - like car parks, hypodermic needles and the angle of a corner - and speculates with them. Ballard is extremely useful if you want to film a garage. He provides you with something similar to a method for filming. He tells you to shoot the incliner, shoot the ramp and try to study their power. Also, there is a story in the anthology *Myths of the Near Future* (1982) in which astronauts suffer from sleeping sickness, their speech slows down and it takes them years to say just one sentence. In this story, Ballard applies a geological temporality to the unfortunate astronaut. In his early stories such as *The Crystal World*

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The Otolith Group, film stills from *Medium Earth*, 41'20", 2013. Conceived as notes toward the making of a film, *Medium Earth* attunes itself to the seismic psyche of the state of California. Commissioned by REDCAT (Roy and Edna Disney/CalArts Theater) and Haus der Kulturen der Welt, Berlin, and complimented by a series of public programmes on the geopoetic practices of prediction and premonition.

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The Otolith Group, film stills from *Medium Earth*, 41'20", 2013.

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(1966) and *The Drowned World* (1962) he speculates on what we'd now call climate change. We can see this especially in *The Drowned World*, where humans descend the spinal ladder and re-assume their reptilian forms as the world turns toward the recapitulation of the carnivorous age. Ballard has an elaborate archeo-psychic notion of the human, where the vertebral column retains its pre-human evolutionary function.

The de-evolutionary dimension in Ballard's work is linked to an embrace of catastrophe. In Ballard's novels and short stories, characters walk towards their doom and embrace the death drive. Technology is supposed to function for our convenience and our leisure. But what if, in fact, it does the reverse of that? And if that's the case, how should we interpret it? Ballard gives us diagrams and vocabularies for understanding our present, which we still find extremely useful. We've absorbed them to such an extent that Ballard's work has become something like a basic operating system for how we look at everything.

Nearly every work we've made is a certain type of science fiction, whether or not science fiction motifs were assigned to them. For us, it's not necessary to have obvious science fiction motifs because, in a sense, everything is science fiction. It's not so much a question of content, but of method, perspective and attitude. Ballard wrote the science fiction of nine minutes from now. The view that Earth itself is the most alien planet is a profoundly de-anthropomorphisational perspective that we find deeply challenging. We attempt to deal with this. The challenge that you mentioned in the beginning – it's a desire to reverse perspective and determine the agency that materials have over us.

It's a challenge to figure out the symbiosis that we enter into with these materials.

E_v**ery**
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the **Su**_{rf}**ace** **of**
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Interview with Matthew Coolidge
Liesbeth Koot

The Center for Land Use Interpretation (CLUI) is a research and education organisation interested in understanding the nature and extent of human interaction with the Earth's surface, and in finding new meanings in the intentional and incidental forms that we individually and collectively create. CLUI believes that the man-made landscape is a cultural inscription that can be read to better understand who we are, and what we are doing. CLUI is dedicated to the increase and diffusion of knowledge about how the nation's land is apportioned, utilised and perceived. Liesbeth Koot asked Matthew Coolidge of CLUI a couple of questions about the organisations approach and research.

Liesbeth Koot Why do you think it is important to research human interaction with the Earth's surface, and to educate people about this?

Matthew Coolidge Land is underneath all of us, all around us, and unites us. So it seemed like an obvious place to start, to build a way of seeing and thinking, from the ground up. What's that? How did it get there? What is it connected to? Who owns it? What do we think about it? Why do we think that way? At the CLUI, there are basic questions we ask every day about all the things that surround us. It's childlike, and universal. And it seems that we, ourselves included, don't understand the world enough, which is why things often seem out of balance.

LK Can you elaborate on the idea that the man-made landscape is a cultural inscription?

MC Every molecule on the surface of the Earth has been affected by humans. Nature, as it used to be understood, no longer exists. If we try to put things back, that would be a reconstruction. If we were to all disappear instantly tomorrow, the future would be different because of us. So everything now, on the surface at least, is in part, or completely, a human construct: an artefact. There is no need to cry about this. All creatures change their habitat. It's a basic necessity of existence. The global scale of alteration by humans is because there are so many of us, and we are large, energetic, creative, and consumptive. Obviously there is much about the nature and extent of the alterations we enact that could be improved, if seeking a more 'sustainable' and equitable way of living is actually something we want. But the first thing to do, maybe, is to get a better understanding of the

current condition. If everything on the surface is an artefact now, we need something like an archaeological assessment of these contemporary material artefacts to understand the present culture. You can do this by looking at specific types of objects, on a certain scale, like jewellery, paintings, telephones, cutlery, or table scraps. Or on a smaller scale, microorganisms, radioactive isotopes, or chemical interactions. Our job, at the CLUI, is to do this at a greater scale, the land-use scale, which is generally the range from the space a single human occupies, to thousands of acres. We focus on one broad region, the United States of America and its culture, with all of its complexities, contradictions and inconsistencies.

LK In the following chapter you present a visual essay on America's uranium disposal cells. How did you work on this project?

MC We do several exhibits every year, and that one was conceived a few years ago, but not completed until recently. In our ongoing study of land use across the US, we encounter all kinds of interesting things, and we think that some of them are compelling enough to be pursued as exhibits. These radioactive entombment sites are unique, and fascinating. They are primitive and simple, yet also state of the art. They are structures made by humans, because of humans, but not for humans. They are an un-enterable architecture, built to keep people out. A non-architecture, maybe. They are time machines, sending their contents into the future, to be dealt with at a later date. Yet they are massively here today of course, too. We have lots of photographs of them from the ground, of the engraved granite monuments that

resemble headstones for these technological by-product tombs, the signage, the fencing, the drainage margins. But these are just features, not the entire thing. This is a type of architecture that can only be seen be seen in its totality from a low-altitude aerial oblique view. Its shape is not discernable from online satellite views, or from the ground. So we hired small planes, which we often do, and took photos out of the window. Had inexpensive remote-controlled quadcopter camera platforms like the DJI Phantom been available then, we might have used them instead, but at that time, a couple of years ago, it was still expensive to use these drones and they presented no real improvement over hiring pilots at local airports and flight schools. We also worked with a group called Lighthawk, which provides pilots and planes for projects it considers interesting. One of their pilots in particular, a retired rural veterinarian, was truly outstanding. He had a tricked-out, hot-rod Cessna, which enabled us to photograph several far-flung sites in a single day, flying high over the Rockies, from one corner of Colorado to the other.

LK The uranium deposits seem enormous in several ways (in size, the time span for which they are meant to last, and the impact of the material), yet at the same time they seem to be made to blend in with their surroundings. Are there uranium disposal sites in any way comparable to other sites you have documented?

MC We have covered a fair number of radioactive sites and places related to the production of atomic bombs, since that is such an important part of contemporary America, locally and internationally. The production of the nuclear bomb produced a new



CLUI Wendover Residence Program, support unit.



CLUI Wendover Residence Program, group on salt flats.

type of industry, one that spanned the nation, and through its wastes and by-products, transcended human-scale time, entering geologic time. So yes, we feel it's important, and its impact is widespread. These uranium tombs resemble other waste landfills in some superficial ways, such as in their size, and shape. But regular consumer waste landfills are organic and alive: fermenting, belching, off-gassing, draining, and undulating. These uranium mounds are inert, dead, motionless, stable. At least in theory, and for now. More extreme forms of waste disposal and isolation for hazardous chemical wastes are closer, but still quite different - they are often just cells filled with containerized waste, lined with plastic sheets, and covered in local dirt.

LK In general, how do you decide on a project, and how do you organize your research?

MC We have many ongoing projects, most of which are not produced as a finished programme, but all the materials go into our database and image archive, and are a resource for other projects. Exhibits can 'precipitate out' of this continuous documentation and exploration, or can be directed from start to finish as a single idea, though the ideas do tend to shift as we move into production. We focus on things that seem interesting to us. If we are effective interpreters and curators of our times, then what is interesting to us, is interesting to others too.

LK Your work is about the US. Would it be interesting to expand worldwide?

MC We have no desire to expand to other countries. The US has done enough of this already. And what we do is about America, on its own turf, which is large enough to keep us busy for a while. We do think that what we do is a good thing to do though - otherwise we wouldn't do it - so if others develop similar programmes in their own communities or nations that's wonderful. And they have done, and do. We did not invent this methodology. It's structured and driven by simple common sense, and manifests in many ways.

LK In a previous interview you say, '...the way we see the world is as important as what we do to it'.¹ Curiosity for the world around us, and the attempts at providing new perspectives on the world seem immensely important. You have a residency programme that is open to artists, researchers and theorists. What is for you the particular importance of art in this context?

MC Art, at its most fundamental, is creative communication. It is the conveyance of an idea from one mind to another. Because each mind has its own context, its own subjective environment, it alters to a certain degree as the idea is transmitted and received. This is the arena of interpretation, where we work. Artists, self-proclaimed or not, often push the boundaries of interpretation, they

deconstruct the process, and expose new truths and ideas. Our Wendover Residence Program is an 'interpretive R&D' site, on the edge of the 'nothingness' of the salt flats of Utah. It's a place to disintegrate, dissipate, reassemble, and reassemble.

LK Do you think scientists and artists should interact in their work or are their methods and goals too dissimilar? Do scientists and artists work on different aspects of perception and interpretation?

MC Science and art are both composed of research and theory, and can certainly work together. Both are about discovery and creation. Generally though, scientists work with a hypothesis that they are trying to prove, and they want reproducible results. Art allows for research that is open ended, that has nothing to prove, or even no idea what it is doing or why, in a rational sense. So along the way you can discover things that a more focused methodology would miss. This allows for things that are truly singular, precious - irreproducible - to exist.

1. Amelia Taylor-Hochberg, 'No Such Thing As Nowhere: Discussion with Matthew Coolidge, author of *Around the Bay*, archinect.com, 23 September 2013, <http://archinect.com/features/article/81536319/no-such-thing-as-nowhere-discussion-with-matthew-coolidge-author-of-around-the-bay>

T_{er}**mi**_{na}**l**
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Center for Land Use Interpretation

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The underground catacombs built to store nuclear waste are the most negative spaces on Earth. They are intended to stay inert and isolated for as much of forever as possible, isolated from the present, destined for the future. They are uncanny monuments to our civilization. The Center for Land Use Interpretation made a survey of these mounds in the US and photographed them from the air.

Though the system of underground nuclear catacombs for the spent nuclear fuel of the US is yet to be completed, many radioactive tombs for America's various nuclear programmes already exist today, with more to come. Most are repositories for the remains of uranium mills, processing facilities, weapons plants, and contaminated tailings (residues), bulldozed into engineered isolation mounds designed to limit contact with their surroundings for hundreds of years. There are dozens of these mounds across the US from Pennsylvania to Arizona, built mostly by the Department of Energy (DOE), and maintained by their Legacy Management office.

These disposal mounds are generally low, rectilinear piles, with flat, sloping tops – terrestrial umbrellas – keeping moisture out of the pile as much as possible. In arid environments, the outer layer is a coating of coarse riprap rock, a dead space where nothing grows, where no soil forms, and no roots that could pierce the radioactive core can take hold. This tough skin allows occasional rains to pass through it to the next layer, a low-permeability clayey mixture a few feet thick. Water drains off at the side of the pile through channels at the base held in place with more layers of crushed stone.

These disposal cells are located primarily in arid areas of the Southwest, where natural uranium deposits were found and exploited. Some of these former uranium mills were set up secretly for the Manhattan Project. Most started operating in the 1950s, and many continued into the 1990s. Presently, only one conventional uranium mill is operating in the US, the White Mesa Mill in Blanding, Utah, in the heart of the uranium district and Indian Country. However, that may change as the US shifts towards more self-reliant energy sources.

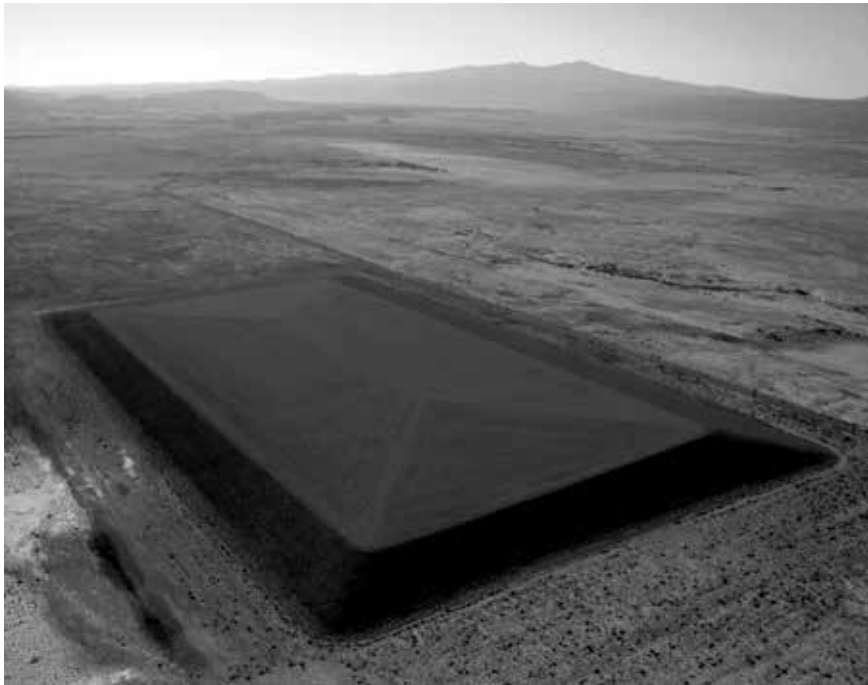
In parts of the US with more rainfall, the surface of these disposal cells is covered in soil, which acts like a sponge, capturing and slowing the movement of water, which then drains away over the

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top of the engineered clay barriers beneath it. This soil is usually planted with grass, whose roots help to hold the soil layer in place. The grass is maintained and monitored, and sometimes mowed, and even harvested for animal feed. Regular inspections remove any seedlings from larger plants, whose roots would pose a threat to the integrity and impermeability of the mound. As with the mounds in arid areas, the steeper slopes and drainage channels are lined with coarsely crushed riprap rock. Each disposal cell covers many acres, some as much as 1.3 square kilometres. They resemble ancient pyramids or relics from a geometrical mound-building culture; they are archaeological forms made for the future. They represent the legacy of the most advanced technology of a global culture: the creation of the atomic bomb, the ability to destroy the world at the push of a button. They are part of the largest machine ever made, the statewide network of industrial sites created to extract, process, manufacture, and engineer nuclear fuel for reactors and weapons – a continent-wide landscape machine to concentrate a naturally occurring trace material into such compressed atomic density that it explodes with galactic energy.

These mound sites – by-products of this effort, the end of the line – are meant to be unconnected to the rest of the world, like deadly anachronistic time capsules. These are the most negative of spaces, non-places, intended to stay inert and isolated for as much of forever as possible, isolated from the present, but destined for the future.

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Ambrosia Lake Disposal Cell, New Mexico

Inside this geometric mound covered with a skin of coarsely crushed rock is a demolished uranium mill and its radioactive tailings. The mill was buried in 1992 by the DOE, one of about 20 uranium mill tailings sites in the US that were remediated as part of the Uranium Mill Tailings Remedial Action Project (UMTRA). The site covers approximately 196 acres of this remote valley north of Grants, New Mexico. The uranium-mining district around Grants was the most productive in the nation, operating from the 1950s to the 1980s. The mill at this site was built in 1957, and operated by the Phillips Petroleum Company. It was later bought by the United Nuclear Company. As at some other UMTRA sites, the DOE has installed carved granite warning monuments (resembling tombstones) near the fenced entrances to the mound.

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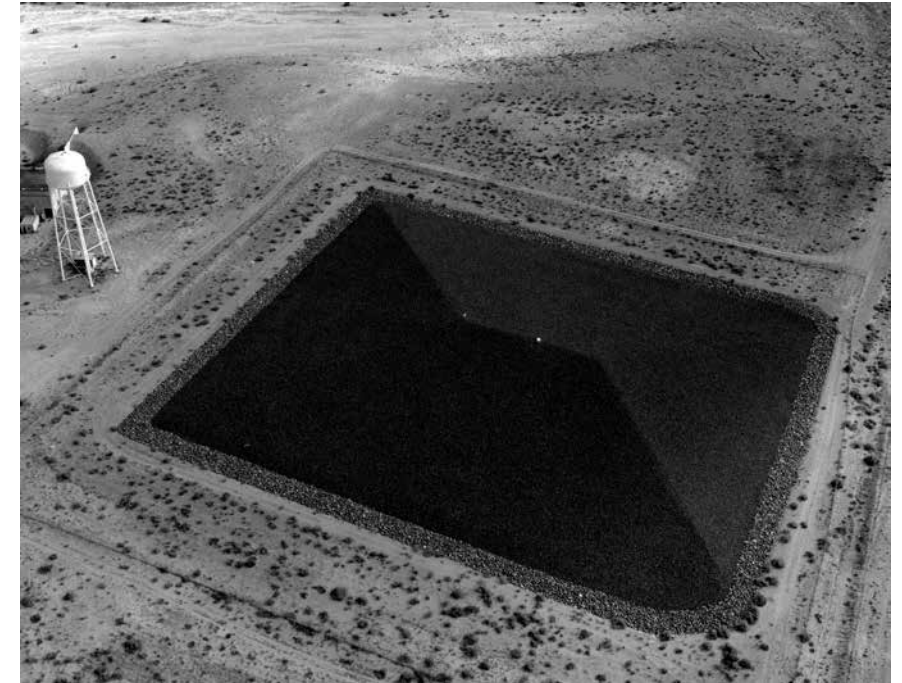
Crescent Junction Disposal Cell, Utah

This new disposal cell, north of Interstate 70 in eastern Utah, was constructed for uranium mill tailings and debris from a mill site in Moab, 48 kilometres to the south. Contaminated material started arriving in 2009 on a specially constructed railway, at the rate of around 4500 tons per train. The total amount of material destined for the site is 14.5 million tons. When the site is complete (sometime after 2019) it will be 1.6 kilometres long, 800 metres wide, and 7.5 metres high, with another 7.5 metres of subsurface material.



Durango Disposal Cell, Colorado

This disposal cell, near Bodo Canyon, in the hills above the town of Durango, Colorado, was built by the DOE to contain almost 2 million cubic metres of radioactive tailings and buildings from the days of uranium processing at a mill in town. The mill operated from 1942 to 1963, producing vanadium and uranium. The disposal cell was created in the early 1990s, and covers 42 acres, and is nearly 800 metres long. Some of the surface of the pile is seeded, though no plants taller than grass are allowed to grow there. The cell and mill clean up were performed as part of the UMTRA Project.



Green River Disposal Cell, Utah

A disposal mound for radioactive tailings, located at the site of a former uranium mill, operated by Union Carbide from 1957 to 1961. The mill site was bought by the State of Utah in 1988, and the buildings still remain, gutted and abandoned. The DOE took over the disposal operations, and built the mound in 1989. It contains tailings, as well as contaminated material from 17 other properties in the area. The mound is 140 metres by 160 metres, and 12.5 metres high. It covers 6 acres, and is surrounded by a chain link fence, ringed by signs warning of radioactivity.



Gunnison Disposal Cell, Colorado

A 29-acre disposal cell created by the DOE in 1995 to contain the contaminated tailings and mill buildings from a uranium mill in Gunnison, Colorado, 9.5 kilometres away, which was cleaned up as part of the federal UMTRA Project. The mound is 365 metres long, 15 metres high, and contains well over half-a-million cubic metres of contaminated material. It is situated alongside a landfill.



Maybell Disposal Cell, Colorado

There are two disposal cells at the former uranium mining and processing centre near the town of Maybell, in the north-western corner of Colorado. The east cell is a repository for waste from the uranium mine and mill that operated here from 1955 to 1964, producing 2.3 million tons of ore. The west cell contains radioactive materials generated by operations that continued until 1994, by the company that operated the site, Umetco. The west cell contains almost 2 million tons of tailings. Between the east and west cells are pits from the former uranium miners.



Mexican Hat Disposal Cell, Utah

Mexican Hat Disposal Cell is the storage site for radioactive material from a uranium mill located nearby, which operated from 1957 to 1965, and from another uranium mill site 24 kilometres south-west, near Monument Valley. The mill there operated from 1955 to 1968. 1.2 million tons of tailings and waste were brought from the mill site by truck in the early 1990s. It was combined with demolished buildings and tailings from the Mexican Hat mill site, along with 11 buildings in the area that were constructed with contaminated tailings material, including a school, for a total of 4.4 million dry tons of material (almost 2.5 million cubic metres). The collected contaminated material is covered by a 60-centimetre thick radon barrier and about 50 centimetres of coarsely crushed riprap rock. The clean up and cell was done as part of the DOE's UMTRA Project. The disposal site and the original mill sites are on Navajo Nation land. The disposal cell is 430 metres long, and covers approximately 68 acres. It was completed in 1995.



Rifle Disposal Cell, Colorado

The 71-acre radioactive tailings disposal mound built by the DOE for the interment of well over 2.5 million cubic metres of material from two former Union Carbide uranium mill operations in the nearby town of Rifle. The Rifle Disposal Site is on 205 acres of Estes Gulch, former Bureau of Land Management (BLM) land, transferred to the DOE in 1991. The cell sits on an alluvial fan surface, and the structure reflects this form.

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Shiprock Disposal Cell, New Mexico

A 77-acre disposal cell containing tailings and buildings from a former uranium mill originally built by Kerr-McGee in 1954, which operated until 1963. The mill is on Navajo Nation land, in the town of Shiprock, next to the San Juan River. The DOE consolidated the contamination at the mill site and enclosed it in a cell covered in riprap rock in the late 1980s.

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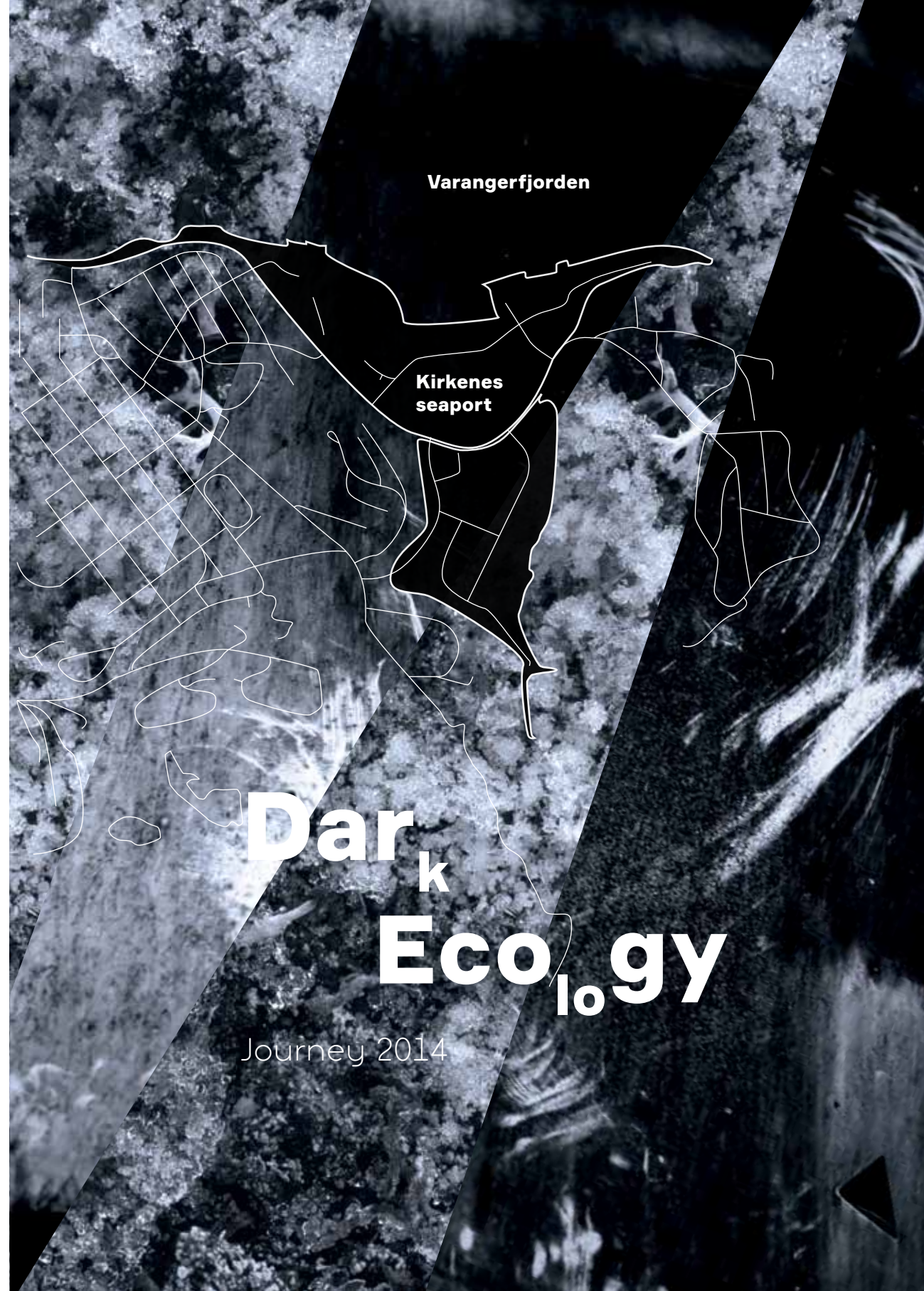
Slick Rock Disposal Cell, Colorado

The Slick Rock Uranium Disposal Cell in Burro Canyon is one of about 20 similar radioactive waste disposal cells in the USA created to entomb the remains of former uranium processing operations. The cell is 275 metres long, covers 12 acres, and contains just less than a million dry tons of waste material, composed of tailings, soil, and buildings from two uranium mills, known as the Slick Rock Uranium Processing Site, five miles away. The mills closed in the 1960s and the site was cleaned up as part of the DOE's UMTRA Project in 1995.



Uranium Disposal Cell, Colorado

A disposal cell for more than 600,000 cubic metres of radioactive soil and building debris from a uranium mill site 24 kilometres away in Naturita. The mill operated from the 1930s to 1963. In 1942, the mill became one of two in the US used to produce uranium for the Manhattan Project. Material was moved here between 1993 and 1997, as part of an extensive clean up of the mill site and its tailings. This disposal cell is 210 metres long, covers 10 acres, and was completed in 1999. The cell is in a former sandstone quarry, on land above the former townsite of Uranium, which was evacuated and demolished due to contamination following uranium mining there by the Umetco Company.



**Dark
Ecology**

Journey 2014





Moods of the Anthropocene

Interview with Dipesh Chakrabarty
Liesbeth Koot



Liesbeth Koot discussed the topic of the Anthropocene with the historian Dipesh Chakrabarty at the Institute for Human Sciences in Vienna. Meeting in Vienna was somewhat coincidental; it could have been Chicago, Berlin or Basel as well, as Chakrabarty travels the world, delivering lectures. Chakrabarty speaks with great concern for humanity and conveys a surprising perspective on thinking about the Earth. He states that we have to integrate earth system science and evolutionary thinking with thinking about capitalism. According to Chakrabarty humans have contributed to planetary climate change with a force that is usually associated with tectonic activity or major volcanic eruptions. 'We therefore cannot continue to tell a story that only focuses on human justice and human flourishing.'

Liesbeth Koot You are a historian and your work has been in the area of subaltern, indigenous, and minority histories. Your work on environmental history and the implications of climate change for human history is comparatively new.

Dipesh Chakrabarty I studied physics and geology in my undergraduate days and became a historian in my PhD years. My Indian background would not have aroused an interest in climate change; instead it made me a postcolonial writer concerned with issues associated with European imperial rule, the problem of Eurocentrism in the humanities and the social sciences, in anti-colonial movements, and in postcolonial issues. My interest in climate change arose from my time in Australia, where I lived for many years; I'm a naturalised Australian. I loved Canberra because that was where I discovered nature when I went there to do my PhD. There was no nature in Kolkata when I grew up. Kolkata is all people and buildings and slums; it's a very crowded place. In Australia I discovered this huge landscape, sparse and very beautiful. There were small pleasures like swimming in brooks, hiking in the bush, and stargazing. But Australia suffered a massive drought for about ten years. What happened in 2003 during the drought was tragic and made a deep emotional impact on me. There was a huge fire in the hills around Canberra that entered the city and destroyed more than 300 homes and claimed some lives as well. All the natural spots I loved were destroyed by fire. Animals were burned to death. It took over ten years for the drought to break and grass to re-grow. During that time I became interested in the history of natural fires in Australia. I realised that there was an ongoing discussion about whether the ten-

year drought was part of Australia's normal drought cycle or whether it was being exacerbated by this thing called climate change. Meanwhile, in 2007, the fourth report by the Intergovernmental Panel on Climate Change (IPCC) was published. It received a lot of attention. I thought, 'Wow, this is changing my idea of what history is, because it's talking about the geophysical agency of humans. It's talking about human agency in a very different way from how historians use the expression.' Historians tend to take the really 'long term' (like the history of mountains and seas and continents) for granted, nature is in the background and history is defined by human actions in the foreground.

LK In your work you make a connection between postcolonial thinking and environmental studies, you relate injustice and capitalism to climate change. What is this relation?

DC Climate change is - as of now - still pretty much a Western issue. I wrote an essay in my own language, which is Bengali, for a Kolkata magazine, on climate change and how it changed my sense of history. This was around 2008. It was my first ever statement as an historian on the climate problem. It just sank without a trace; nobody was interested. Then I revised it and wrote it in English and published it in the American journal *Critical Inquiry*. This was the 2009 article 'The Climate of History: Four Theses', and suddenly a lot of people in the West were interested. The point is, in China climate is about business and policy - they will sell solar panels to the West and elsewhere. In India it's not seen as a business opportunity or a public life issue, or even an issue of general discussion. It should be, but it isn't; it is displaced by concerns

about corruption, crony capitalism, the nexus between politicians and criminals. One seldom hears the phrase 'climate change' in India. The literature of globalisation and postcolonialism is focused on what I call intra-human justice, rather than on the environment. It is environmentally blind to a certain extent. Globalisation theorists focus on the issue of injustice between human beings, between nations, between migrant populations and host populations. They usually do not think about the environment and the collective human footprint. Though now we are beginning to see the emergence of 'environmental humanities' that seek to bring some of this together.

LK In your lectures you say that using the framework of the history of industrialisation and capitalism is inadequate when thinking about climate change, and that we have to incorporate more histories: the history of humans as a species, evolutionary history, and planetary history as well. You say we need a different perspective...

DC The climate crisis was defined by people who weren't necessarily environmentalists. Climate science was partly created by people like James Lovelock, originator of the Gaia theory, and James Hansen, the NASA scientist. Or even before them, by people like Roger Revelle, Hans Suess, and others. They weren't environmentalists. They all studied this planet and in some cases even other planets. Lovelock used to study Mars; Hansen used to study Venus. And they were interested not so much in ecology, but in the origin and maintenance of life. Did Mars ever support life? How would you detect its signals today? What does life do to a



The Brindabellar is a mountain range rising to the west of Canberra, the capital of Australia, and includes the Namadgi National Park in the Australian Capital Territory and the Bimberi Nature Reserve and Brindabella National Park in New South Wales.

Top - The Brindabellar after the fires in 2003.
Middle - The Brindabellar in 2007.
Bottom - The Brindabellar in 2012.

planet? Had Venus seen runaway planetary warming? Questions like these meant the scientists often had to consult data about the Earth for comparative purposes. The planetary consciousness that climate science embodies is actually interplanetary consciousness. So for many of these scientists the question became: 'What makes this planet so exceptional that it engendered life and has supported it for so long? All these issues arose during the Cold War and with space research in the late 1960s and 1970s that was conducted with distinct military goals in mind. It was also when we began to see photographs of the entire planet taken from afar. When astronauts went into space and looked out of the window they saw that the universe is dark, and there were bright, shining, white objects. The only thing that had colour was this dot: the sea, the atmosphere, the 'thin film of life' that covers this planet. Most early environmentalists focused on man's impact on the environment. That's different from the question of how life originated. These different approaches should open up to each other, and now they are doing so, I think.

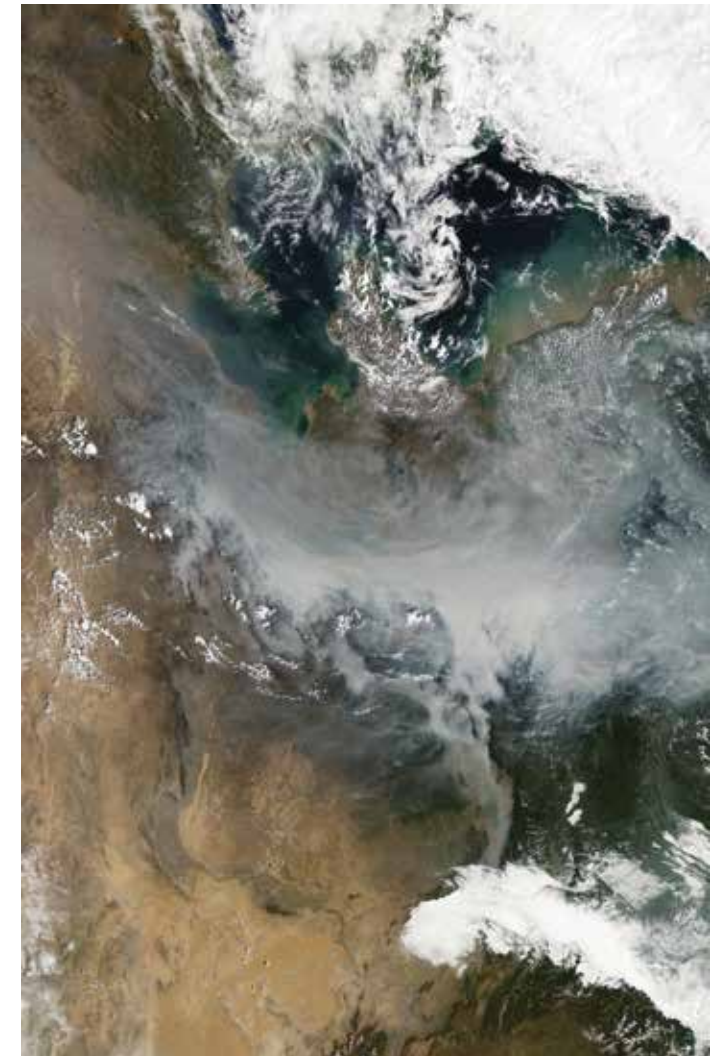
LK Matthew Coolidge from the Center for Land Use Interpretation says that the uranium disposal cells are time machines, sending their contents into the future, they transcend human-scale time, entering geologic time.

DC Thinking both back in time and centuries forward suddenly situates the human on a much larger canvas. We have to think of human history and the history of life as one thing: the history of modernity together with the history of our species. As humans we don't know what we're doing as a species because it's

something that isn't immediately available to us, it's not transparent. The climate crisis has revealed to humans the considerably greater history of life and its relationship to the geo-history of the planet. Capitalist institutions are built around and on those histories.

LK Scientists have stated that we might be living in the Anthropocene. Naming a geological epoch the 'Age of Man' seems to give humanity a very central position. But actually we have to wrestle with our anthropocentric perspective, and supplement it with the idea of not putting humans first.

DC How to put the two together is indeed the question. Our greenhouse gas emissions are changing the glacial-interglacial cycle. Some scientists say that we have postponed the next Ice Age by as long as 500,000 years. The science also warns what this warming could or will do. It will acidify the oceans, which means marine biodiversity will change, with a knock-on effect down the food chain. In that sense we are a geological force. And with that, in some ways, what looms is a 'zoocentric view' of the world. In the zoocentric, life-centred, view humans can be considered as a species, as opposed to an anthropocentric or human-centric view. In the human-centric view we think of humanity as the imagination of our collectivity, a mode of existence in which we have the capacity to project ourselves into the future and do good or bad things. We can speak of it in moral terms. Whereas, when I say that our global emissions are changing the glacial-interglacial cycles, I'm not making a statement about who is responsible, I'm simply stating a scientific fact. The 'we' here doesn't refer to all of humanity; it simply



Natural colour satellite image of a smog event in China, 2010.

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View from the Park Hyatt in Shanghai, China, 2008.



A view of New Delhi taken from Jama Masjid, the principal mosque of Old Delhi in India, 2011.

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makes the point that this episode of planetary warming on Earth is of human making. That's why I make a distinction between the *homo* and the *anthropos*. *Anthropos* is not a figure of culpability and responsibility, but the *homo* – and humanity – is. If we read the 'anthropos' in the expression 'anthropogenic climate change' as referring to all of humanity, we will naturally become agitated about issues of responsibility, human justice and human flourishing. Some people argue that capitalist inequalities led to global warming. If it were primarily injustice that caused global warming, then global warming will not stop until we have addressed the relevant problems. Some people will also argue that the very process through which we agree to take care of the warming must be answerable to questions of justice. While there should be justiciable aspects to the measures adopted in the face of climate change, addressing intra-human justice issues as a way of solving the climate problem could mean working to an indefinite calendar. But according to the IPCC's fifth report, the time we have to reduce carbon emissions is limited to a few decades. If we miss this window, we increase the likelihood of dangerous climate change by which the poor will suffer more than the rich. I'm not saying that humans shouldn't fight for intra-human justice. We have to. But we could do it with some shared perspective about how, in spite of the justice issues, we humans bear a shared responsibility toward other lifeforms, and to ourselves, and by unequivocally acknowledging that both rich and poor may have benefited from the fossil fuel age. We have to tell the human story from another angle to arrive at this shared perspective. We have to tell

the story of how the planet functions as a life-bearing planet. So we have to bring together earth system science, evolutionary thinking, and thinking about capitalism. We become a minor participant in the story, minor compared to the very large-scale planetary processes that our economic and social institutions now seem to be significantly affecting. When we confine ourselves simply to the blame-game of 'who's responsible for this mess?', we don't acknowledge what human flourishing as a whole owes to fossil fuels, and we renounce our collective geophysical agency. We shouldn't.

LK What do we mean when we talk about the Anthropocene?

DC In discussing the definition of the term 'Anthropocene' it is vital to include the point I have already made: that climate change is a problem defined by scientists. Sometimes people don't quite understand what scientists are saying when they speak of planetary climate change and its problems. Sometimes lay readers don't fully get the precision with which scientists say human beings now exert a geophysical force, and they carry on with vague or popular ideas of the Anthropocene. So for many it simply has come to mean 'the age of humans'. If you think of it as the age of humans, you could start it with the killing of the big mammals, the megafauna of America, 15,000 years ago. You could start it with the expansion of the human brain, with eating more meat and protein, the development of language, music and all these things that have helped us become a very powerful species. In *The Earth After Us* (2008) Jan Zalasiewicz imagines future geologists coming to this planet from another planet in a million years

time. His question is: would these future geologists find enough stratigraphic evidence to state that the planet was significantly affected geologically by the presence of humans? That is a very different question from the destruction of the megafauna, and it is a very precise question. Scientists like Jan Zalasiewicz have run into all sorts of trouble by naming the Anthropocene. What they are trying to do is a kind of 'weird' exercise, in terms of the history of geology. They try to imagine themselves as future geologists and then present enough evidence to justify their idea of what these future geologists may find.

As the Brazilian anthropologist Eduardo Viveiros de Castro once wrote to me, the Anthropocene is thus both a name and a concept. It could be a catchall phrase for the period of human domination. But it can be a geological concept too. The people who are trying to have the term approved by the International Commission on Stratigraphy will have to present a scientifically justifiable concept. In popular discussions, it becomes a matter of generally prevalent mood; our use of the word 'Anthropocene' reflects a general mood that humans are becoming too dominant. And that mood is important to the discussion.

LK The point of view from which we look at subjects is very important to you. You have called it 'perspectival' thinking...

DC From Aristotle to Kant there is an idea that you start thinking rationally once you separate your emotions and passions from your ability to reason. Rationalism eventually claims universality: 'I'm not thinking through my experience, I'm thinking of everybody's experience.' In some ways Heidegger was rebelling against that tradition. Heidegger

was saying that, when in everyday life I read the news about the world, it speaks to a background orientation. So that's why his expression 'die *Befindlichkeit*', which is the 'how I find myself-ness', is so important. Even before I make a rational proposition, I'm oriented towards the problem through my basic mood. It's something that makes me anxious, or makes me fearful, or makes me feel bold. This thought seems really important to our discussion of planetary change. Because the moment you tell people the story of how the world might become worse, more stressed, with more thunderstorms, more food insecurity, water scarcity, what they immediately experience are moods. It can be a mood of fear, it can be a mood of determination, it can be a mood of denial. Heidegger teaches us to think about these moods - they can inform thoughts that in turn inform our political, rational, or policy decisions. Therefore, following Karl Jaspers, I have been saying in my Vienna lectures that I'm trying to find a form of thought, a perspective, that precedes politics and gives me a handle on how to think about moods. Something that we can think before - and 'before' indicates the pre-positional aspect of what I'm trying to think - before, say, India says that America is responsible for climate change or America says that India has too many people. Before all of that, before we enter the process of political bargaining starting from divisive points of view, before all of that there is the question of mood, of *Stimmung*... So in that sense, I think this connects with your *Geologic Imagination* project. What actually helps people to think about these moods and experience them is precisely art. Performance, photography, paintings, films. That's where you can see that the

humanities must be central to our discussion of planetary change. Science cannot address these moods that are fundamental to human action.

LK And hopefully we won't all have the experience of fires razing nature spots.

DC Art gives you a kind of simulated experience, which speaks to your mood. It's entirely legitimate to say that I'm worried about climate change, and that's a mood. It's legitimate to say that I feel sad about what human beings have done to themselves. And this has to be acknowledged, instead of creating policy that is in the tradition of saying 'my policy is just scientifically rational'.

LK Considering CO2 emissions, there's a span of say 25 years in which we have to act?

DC Spend the carbon budget if we want to. But we can't do it without acknowledging that it's everybody's problem in spite of the differentiated impact of climate change. I am trying to convey this in my philosophical work. The politics of what I think you're doing, or what I'm doing, is to find this space that we all have to occupy before we enter, as we will have to, the process of bickering and bargaining over responsibility and culpability. Somebody said to me after my last Vienna lecture, 'Why can't the Americans just consume less?' It's a good moral question, but the Americans won't. Well, not until they're forced to. Similarly, one could also ask: 'Why does India want to follow a neo-liberal, environmentally destructive capitalist path?' Well, because lots of people are making lots of money out of it. Many of the poor voted with enthusiasm for the

present neo-liberal government. So, in some ways I think that the global concerted action so urgently promoted by a body like the IPCC cannot happen unless we learn to adopt a perspective that doesn't deny issues of intra-human justice, but helps us to see what is truly shared in the climate crisis. We can fight and bargain, but we also need to rise above that in our overall perspective. We might not be able to. I don't know what it will take to create the sense that we're living together on a single planet and that both rich and poor have benefited so far - of course, in very different ways - from burning fossil fuel. More extreme weather events, sadly, mean a lot more suffering. One person will not make the difference; no one wants to be the idiot who loses out while others are having fun. Which unfortunately means that what is required now is genuine shared suffering that will force us to take a decision. That's probably what has to happen. When I think about it, I ought to tremble with fear, I ought to feel sad. That's why moods are very important.

Talking about Heidegger's mood, Chakrabarty's third lecture in Vienna comes to mind. In it he explained how we should be aware of the potential radical uncertainty of climate change. "We should try to manage the risk of climate change, but while science can model for change, it cannot model for the tipping point. We should make room for climate being a wildcard. And also, there is nothing more unpredictable than human behaviour."

Prac_{ti}ces
fo_r Turn_{in}g
in_{to} the
Anth_{ro}po_{ce}ne

smudge studio

Jamie Kruse & Elizabeth Ellsworth

In their collaborative artistic practice under the name smudge, Jamie Kruse and Elizabeth Ellsworth have taken up the challenge of responding to the conditions of living in the Anthropocene. The images that follow their short essay were made from within the practices they document. Unlike fine art photographers or documentarians of performance art, Kruse and Ellsworth enacted the making of these images as elements of their respective practices.

When Anthropocenic events and materialities pass through us, when they alter our trajectories, moods, imaginations, and experiences of self, they reverberate sensation-ally in our bodies and minds. Our work, now, is to make aesthetic equivalents of some of the sensations entering into our Western cultural awareness and our individual psychologies. Our current work makes practices out of sensations that arise from our human-bodied samplings of objects and interactions that compose the Anthropocene. We have begun by inventing practices that turn us toward and into the Anthropocene. In particular, we are experimenting with practices that are similar to a long-exposure in photography, practices that allow minute impressions to accumulate, that coax into awareness events that occur beyond the thresholds of ordinary stimuli or cultural habits.

Without necessarily intending it, the practices we've invented so far have some of the qualities of ritual. They move us out of the 'ordinary' and aim to attune us to nonhuman dynamics that co-exist and co-act with our (human) present. Our performances of them are not about rational communication, teaching, or prescribed change. Our enactments of them have been highly reflective, psychological, and individual. And at the same time, each practice so far has required us to project our imaginations and conceptualisations in highly *connective ways across human and nonhuman distance and difference*. For us, at this point in these experiments, proof of each practice is that it sets up occasions in which we sense for ourselves some of the ways that we are deeply entangled with dynamic and changing Earth forces at cultural and material boundaries. A practice 'works' for us as an aesthetic equivalent of Anthropocenic sensational awareness when it enables occasions for us to invite, respect, and turn towards the *difference* that such sensation

presents to our daily habits and assumptions. It's particularly important that the practices we invent turn us towards our conditions as entangled and exposed with something other than fear. Instead of trying to control, dampen, ignore or erase our compounding feelings of radical inter-involvement and raw exposure, the practices we've invented aim to address such feelings as interminable, and as material traces of being alive on this planet. Many of us who are Western-cultured humans have difficulty recognising – much less attuning to – or turning at our limits as individuals, or even as a species. As 'smudge', we make our best attempts to do all three, with practices that move us with material consequences.

HUMAN
NONHUMAN



C-Scape dune shack, Provincelands, Cape Cod National Seashore, 2007.



Clean Livin' 'South Base'
(designed by JIMPARCH),
Center for Land Use
Interpretation, Wendover,
Utah, 2009.

INHABITING CHANGE

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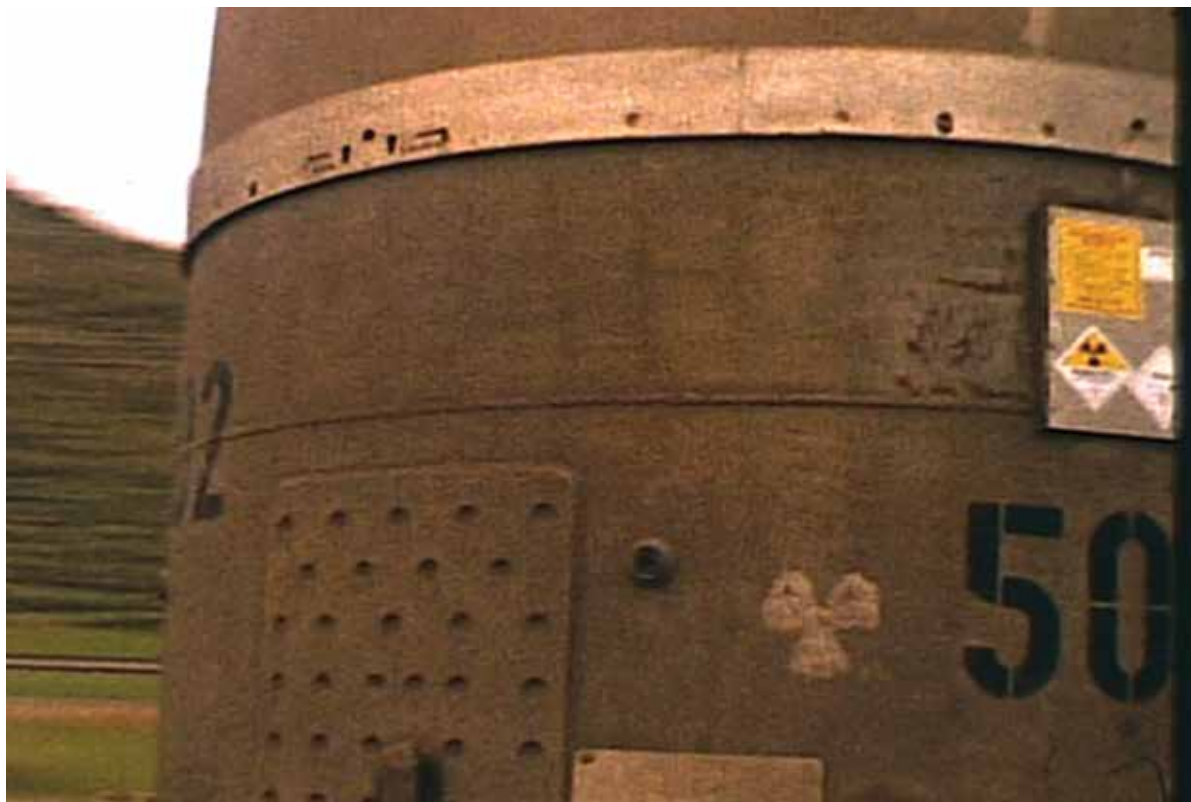


smudge studio, *32 Days/Worlds to Come*, 2009. Project *Faultless*, atomic bomb test, 1968, 1 megaton blast at the bottom of a 975-metre shaft, near Warm Springs, Nevada.

IN-FLOWS OF FORCES

114

VIBRANT MATTER BENDS REALITY



smudge studio, *best attempt (142, 192, 502)*, Super 8 transfer, 36", 2010.
Truck transporting TRU PAC containers of transuranic nuclear waste along Interstate 15 South, Idaho.

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smudge studio, *Look Only at the Movement*, two-channel HD video, 171', 2013.
Truck transporting remote-handled transuranic nuclear waste along Highway 285 South, towards the waste isolation pilot plant, New Mexico, September 2012.

AROUND ITSELF

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smudge studio, *Super 8 still*, Kyoto Japan, 2012.

THE MOMENT OF
CHANGE ITSELF

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PAUSE. YOU ARRIVE
ONLY ONCE



smudge studio, *Turning at the Limits of the World*, performed at Öndverðarnes, the westernmost point of the Snæfellsnes Peninsula, Iceland, 30 May 2014.

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BOWING TO
BILLIONS OF
YEARS



smudge studio, *Turning at the Limits of the World*, performed at Steilneset Memorial in Vardø, Norway, 13 June 2014.



PRACTICES FOR
RETURNING A
DIFFERENCE

Poe^{tr}y and Bo_{ok}kee_ping

Michael Welland

Geologist Michael Welland explores both the scientific and the poetic aspects of the geologic imagination, taking into account scientific, historical and spiritual stories of landscape. He argues that we cannot escape the Anthropocene, but that with a little geologic imagination, we might perhaps reduce our more destructive influences and escape not only the curse of anthropocentrism, but also that of ethnocentrism.

Geologists and Australian Aboriginal peoples have much in common. They share an intimacy and a connectedness with the landscape, see in it stories that have to be understood and recounted, and enjoy a geologic imagination. To the indigenous owner of the Australian Outback, the spectacular hills west of Uluru are not 'The Olgas', named, in the grand tradition of Western colonial patronage, after a queen of Württemberg, but rather 'Kata Tjuta', 'Many Heads'. These hills are sacred, the home of the snake Wanambi who lives among their summits, descending to the canyons during the dry season whose winds are his breath. The dark lines of desert varnish on the smooth, rocky slopes are the hairs of Wanambi's beard. Elsewhere in these hills are mice women, snake and kangaroo men, all ancestors of the local Pitjantjatjara people, carrying the stories of the dreamtime and the origins of the landscape. To all Aboriginal peoples, the land is richly symbolic, the stories *are* the land, and the land, on every scale, *is* the story. The land, like everything, is alive, and humans are simply an inseparable, connected part of it.

To the geologist, these hills tell stories too, but stories from several hundred million years ago of ancient mountains corroded and disintegrated by time and the atmosphere, the resulting debris of sands, gravels and boulders coming to rest along their flanks. Time and burial in the Earth's kitchen turned these sediments into rock that later – much, much later – would be heaved back to the surface to suffer, over the last few tens of millions of years, the vicissitudes of weathering and erosion. History repeats itself.

These are different stories of landscape, one more scientific, the other more spiritual, but both originate in the human imagination. The title of this essay is taken from the work of Peter Medawar, the Nobel Prize-winning immunologist and brilliant writer on science

and scientists. In a 1965 lecture and essay, he contemplated the 'Two conceptions of science' – 'above all else an imaginative and exploratory activity' or a purely evidence-based 'critical and analytical activity'. He concludes, eloquently, that both are true, 'For a scientist must indeed be freely imaginative and yet sceptical, creative and yet a critic. There is a sense in which he must be free, but another in which his thought must be very precisely regimented; there is poetry in science, but also a lot of bookkeeping.' He comments that 'Scientists are building explanatory structures, telling stories which are scrupulously tested to see if they are stories about real life', and that 'Today we think the imaginative element in science one of its chief glories.'

I am a geologist – and therefore, I like to think, a scientist – and Medawar's descriptions resonate deeply. Deciphering our planet's history requires reconstructing events that, inevitably, cannot be witnessed, comprehending the significance of the immensity and potential of geologic time, visualising objects in four dimensions, and unravelling the testaments of a single sand grain *and* the vast 200-million-year-old sand seas of Utah. This cannot be accomplished without creativity and imagination, without ideas. How these ideas first originate in the mind of a geologist remains as mysterious as the workings of Newton's imagination as he observed the falling apple, but without them the study of geology would be static and distinctly unexciting – a body of knowledge, yes, science, no.

As physics has Newton in his orchard as a creative event, a 'paradigm shift' in the words of Thomas Kuhn, so geology has James Hutton and his Scottish boat trip. In 1788, towards the end of what we have come to call the Enlightenment, this farmer and naturalist stepped ashore with two eminent geological colleagues at Siccar Point, on the east coast of Scotland, not far from Edinburgh. The rocks there were testament to radical ideas that had been maturing in Hutton's mind for some time, and they remain today a pilgrimage destination for a geologist.

John Playfair, one of Hutton's companions, later wrote:

The palpable evidence presented to us, of one of the most extraordinary and important facts in the natural history of the earth, gave a reality and

substance to those theoretical speculations, which, however probable, had never till now been directly authenticated by the testimony of the senses... What clearer evidence could we have had of the different formation of these rocks, and of the long interval which separated their formation, had we actually seen them emerging from the bosom of the deep? ... The mind seemed to grow giddy by looking so far into the abyss of time; and while we listened with earnestness and admiration to the philosopher who was now unfolding to us the order and series of these wonderful events, we became sensible to how much farther reason may sometimes go than imagination can venture to follow.

Here was a radical idea, the immensity of geologic time. That, in Hutton's own words, 'we find no vestige of a beginning, no prospect of an end', and that our planet's history can only be understood – and, indeed, anything be conjectured about its future – by careful observation of how it works today (the concept that would come to be known by the somewhat ungainly term 'uniformitarianism'). Hutton's ideas were poetry, but he had spent a great deal of time on bookkeeping. Geology has enjoyed a number of additional paradigm shifts, the greatest one of recent times being the 'revolution' of plate tectonics. It is worth noting that Harry Hess, whose radical ideas set out and stimulated the understanding of plate tectonics, referred to his original 1962 proposal as 'an essay in geopoetry'. The poetry and the bookkeeping continue.

Geologists tell 'stories which are scrupulously tested to see if they are stories about real life'. While the heart of geology remains an intimate experience with the landscape and the rocks, much effort is expended in bookkeeping, in the laboratory, documenting, analysing, measuring, asking questions of isotopes and molecules. The answers often do not fit the ideas and the latter must be discarded, but the answers stimulate new ideas – such is the geologic imagination.

As a mysterious process of the human mind, the geologic imagination shares much with the inspiration of the artist, the writer, the musician and the philosopher – but they are different. Peter Medawar writes that:



Kata Tjuta or The Olgas (Mount Olga) is a range of hills near Uluru - Ayers Rock, Australia.



Hutton's Unconformity at Siccar Point: More than 50 million missing years of geological turmoil between the two different rock formations.

No one questions the inspirational character of musical or poetic invention because the delight and exaltation that go with it somehow communicate themselves to others. Something *travels*: we're carried away. But science is not an art form in this sense; scientific discovery is a private event, and the delight that accompanies it, or the despair of finding it illusory, does not travel.

I find this a powerful idea, one that perhaps suggests that scientific discovery, as it has become more complex, has also become private, and that enabling the geologic imagination to travel would help address the source of many of the challenges we face: the current apparent disconnect between Western society and its home planet.

Arguably, this seeming disconnect between poetry and science, between society and a curiosity about how the Earth works, has not always been – and need not be – inevitable. James Hutton was a 'natural philosopher' – the term 'scientist' was not coined until well into the nineteenth century, by William Whewell, a geologist and philosopher of science (who also originated the term 'uniformitarianism'); he was a firm believer in the creativity and bold conjectures of science. In the Enlightenment and on into the age of the Romantics, natural philosophy and its ideas mingled freely, if sometimes controversially, with the arts. A year after Hutton's death in 1797, Wordsworth would write that 'Poetry is the breath and finer spirit of all knowledge; it is the impassioned expression which is in the countenance of all Science.' In a letter written in 1817, Keats (who had little interest in bookkeeping) celebrated the idea of 'Negative Capability, that is when man is capable of being in uncertainties, Mysteries, doubts...' This is a compelling vision of the excitement of what would become science, echoed 150 years later by Richard Feynman when he wrote on the importance of doubt and uncertainty as the drivers of science:

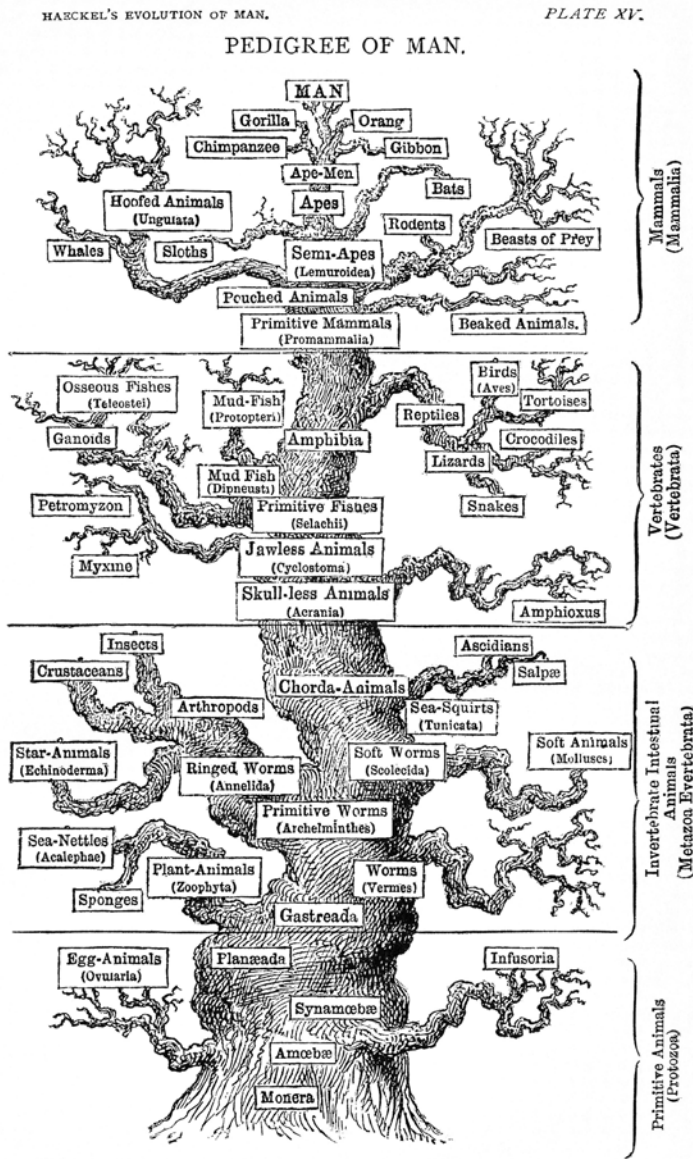
The freedom to doubt is an important matter in the sciences and, I believe, in other fields... doubt is not a fearful thing, but a thing of very great value... Scientists, therefore, are used to dealing with

doubt and uncertainty. All scientific knowledge is uncertain... if we did not have a doubt or recognize ignorance, we could not get any new ideas... So what we call scientific knowledge today is a body of statements of varying degrees of certainty.

In 1821, Shelley declared that 'Poetry is indeed something divine. It is at once the centre and circumference of knowledge; it is that which comprehends all science, and that to which all science must be referred.' Those words were first published in *A Defence of Poetry* in 1840, a year after Darwin had written his account of the *Beagle's* voyage, and at the time when a Scottish stonemason and geologist (and a devout but imaginative Christian), Hugh Miller, was giving enthusiastically popular lectures on his discoveries of ancient fossil fish and their significance for the world around us. Miller's lectures were poetic, as were his writings: his books sold tens of thousands of copies on both sides of the Atlantic and were an inspiration for John Muir. In one of his public lectures, he observed that 'Nature is a vast tablet, inscribed with signs, each of which has its own significance, and becomes poetry in the mind when read; and geology is simply the key by which myriads of these signs, hitherto indecipherable, can be unlocked and perused, and thus a new province added to the poetical domain.'

So, did the geologic imagination cease travelling, and, if so, when and how? Perhaps with the rise of technology in the Industrial Revolution, with natural philosophers becoming scientists, with science becoming inaccessibly complex and the scientist being (incorrectly) viewed as claiming omniscience? Perhaps with the politicisation of science amid the imperatives of colonial ambitions? It was, after all, that revolution and those ambitions that changed the Western dialogue with the world around us from one of awe and respect for The Sublime to one underpinned by the vocabulary of conquest. The Western, 'civilised', world developed its sense of Manifest Destiny and of nature as something separate that must be subdued.

That narrative of Manifest Destiny was supported by science – or at least convenient interpretations of it. Scientific achievements surely demonstrated clearly man's superiority and unrivalled potential. Among these convenient interpretations, none



Ernst Haeckel's 'Tree of Life' from his book *The Evolution of Man* (1879), one of his several depictions of a tree of life.

has proved more tragic than the misappropriation of Darwin's ideas to construct the narrative of 'The Ascent of Man'. In 1879 Ernst Haeckel, the German biologist (and superb artist), published *The Evolution of Man*, within which appeared an illustration titled 'Pedigree of Man'.

This is but one example of the Tree of Life, as conceived post-Darwin – erroneously and conveniently. Darwin only occasionally sketched tree-like diagrams (the most famous annotated with the words 'I think'), doubted any empirical basis for such trees, and specifically titled one of his works 'The *Descent of Man*'. The numerous and enduring depictions of the hierarchy of life, with *homo sapiens* gloriously but self-servingly positioned at the pinnacle of this edifice, reflect neither Darwin's ideas nor the reality of the living world and evolution. Nevertheless, this conceit, this fairy-tale of 'progress' that has been described as an infection, thrives today.

As Steve Gould, another brilliant communicator of the realities of science, wrote:

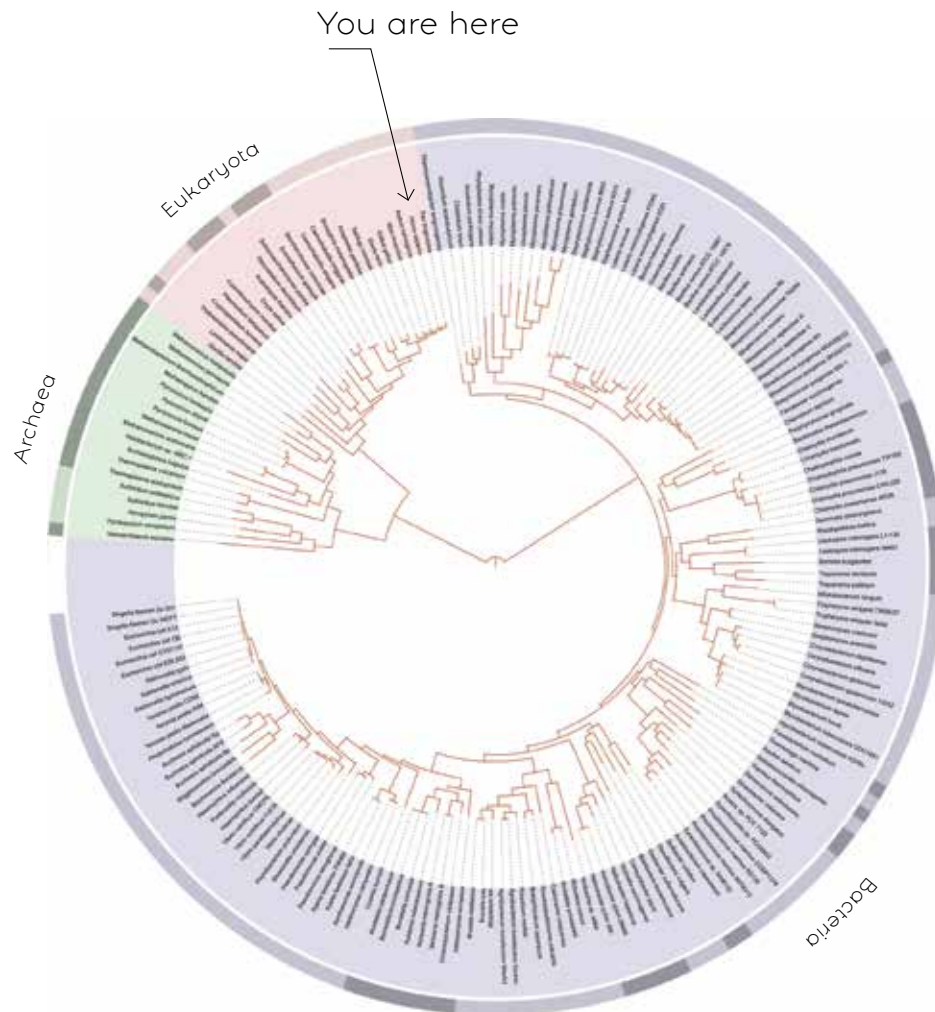
... our conventional desire to view history as progressive, and to see humans as predictably dominant, has grossly distorted our interpretation of life's pathway by falsely placing at the centre of things a relatively minor phenomenon that arises only as a side consequence of a physically constrained starting point.

And:

Humans are not the end result of predictable evolutionary progress, but rather a fortuitous cosmic afterthought, a tiny little twig on the enormously arborescent bush of life, which if replanted from seed, would almost surely not grow this twig again.

Gould's work travels, but not far enough. These utterly erroneous visions of human exceptionalism, icons of anthropocentric hubris, have cemented the disconnection between 'us' and 'everything else' – the latter, at least through the eyes of Western 'civilisation' being whatever we choose to define as 'nature'. Today, scientifically and graphically creative work, poetry and bookkeeping, continues to

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One version of the Interactive Tree of Life (iTOL), an online tool for the display and manipulation of phylogenetic trees, 2008.

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apply molecular and genetic biology to understanding the evolutionary relationships between living organisms. The result, which shows only a limited number of known species and is far from complete (if it ever will be, since we have no clear idea of how many species co-habit the planet), is captured in the image (facing page) from the international collaboration that is the Interactive Tree of Life project. So there we are, nestled inconspicuously between the common chimpanzee and the Norwegian rat, a scarcely discernible mote in a world of microbes. Life's ultimate common ancestor resides, alone and mysterious, at the centre – Aboriginal Australians must be delighted.

This evolving view of life's connections is but one example of the way in which science today not only rejects any disconnection between 'us' and 'everything else', but rather emphasises quite the opposite. Much of the geologic imagination today is focused on earth system science, the approach whereby geologists, geophysicists, geochemists, sedimentologists, palaeontologists, geomorphologists, climatologists, stratigraphers, isotope analysts, archaeologists, biologists, botanists, bacteriologists, sociologists, anthropologists, historians and philosophers are locked away in a dark room and are only permitted to emerge when they have understood the connectedness, on an immense range of scales, of their individual disciplines. These tribes have not yet settled their differences, but every day brings startling results that restructure the comfort of conventional wisdom. Even the familiar separation of the organic from the inorganic begins to break down: minerals have undergone a process of what is best described as evolution. Since our planet's beginnings, the diversity of minerals, their relative abundances, and their chemistry and physical characteristics have changed dramatically, and most of these changes have been intimately entwined with the evolution of life. One provocative question that emerges from the locked room of experts is when and how did geochemistry become biochemistry?

There are perhaps a dozen mineral species present in interstellar space, 250 in meteorites or a newly forming planet, 1500 on a lifeless planet and more than 4000 on Earth today as a result of the conspiracy between organic – particularly microbial – and inorganic processes. A large number of the newest minerals on Earth today are a direct result of the conspiracy between the 'inorganic' world and one particular lifeform: us.

This surge in the number of minerals is but one of the many yardsticks used to frame the compelling concept of the 'Anthropocene', a new epoch of geologic time marked by the moderation of the planet on a vast range of scales by a single organism. The term has yet to be agreed or formalised by the arcane workings of the geoscientific supreme court, but the poetry of the geologic imagination is already there – it is simply the bookkeeping that continues. And the poetry *is* provocative, and has the potential to travel. As an enthusiast for sand, the unsung hero of our planet, I would argue that it is perhaps one of the most visible – and familiar – symbols of the Anthropocene. Vast swathes of the earth's surface have been re-sculpted and redistributed as a result of our playing with sand. The development of Singapore continues to rely on the devastation of its neighbours' beaches and rivers; Dubai, having exhausted its own supplies, imports sand from Australia for its manic constructions. Huge amounts of money and energy are wasted attempting to 're-nourish' beaches that have been washed away as a result of developers' ambitions and ignorance. Worldwide, 58,266 dams more than fifteen metres high prevent sand from going where it is supposed to, and entire communities are destroyed by mining and dredging for construction and mineral sands.

Whatever 'culture' is, its demands have resulted in a wholesale re-shaping of whatever 'nature' is, and it does not take a great stretch of the geologic imagination to appreciate this. We cannot escape the Anthropocene, but, with a little geologic imagination, we can perhaps understand it better, and understand how we might mitigate our more destructive influences. We might, at least to some extent, escape not only the curse of anthropocentrism, but, since much of the 'debate' is dominated by Western thought, also that of ethnocentrism (it would be interesting to know how Aboriginal peoples view the Anthropocene).

We do, however, have a great deal of catching up to do. The 2011 Japanese earthquake and tsunami, with their catastrophic consequences at Fukushima, are often cited as natural events that exceeded the human imagination, but this is not true. Well-documented in recent historical time were numerous tsunamis of equal or greater magnitude, each depositing its testament of layers of marine sand many kilometres inland. These records – and

the associated risks – were explicitly communicated, but ignored. Whether they were ignored through complacency, ignorance or greed hardly matters. If we cannot respond to evidence, how can we value the geologic imagination? How can we come to terms with the fact that, in the words of the physicist Per Bak, 'An unlikely event is likely to happen because there are so many unlikely events that could happen'? Or, as Bruno Latour observed in attempting to dispel the myth of 'nature versus culture', that 'natural objects are naturally recalcitrant'. We need to both celebrate the poetry and attend to the bookkeeping – and remember the wisdom of John Lennon: 'Reality leaves a lot to the imagination.'

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Subl_{im}e
L_{an}dscap_{es} 3.0

Interview with Kurt Hentschläger
Mirna Belina

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Kurt Hentschläger's latest audiovisual installation, *Measure* (2014), reflects on nature as filtered through communication channels and media. In the tradition of eighteenth-century panoramic landscape paintings, the piece offers a broad view across a partly filmed, partly manufactured landscape. *Measure* was shot in late 2013 and early 2014 in the Vallée de Joux, one-hour's drive from Geneva into the Jura Mountains, as part of a new artist programme initiated by one of the oldest Swiss watch-making companies, Audemars Piguet.

Mirna Belina You say '*Measure* is about nature and how we perceive it in today's age'. Why this urgency to redefine nature?

Kurt Hentschläger *Measure* is partially a reflection on what the so-called civilized world now perceives as nature or natural. The paradigm started shifting during the nineteenth and twentieth centuries, and continues to do so with ever increasing rapidity. The integration of digital technology demonstrates that in just two decades we can restructure the ways our species organises, interacts, creates, and feels about the world, including (what's left of) nature. There is a sense of exponential empowerment, and with it the assessment of exponentially accumulating 'man' power. Throughout human history, original, unmapped and uninhabitable nature has, across most of the planet, been transformed into managed and cultured 'real estate'. I don't think anybody feels the urgency to consciously redefine nature, but clearly our traditional idea of nature has changed as it shrinks and becomes more of a memory than an omnipresent reality. Change is a fact of life, so I try not to be sentimental about any of this, but the scale of change in my lifetime alone is undeniably mindboggling.

MB Does 'real nature' exist at all?

KH What is real nature anyway? Is nature what existed before we became a conscious species? Is nature what surrounds us at any given time? Are cities, farms, industrial areas not just part of today's nature? We deem something unnatural or artificial when it's newly introduced. Once mass adopted, it quickly becomes a 'natural' part of our lives. I saw a movie recently depicting the

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early 1990s in the US with a group of people gathered around one cell phone. Twenty years later, we all carry phones as if it was never any different. Nobody feels that it's unnatural in any way, battery life still sucks, et cetera, but phones are now physical extensions of ourselves. Moreover, we sense and frame the world through our smartphone cameras. It is two worlds that we try to bridge with these devices, the physical world and, dare I – vintage inclined – call it the cyber territories. The now ubiquitous camera enables continuous documenting of the world around us. It creates an omnipresent media veil of sorts, augmenting and distancing reality at the same time. It's nothing new really to look through a camera lens, but the regularity with which we look through a device, relying on it to memorise for us, and how we trade images and sounds now as effortlessly as we converse via language, has taken a quantitative leap. Our impression of nature (of anything really), from the way we grow up looking at it, is always based on a set of cultural concepts and perceptual habits rooted within a culture. Subsequently, as our culture changes, so do our habits and how we formulate a worldview. Thus, even when we look at a stretch of pristine land, in our media-informed minds nature is no longer an untamed, undisturbed terrain, but a managed, protected and framed area of property.

MB What about the idea of nature as the 'sublime'?

KH I am interested in sublime landscapes, experienced by individuals. Much has been said about the nature of the sublime and more about the various ways to define it – from the object-related

perspective to ideas of mind and emotion, from the notion that it frustrates the distinction between cause and effect, to the sublime as manifestation of the divine. I'm intrigued by the conundrum of the sublime, its apparent ambiguity and ephemeral nature, congealing in the processes of the mind. Talking about the sublime always seems fraught with contradiction, as really the concept of framing it prevents its emergence. To have an experience of the sublime in many cases requires physically bringing yourself to certain locations, exposing yourself to phenomena – and also potential danger – and so for some time at least suspending your analytical faculties.

MB How does the term 'Anthropocene' resonate with *Measure*?

KH 'Anthropocene' is a label applied to the planetary reach and scale of changes brought about by the scientific, industrial and cultural accomplishments of civilisation. *Measure* is a comment on the increasingly technical, mediated way of experiencing the world today, arguably at the peak, if not (self-inflicted) end of the Anthropocene. Untamed nature has become the exception to a city and urban sprawl perspective, access to which requires an effort, if not an expedition (if one wants to truly escape any vertiger of civilized comfort). On our behalf, legions of documentary filmmakers are documenting species, ecosystems and landscapes on the brink of extinction, conscious that they might be gone in a year or two. The footage emerging from these media expeditions is edited to serve up a 'best of' to produce the most spectacular and acutely condensed viewing experience, a meta-reality perspective if you will. While the

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disappearing original environment gets a last in-depth scan, it also marks our pragmatic and romantic farewell to the planet as we know it. The current tempo of nature's transformation is breathtaking. Of course the Anthropocene and human meddling are marginal in the eons of planet Earth.

MB Are you also rethinking the idea of a digital landscape in *Measure*?

KH The 'digital' isn't really my concern. It's an obvious game changer, but in the end, technology in itself does not create anything. People do. What did happen though is that 'the digital' enables a malleability of everything. Our aesthetic tools have become more potent. In *Measure*, the malleability shows up in regards to time-based elements, which in both filming and post-processing are dynamic and fluctuating, yet the final edited flow appears perfectly natural and in real time. In *Measure* some manipulations and added layers are obvious, while others blend in as seemingly natural. I feel the whole question of the fake, the processed or the manipulated, is now irrelevant. Whether we realise the artifice when looking at something or not, doesn't matter – we simultaneously believe something to be real and not real now. It's a consequence of our media education of the last hundred years. I would say *Measure* is a layered fabric – constantly moving while going nowhere.

MB Can you tell me about the sound in this piece?

KH It's largely a grid of discrete sounds. It's not a rigid system obviously and sounds weave in and out, but the sequenced grid constitutes the rhythmic backbone

of the work. Beneath it flows a low stream, as an asynchronous subconscious, and there are a few handcrafted sound events, a few FM spectral fields and a small selection of field recordings, birds and highflying planes from the area where the footage was shot. The sound is a processed amalgam of synthesised and sampled structures, predominantly digital, that stand in contrast to the visual appearance, which feels mostly like real world footage.

MB When working on a piece, do you start with a familiar image that becomes artificial or with an abstract idea that is embodied in the image? I am thinking about your 're-animated' works like *Range* (2008), *Cluster* (2009-12) or *Hive* (2011), but also about *Measure*.

KH Generally, this body of work began from a feeling of absence and longing. About five years ago I realised that I had all but stopped venturing out into open natural landscapes. I was travelling a lot, mostly through airports connecting cities around the world. That had become my natural habitat. As somebody who grew up halfway between the city and the countryside, I always miss being 'out there'. Part of what I love now about living in Chicago is that it is close to Lake Michigan: a large body of open water and wide skies. The sense of absence of open nature, of living in a city all the time, made me decide to embark on a conscious re-visiting of natural and non-natural landscapes. In this case the work started with a clear image of myself being outside, with a camera, as an older person and artist. Incidentally appropriate opportunities fell into my lap during those years. For example, in 2012 I was invited to do a commission for

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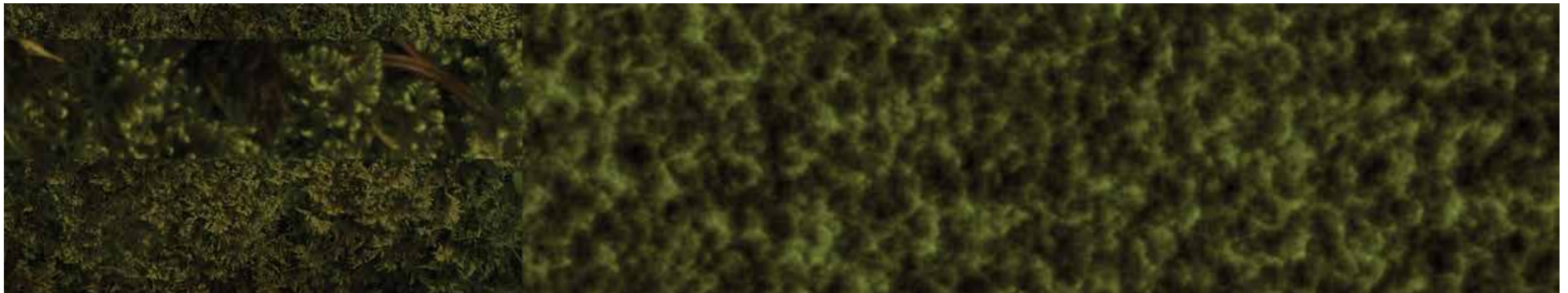
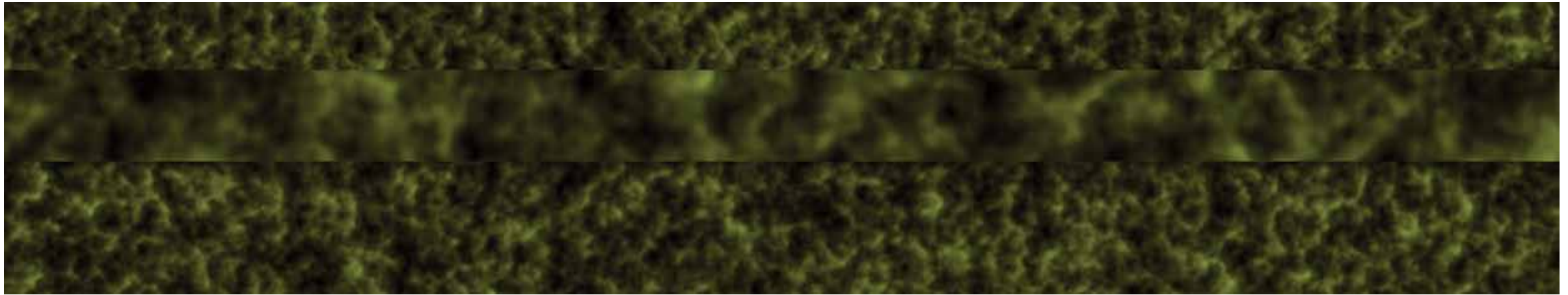
Ironbridge in the English Midlands, one of the birthplaces of the Industrial Revolution, which is now a very bucolic World Heritage Site. It's a place that has come full cycle, from a wilderness in the early eighteenth century to an industrial centre exploited for all its resources, then sinking into oblivion as industrial needs became greater and production moved to more suitable places, and now the whole valley feels like an idyllic park. It is a tastefully maintained region – cute, one could say – that is humane and attractive to tourists. All these experiences have informed *Measure*.

MB Your works play with human perception but I would argue that the physical response to what we perceive is also very much a part of the work, for example, in intense pieces like *Feed* (2005-6) or *Zee* (2008).

KH With *Feed* and *Zee* I was interested in working with extreme perceptual, immersive sensations, designed sensations that is. I created an artificial environment that could instil a sense of sublime intensity normally found only in the experience of nature. Taking away all spatial cues and the usual means of spatial navigation successfully created an 'unreal' physical space. This is impossible to achieve in a more traditionally presented work like *Measure*, which, like painting, allows the viewer to remain at a safe distance.

MB It seems as if you are trying to stage something like a 'representational void' in pieces like *Feed* and *Zee*. Is the immersive sensory overload something that can create an immediate, non-mediated realm, or do you think a narrative is always present?

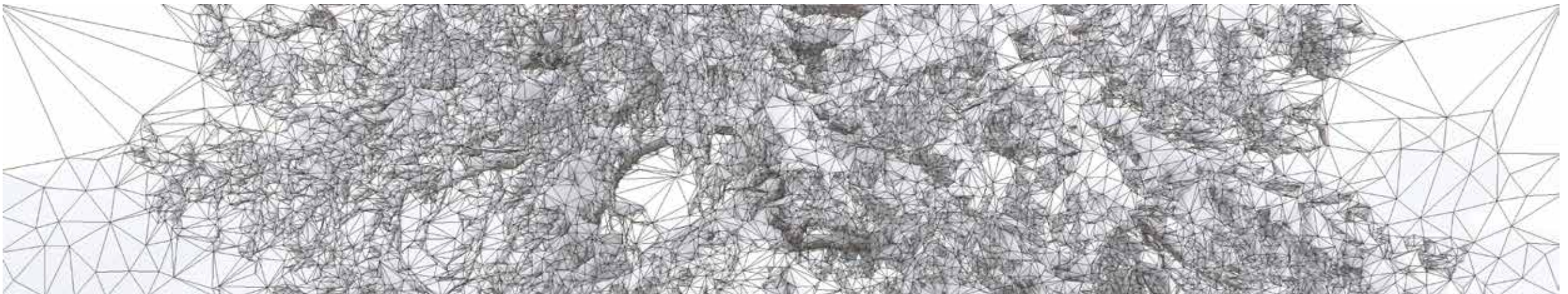
KH You can't really escape narrative. I would also question if there can be anything like a representational void. The way our brain is organised to find cues and create meaning at all times, it seems close to impossible to prevent ourselves from consulting our memorised reference library. Having said that, it's always surprising when, at least for a moment, our everyday routines are brought to a standstill, and we re-evaluate. For me this is the essence of art.



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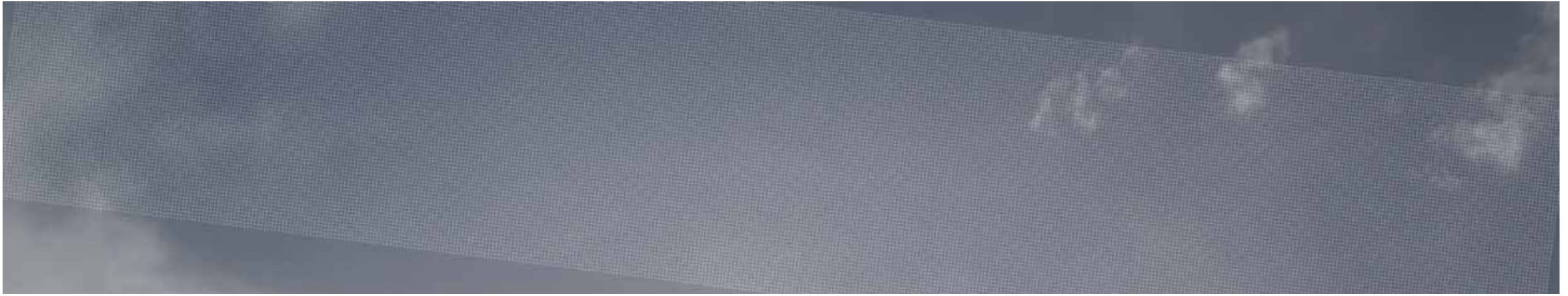
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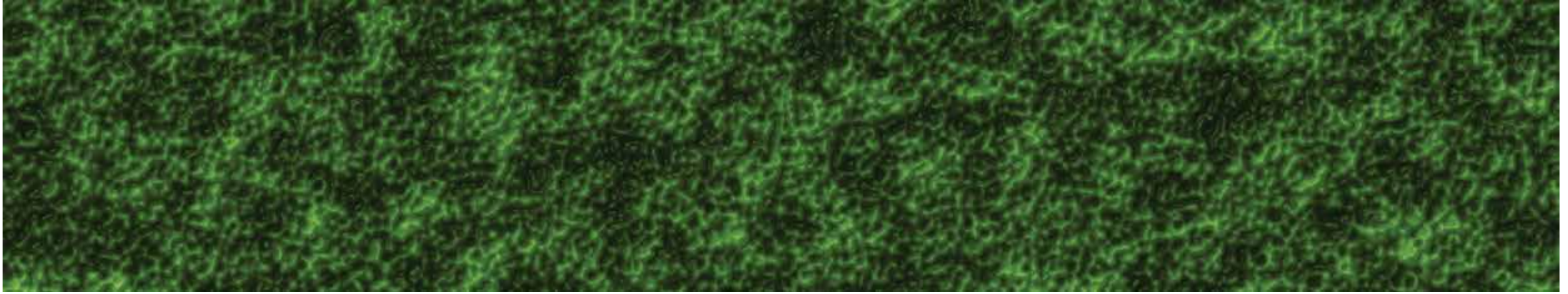
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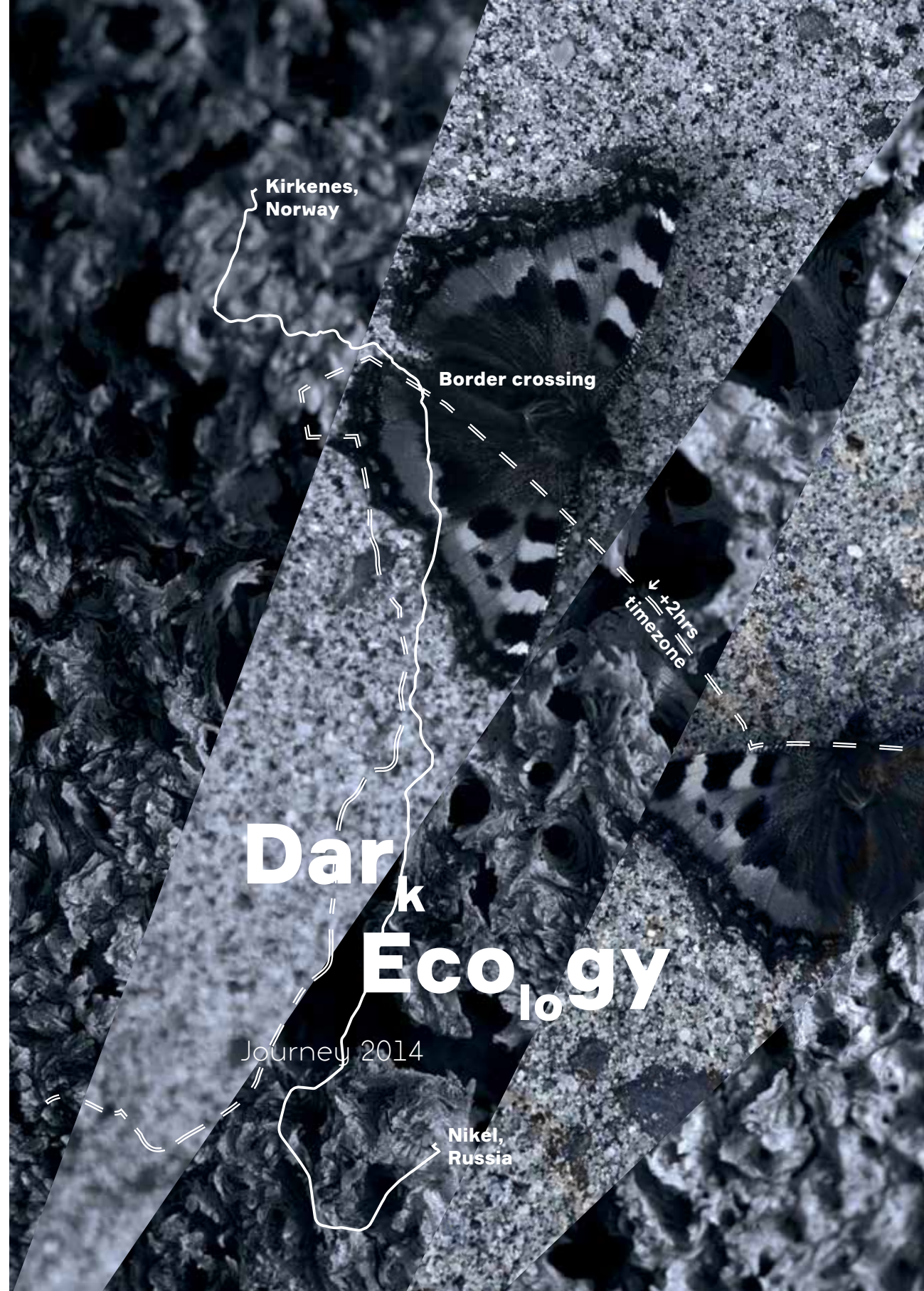


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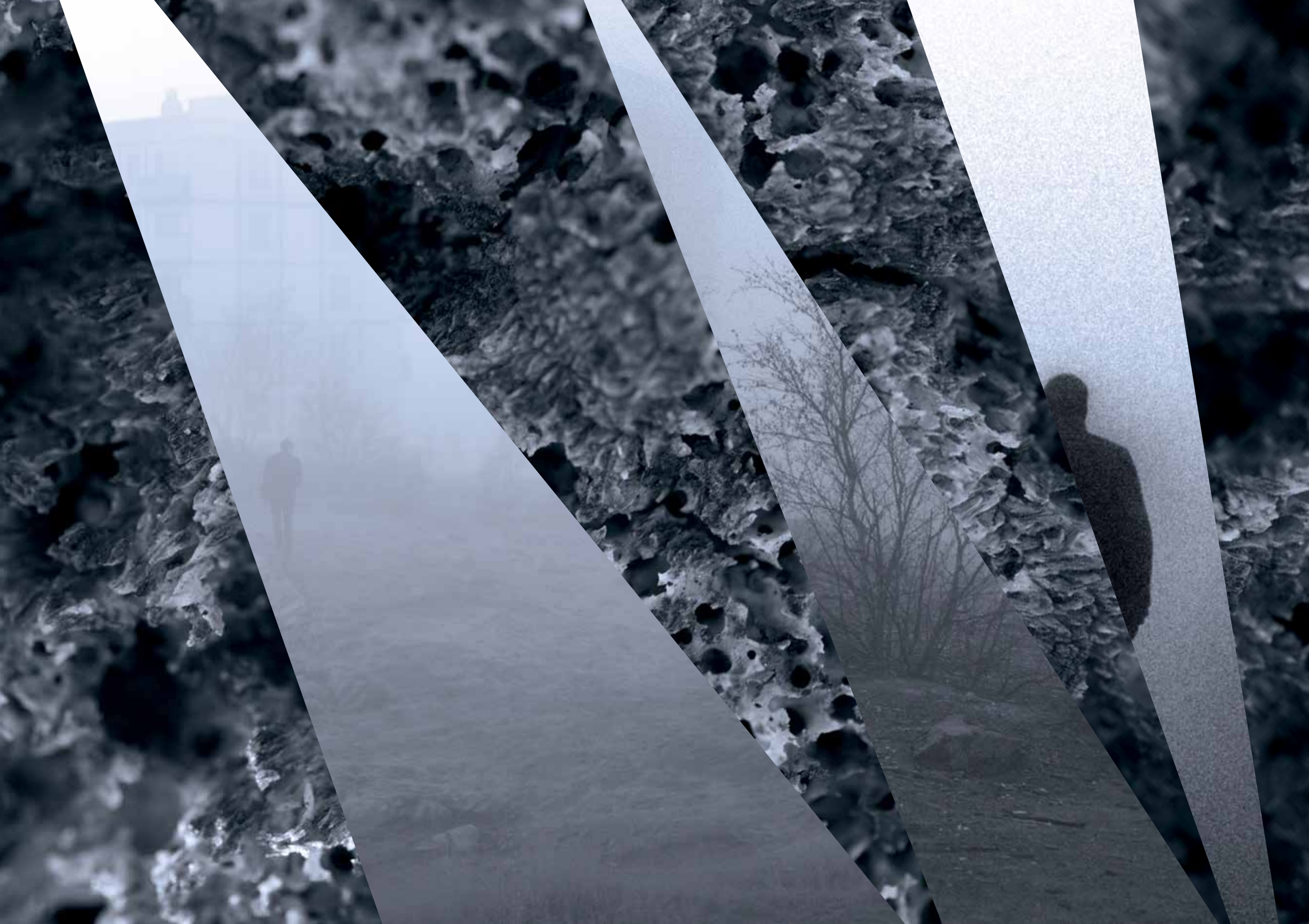
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Dark Ecology

Journey 2014

Nikel,
Russia





H_{um}an Th_{ough}t at Ea_rth Mag_{ni}tude

Timothy Morton



Over the past few years theorist Timothy Morton has explored what ecological thought can be. He coined the idea of a 'dark ecology', and an 'ecology without nature', and introduced the term 'hyperobject' to refer to very large objects such as global warming. In this essay he asks the question: 'What happens when we think at 'Earth magnitude'? At a magnitude of signals that travel around the Earth, the magnitude of the aurora, of an earthquake, or of global warming. He concludes that thought at Earth magnitude cannot be contemptuous or cynical, but instead should involve a compassionate laughter.

Media arts and experimental music theorist Douglas Kahn recently invented the term 'Earth magnitude'.¹ When we scale up to Earth magnitude, very interesting things happen to thinking. Far from making supposed universal generalisations, as many still assume ecological statements to be, thought at Earth magnitude is highly accurate and specific. Yet it is also deeply entwined with paradox in such a way that it reveals something basic to the structure of thought: a loop form. I take the loop form to be the structure of being anything at all: a logical system, a solar ray, an electromagnetic shield, an aurora, an oil refinery.

Moreover, Earth magnitude is the correct scale on which to think something seemingly near to us, yet which is in fact is more distant than Sagittarius A: human being as such.

I take Earth magnitude to mean 'at a scale sufficient to open the concept Earth to the true extent of its range'. Solar winds do this when they interact with Earth's magnetic shield: they produce auroras. Global climate does this, as the mass of terrestrial weather events are downwardly caused by a massive entity that exists at Earth magnitude. Human thought at Earth magnitude is human thinking that is as 'large' as the aurora. Namely, it's a thought that can think the aurora in such a way that its vastness is witnessed and opened in us. Of course, a single person can do this on the ground.

1. Douglas Kahn, *Earth Sound Earth Signal: Energies and Earth Magnitude in the Arts*, Berkeley: University of California Press, 2013.

You don't need to be a geostationary satellite, or a scientist, or an astronaut.

It isn't at all difficult to understand how thinking the aurora is thought at Earth magnitude. We shall see that it's quite tricky with what I take to be the most provocative thing about the Anthropocene, with its mass extinction: namely the fact that we can now think species fully, precisely not as a thing we can point to, but as something like the aurora, a mysterious yet distinct, sparkling entity.

It seems superficially easy: look, I'm a human, I'm not a duck or a doughnut. But this superficial sense of ease is blocking something stupendously difficult. This is that human thought follows and witnesses the being because of which thinking is happening. Thinking goes into a loop. And the loop could be endless, or not – we don't know yet. And the thinking becomes a weird openness to things, disengaged from cataloguing and classifying beings. This being is further from thought than Sagittarius A, the black hole at the centre of the Milky Way.

The Anthropocene is a deeply anti-anthropocentric concept, because it enables us to think the human species not as an ontically given thing I can point to, but as a hyperobject that is real yet inaccessible.²

There is a problem with some forms of Marxism, notably the kind of cultural Marxism that seems to have been hounding me lately. The problem is very simple: it's implicit anthropocentrism. This anthropocentrism does indeed pick up on a theme in Marx's own thought. Marx himself was happy to write about things that were outside the human sphere, and about things outside the sphere of capital. But there is an anthropocentric thread.

Marx writes that the best of bees is always worse than the worst of architects.³ That's because the architect imagines her or his building, and the bee just executes an algorithm. Well – prove it. We could set up a lot of expensive experiments to find out if bees imagine things. Of course we'd have to know what we were looking for, namely empirical evidence of imagination. We could set up an

2. I use the term *ontic* as Martin Heidegger uses it, in *Being and Time*, tr. Joan Stambaugh, Albany, N.Y.: State University of New York Press, 2010.

3. Karl Marx, *Capital*, tr. Ben Fowkes, Harmondsworth: Penguin, 1990, pp. 283–84.

experiment to see whether bees hesitated. If they hesitated and displayed some sense of caution while executing a task, it could be evidence that they aren't just blindly following an algorithm.

By the way, some Marxists can be so defensive about this bit in Marx – they do perhaps sense the danger at this point – that they sometimes tell me this passage is just metaphorical. That by *bees* Marx really means workers and by *architects* Marx really means the bourgeoisie. Isn't that even more insulting? To humans as well as to bees? I mean, then Marx is saying that workers are merely mindless automatons. How on earth are these poor, very crude androids going to figure out what's going on and start a revolution, which depends on a goodly slice of imagination?

Back to our experiment... In fact, this kind of experiment has been done with ants. It's been shown that ants, while climbing up little ladders, look around them rather than walk up automatically. They weigh options when it comes to where to live, and so on.⁴ This suggests that ants anticipate and assess situations, which is at least part of what architects are supposed to do when they design a building. Bees build mental maps to find their way home – they aren't just on autopilot. And rats experience regret, and so on. The trouble is, our poor scientist has to already know roughly what she is looking for before running the experiment, and this means that she is forever haunted by a deep problem that affects both science and humanities in the Anthropocene, that is to say, the age of Hume. The age in which there is no objectified, obvious cause and effect churning away below phenomena like cogwheels: cause and effect are inferences we draw from statistical correlations in data.

Cause and effect are 'in front' of things, not behind them. In front ontologically, rather than spatially.⁵ In order for there to be causality there must always already be objects. Which is why causality is really part of the aesthetic dimension, a fact that seems quite clear, though still weird, in a post-Newtonian world. Which means that scientists are now beginning to figure out something

4. T. Sasaki and S.C. Pratt, 'Ants Learn to Rely on More Informative Attributes during Decision-Making,' in *Biology Letters*, 2013, vol. 9, no. 6, DOI: 10.1098/rsbl.2013.0667

5. Timothy Morton, *Realist Magic: Objects, Ontology, Causality*, Ann Arbor: Open Humanities Press, 2013.

we've known in the humanities and arts for ages and ages. Namely that you are entangled in what you are seeing. After all, this is basic Kant, who grounded Hume's insight about causality in exactly this thought, which we now call 'correlationism'. We can't see things in themselves; we can see human-flavoured correlates of those things. But there are things that are things in themselves. So we are caught in a dilemma. The name for this dilemma is 'hermeneutic circle'. Scientists now call it 'confirmation bias', which is why only a small percentage of physicists now think that physics says anything true at all about reality.⁶ They are suddenly freaked out by a basic implication of Hume that they've been blocking for 200 years.

Of course the term 'confirmation bias' is itself a symptom of some kind of confirmation bias! Because it suggests that there are things, over there, and there are interpretations, over here, and that those interpretations can therefore be biased. But this idea of objects over there and subjects over here is precisely what correlationism and its consequent hermeneutic circle is saying is impossible – or rather that it's a metaphysical factoid that you've smuggled into your view, pre-theoretically. Never mind that Kant himself smuggled in this view, which is the old Aristotelian – and I would argue, agricultural – portrayal of bland substances decorated with accidents.⁷ That's exactly what we can't assume things are like. It's the kind of thing that gives rise to ideas that bees are just blind robots while architects are gravity-defying subjects. Heaven help us, we would never, ever want to be denigrated to the status of a thing. Because we all know in advance that things are lumps. That's one reason why Object-Oriented Ontology has come in for lots of criticism. By saying object we come into contact with this third rail. And behind that, there is an even more sensitive third rail of beliefs about what entities are; sensitive because of the political implications. Sensitive because those beliefs are now hardwired into Earth's surface in a way so effective that millions of lifeforms are now going extinct in the Sixth Mass Extinction. Just last week the

6. Michael Suk-Young Chwe, 'Scientific Pride and Prejudice,' in *New York Times*, 31 January 2014.

7. Martin Heidegger, *What Is a Thing?*, tr. W.B. Barton and Vera Deutsch, analysis by Eugene T. Gendlin, Chicago: Henry Regnery, 1967.

WWF revealed that between 1970 and 2010 the populations of mammals, birds, reptiles, amphibians, and fish around the globe dropped by 52 per cent. This evokes a horribly uncanny feeling in us, and we want to carry on dreaming because it feels safer. And it's a 12,000-year dream.

The lack of obvious empirical evidence concerning imagination points to a much more efficient and much cheaper way of proving whether or not the best of bees is always worse than the worst of architects. What do we have already? We already have some sense that bees and ants with their very limited (according to our prejudice), tiny brains can do things that resemble some of our own activities. So by inference we aren't as special as we thought.

But we can go one step beyond this and think about the actual, really obvious state of affairs, which is that we lack reliable empirical evidence for imagination. Now I'm not saying there is no imagination. Far, far from it. What I'm saying is – prove that the architect has imagination. Prove that I have imagination, as a human being. Prove that I'm not executing an algorithm. More to the point, prove that my idea that I'm not executing an algorithm is just the kind of algorithm that I've been programmed to execute.

Being paranoid that I might not be a person is in fact a default condition of being a person. In other words, we have a profound philosophical hesitation here. It's so stimulating that we usually like to collapse the duality into one of its terms. For instance, we could decide that there is no imagination, that we are totally conditioned, a thought that is usually close to reducing things to matter. Thoughts are functions of brains and so on. Or we could say that there is personhood and that it's totally different from being a determined machine. We could perhaps back this up with some idea of mental *qualia* or the irreducibility of consciousness. What's interesting is that we are trying to get rid of profound wonderment. And since I take wonderment to be the basic phenomenological chemical of philosophy (as Plato does), we are implicitly trying to shut down philosophy when we take this path.

The point being, when it comes to bees and humans – prove that I, the human, am imagining. Prove it. If you have some difficulty doing so, that's fantastic. It means that you have accepted modern science, which means you have accepted modern philosophy. And if you try not to collapse the hesitation, like the hesitation of an ant on

**'We lack
reliable
empirical
evidence for
imagination'**

a tiny ladder, that's even better. It means you have accepted the deep reason for the validity of modern science and philosophy.

You have not collapsed the wonderment. You are beginning the difficult upgrade of concepts such as person and thing so essential to human thought in an ecological age, and indeed so essential for the continued existence of lifeforms.

In short, you are beginning to think at Earth magnitude.

At Earth magnitude, anthropocentric distinctions don't matter anymore. Or better, they cease to be thin and rigid. They matter in amazingly different ways. These distinctions include binaries such as *here versus there*, *person versus thing*, *individual versus group*, *conscious versus unconscious*, *sentient versus non-sentient*, *life versus non-life*, and even *existence versus nonexistence*. Take evolution science. Quite quickly after biology was established as a scientific discipline, the problem with life as such began raising its head, such that the life–nonlife boundary became not exactly erased, but far from thin and rigid. The same happens to sentience, consciousness, and in an ecological age, between the human and the nonhuman altogether, notably such that ideas like *world* and *here* begin to look not like big abstract concepts, but rather small, localised, and human-flavoured. Not that there is no such thing as place. The very idea that space is the real one, because it's just abstract extension, is the one that begins to melt – we begin to see that it's based on a rather anthropocentric viewpoint, in all sorts of ways. Euclidean space is really a suitable human-scale way to describe motion.

So in evolution science you can't look at a duck and see what it's 'for' in some obviously human-flavoured way. Ducks aren't *for* anything. Ducks aren't for swimming, and Greeks aren't for enslaving barbarians – sorry Aristotle. Teleology is gone. It has evaporated. Hierarchies have collapsed. But there are still ducks, and humans, and Earth, and sentience, and lifeforms as opposed to salt crystals. They become more and more vivid as our ways of distinguishing them become more and more questionable.

This might not be what we were expecting. We might have been expecting, perhaps, that once we could see on a much greater scale, things would become much easier to understand. Indeed, we could criticise those who tried to think at larger scales for being simplistic. We could even argue that they were deluded. Particularly if we had quite a bad case of the anthropocentric blues. We could accuse

someone, if we were a certain kind of Marxist, of being a bit of a hippie for talking at scales bigger than the human or beyond it. The hippie is ideologically deluded into saying that things exist outside of social ideological mediation based on the state of the forces of production. In short, all that 'We are the World' stuff and 'Save the Earth' stuff is bourgeois pabulum meant to keep us docile.

Why does our Marxist have this allergic reaction? Because he is rigidly adhering to a solution to the Kantian shock – the shock that there are things, but when we look for them, we only find human-flavoured thing data. We never see the actual raindrop – we have raindrop feelings, raindrop thoughts, raindrop perceptions. Kant himself tries to contain the explosion by saying that there is a top-level way of understanding the raindrop, namely mathematising it via a concept of extension as the bedrock of what a thing is. Post-Kantians contain the explosion two ways. Either they reduce everything to matter and ignore the implications of modern philosophy and the science derived from it. Or they wish away the gap between phenomenon and thing by claiming more strongly than Kant that some kind of Decider, goo goo ga joob, makes the thing real. So all these powerful substitutes for the Kantian subject arise. *Geist* (Hegel), will (Schopenhauer), will to power (Nietzsche), *Dasein* (Heidegger – and we all know German *Dasein* is the best Decider of all).

And in the case of Marx, human economic relations. Human economic relations make things real. And in the hardcore Hegelian–Lacanian–Althusserian version, these relations are an in-the-last-instance that determine everything else like the sucker of a giant, sprawling undersea creature, attached to a rock in only one place, but attached so tightly that it cannot be peeled off the rock. So for the cultural Marxist, unconsciously retweeting a substance–accidents model of things, there is ideology (accidents) and human economic relations (substance).

Of course by putting it this way I have already committed a horrible sin, because I used the word 'human'. By using that word, I have implied that there might be a world or worlds beyond or different from the human, which is as good as saying that there are such worlds. I have touched the third rail. I have implied that Marxism doesn't explain everything, because there are cats, coral and galaxies. The very concept 'ecology', coined by Ernst Haeckel, was a way to say 'the economy of nature' in a compact way. The economy of nature.

Economic relations that include nonhumans. Highly suspicious. And humiliating – because now it means that claims to geopolitical whateverness aside ('geopolitical' being a term that is often used in certain forms of Marxism), what Marxism can't think precisely is the geopolitical! Oh dear. The very thing Marxism, like Hegel and Nietzsche, claims to do, namely to think everything sufficiently, is exactly what it can't do. It can't think at Earth magnitude.

So cultural Marxism lets fly a whole bunch of accusations against the sinners: they are racist, or sexist, or colonialist because they use concepts such as species. This is because species, in the non-teleological sense, and claims of thinking species-being notwithstanding, is precisely what Marxism can't think. This is despite Marx's grounding in Feuerbach, whose whole project was to show that species was not at all an abstract, universalistic generalisation, but a finite, concrete entity, though at a much larger scale than we normally think beings. And in an ecological age, this is a necessary scale. Because aside from being Tim Morton and aside from thinking that I'm a human being, I am actually a member of a species, *homo sapiens*, that has actually destroyed Earth, this actual species – not lizards or fruit bats.

Unfortunately, in the end species-being is another teleological concept in Aristotle's lineage. Humans produce, which means they imagine, unlike bees, which (I suspect 'which', rather than 'who', for the users of this concept) are just robots. And robots are just things. And things are inanimate, unconscious, lumps of whatever decorated with accidents. The perhaps predictable result is that scholars such as Dipesh Chakrabarty, the historian who writes about global warming, now get into trouble because they use the word 'species' (and related words).⁸

What is it like to think species at Earth magnitude? (If species isn't referring just to humans as I see them: in the superficial sense in which I can point to them, they are constantly present, I know in advance what they are, and so on.) In other words, what is it like to think species as a hyperobject? Because it's the notion of hyperobject that provides a way to think entities at Earth magnitude,

8. Dipesh Chakrabarty, 'The Climate of History: Four Theses,' in *Critical Inquiry*, vol. 35 (Winter, 2009), pp. 197–222.

hyperobjects being real entities that cannot be seen or touched or otherwise grasped – and yet we can think them. They are beyond the human, but they are not infinite or abstract. They are just really, really big.

This thought – thinking the human at Earth magnitude – is utterly uncanny: strangely familiar and familiarly strange. It is as if I realise that I'm a zombie – or better, that I'm actually a component of a zombie, without my willing it. Whenever I start my car, I'm not on a personal mission to destroy lifeforms – which is what 'destroying Earth' actually means. Nor does my action have any statistical meaning whatsoever. And yet, mysteriously and disturbingly, scaled up to Earth magnitude so that billions of hands turn billions of keys in billions of ignitions to start billions of engines every few minutes, the Sixth Mass Extinction Event is precisely what is being caused. Regardless of whether I'm thinking this thought or not, whether I mean to or not, even whether or not I start my own personal car! So, back to that question: am I conscious? Prove that I'm not better than the best of bees. Prove that my idea of consciousness, let alone individual free will, is not just the kind of algorithm that my particular species has evolved to run.

The species thought, stripped of its metaphysical, easy-to-identify, soothingly teleological content, is precisely an uncanny thought that happens not in some universal or infinite realm but at Earth magnitude. It is strictly uncanny in the Freudian sense, if we recall that Freud argues that uncanny feelings in the end involve the repressed intimacy of the mother's body, the uterus and the vagina from which a human emerges. This is very significant for us, because thinking this mother's body at Earth magnitude means precisely thinking ecological embodiment and interdependence. That uterus *is* not just a symbol of the biosphere, nor is it even an indexical sign of the biosphere, pointing to it like a footprint or a car indicator. The uterus is the biosphere in one of its manifold forms, just as me turning the key in the ignition *is* the human in one of its manifold forms. It is, and it isn't, which is how you can tell it's real. To be real is to be contradictory, to be a member of a set that doesn't include you. To be real is to not be easy to identify, easy to think, metaphysically constantly present.

Freud arrives at this notion of the mother's body by thinking of how the uncanny is excited when the seemingly rigid boundaries

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between life and nonlife, or between sentience and non-sentience, become confused.⁹ Is an android alive? Am I alive? Is an android sentient? Am I sentient? This paranoia is evidence of being physically embodied in an irreducible way. Descartes, before he assures himself that God couldn't possibly pull such a stunt, is paranoid that he might just be the puppet of a demon.¹⁰ Being a person means being concerned that you might not be a person. Because there you are, pre-theoretically in Descartes' case, sitting by a fire and holding a piece of paper in your hand.

And being embodied means being the biosphere, in the same way as the uterus and the hand turning the key are the biosphere. Being it and not being it.

Ecological awareness is uncanny like that. Freud thinks of being 'lost in a forest' and returning again and again to the same spot, like someone in the *Blair Witch Project* or a Cure song. This being lost is already sexualised, in a misogynistic way, because the previous example, in the very same paragraph, is about being lost in a red light district, trying to exit and coming back again and again to see the prostitutes, described by Freud somewhere between life and nonlife, puppets in a window who look at you and ask you to buy them. (We could go on a huge digression now about how all of consumer society is animistic.)

Realising we are on Earth, in the full Earth magnitude way, realising that we are permanently phenomenologically glued to Earth even if we go to Mars, realising that we are covered and brimful of skin, pollution, stomach bacteria, DNA from other lifeforms, vestigial organs – realising all this is to experience the uncanny. Try to strip it away and you are doing exactly what caused the ecological disaster in the first place, i.e., trying to come up with one antibacterial soap to rule them all since 10,000 BC. One extreme symptom would be Nazism, trying to peel the abject embodiment off oneself once and for all. Or you can become excited about the uncanny. You can get stuck there. You can revel in pointing it out, over and over.

9. Sigmund Freud, *The Uncanny*, tr. David McClintock and Hugh Haughton, London: Penguin, 2003.

10. René Descartes, *Meditations and Other Metaphysical Writings*, tr. and intro. Desmond M. Clarke, London: Penguin, 2000.

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**'There is
no one
antibacterial
soap to rule
them all'**

You can get stuck in the uncanny, because of the predominance of misogyny. Like Freud and any number of speculative realist horror philosophers, or the world's greatest Hitchcockian–Lacanian, you can juice yourself over and over again with this uncanniness. It's addictive. If you stay there, it means you aren't really acknowledging the depth of ecological awareness. Because one's mother's body isn't some abject disgusting thing from which one must tear oneself philosophically, even though birth involves tearing and fluids and pain on all sides. One's mother's body is the biosphere. Underneath the disgust and the horrific uncanny is a kind of melancholia, another Freudian term pointing to the indigestible physical and psychic memory trace of other beings within oneself. Indigestible, because there is no one antibacterial soap to rule them all. Once you think you've eliminated one, along comes another, like the hydra's many heads.

So you can get stuck in tragedy, like Wagner and the Nazis, the tragedy of realising that trying to escape the web of fate *is* the web of fate.

And within the melancholia is an unconditional sadness. And within the sadness is beauty. And within the beauty is longing. And within the longing is a plasma field of joy. Laughter, inside tragedy. Comedy, the possibility space of which tragedy is a rare form. Comedy, the form of coexistence. One's uterus or stomach is finite, and insofar as they are finite they exist. To exist is to be finite, which is to be incomplete. In this I am the absolute opposite of Badiou, who insists that to exist is to be consistent. For me to exist is to be fragile, because you are never complete.

To be a biosphere, then, is to be fragile, incomplete, inconsistent and finite. It's the same with species. These are just very large objects, thought at Earth magnitude, but they don't go on forever. There is weirdly less of everything than we might suppose. We don't need to be holists and think that biospheres are more than the sum of their parts. That would be awful. That would mean that the parts of a biosphere are replaceable components, so never mind about the Sixth Mass Extinction Event.

Instead, it's much better, and much more accurate, to think of it this way. A biosphere is a set of things that aren't it: a frog, a glass of milk, thoughts about biospheres, a blade of grass in a meadow. To appreciate biospheres and frogs and blades of grass, not to mention

sounds, thoughts and political systems, we need to allow things to be contradictory, which in set theory means allowing sets to contain things that aren't members of them.

We can take some comfort from the fact that the attempt to smooth out logic to exclude things that contradict has never worked. This is because, I intuit, there is something about reality that is also contradictory, namely there is something about being a thing at all that involves deep, intrinsic contradiction. It has been convincingly shown that to be true on its own terms, a logical system must be able to talk nonsense – including a logical system that has excluded, explicitly, any kind of nonsense from being spoken. Indeed, the more efficient at it the logical system becomes, the worse the nonsense it can speak. Which is uncannily – but not accidentally I feel – exactly the same as breeding superbugs by washing with stronger and stronger antibiotic soaps, or how to start global warming by trying to avoid global warming, the geological-time history of the last 12,000 years condensed into a single handy phrase.

Turing proved Gödel's incompleteness theorem – which I've just paraphrased, by imagining a physical machine that could process algorithms by reading tape. No such machine could be programmed to predict when every other Turing machine would go into an infinite loop or not. Since Turing's proof involves physical objects, again I think there is an uncanny pointer here to actual physical objects such as plutonium and quasars. To exist is to be capable of disassembling, of appearing otherwise than you are, and yet to be none other than you are. To be tricky.

Thought at Earth magnitude also reveals itself to be a trickster. Thought itself goes into a loop, or rather its loop form becomes incredibly obvious, even if you aren't a gnostic. *Jñāna* or *yeshē* or gnosis means a kind of knowing that is intrinsic, knowing all by itself, a sort of nonhuman knowing that just happens without me willing it. This knowing knows itself as one of the beings that it knows – it is thought in a loop, or as a scholar of Gnosticism puts it, thought having sex with itself. This is fantastic, because it means that within the structure of thought itself is the strange strangeness, the otherness, the non-you entity-ness that we also find unconditionally in the beauty experience. We don't need endless empirical evidence to prove that something other than me exists. We just need a thought that seems to many like narcissism, because it is. What we need is

an upgrade of how we think narcissism. Because in the end, caring for the self is erotically caring for the other, in what could become an ever-expanding circle, or better spiral, of erotic care for all beings.

So no, thought at Earth magnitude is not grown-up thought that has accepted some preformatted reality principle and finally sees what pathetic little idiots we are, Nietzsche-style. Thought at Earth magnitude sees the cosmic joke that things like Earths and biospheres and species are also toy-like, necessarily incomplete entities that could evaporate under their own steam let alone something else's. Indeed, how they cease to exist is when one form of appearance – say a sound wave of sufficient amplitude and frequency – interferes with the way they appear, such that the rift, an invisible and irreducible rift, between what they are and how they appear becomes weirdly wider and wider, until all you are left with are appearances: memories, some flowers in a jar, a leftover piece of sandwich; or in the classic experiment of opera singer versus glass, fragments of glass, physical glass-memories, a glass only legible in the tiny chips that are strewn all over the floor. Even black holes evaporate.

So thought at Earth magnitude cannot possibly involve contempt or cynicism. It must instead involve a caring sense of hypocrisy, a compassionate laughter that one can never, ever get the ecological recipe just right so as to save all lifeforms all at once, all the time. Because very simply, if you're being nice to the bunny rabbits, it means you aren't being nice to the bunny rabbit parasites. Something is always missing from the ethical and political jigsaw, because something is always missing from the ontological jigsaw. So peel yourself off the floor and start to smile.

On L_{on}g-Wa_{ve} Syn_{th}es_{is}

Raviv Ganchrow

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On 12 October 2014 Raviv Ganchrow gave an on-site research presentation of his large-scale infrasonic project *Long-Wave Synthesis*. The prototype was installed on a site close to Høybuktmoen, Kirkenes' airport, in Norway's northern extremes. In the months leading up to the presentation Ganchrow explored the outer edges of infrasound and the Northern sonic context, he made recordings, developed loudspeakers, and performed tests, working towards a land-art-scale sound installation. As he makes clear in this transcription of the lecture he delivered outdoors at the installation site, he discovered that we have only just begun to comprehend infrasound.

Raviv Ganchrow – This is a research presentation about a large-scale outdoor sound installation I'm working on titled: *Long-Wave Synthesis*. What you see and hear is not really the work itself yet; it's a gesture towards what the work can become. The piece is still very much in flux in terms of how it is going to manifest landscape. In this talk I want to share with you some insights into the different trajectories connecting to this piece.

Long-Wave Synthesis was one my 'drawer projects' – an idea sketched out on a piece of paper and dated and dropped into a drawer. Most of the drawer projects will never be realised, but I keep them there to remind myself that I had a particular idea at a certain moment in time. *Long-Wave Synthesis* waited in the drawer for at least three years until suddenly the context of the North and the issue of perceptions of landscape converged in the *Dark Ecology* project. Kirkenes is the optimal setting to test this idea of long-wave synthesis. The practical side of the work is based on an extension of a technical principle to produce sound *fields* rather than sound *sources*. In wave-field synthesis the coordination of phase and amplitude on a group of transducers allows for the *production* of acoustic territories rather than the *reproduction* of a sound. This aspect, and the ways sound weaves itself back into the structure of our acoustic environment, are what initially interested me in wave-field technology. This physical property is also the aspect that links back into the notion of landscape. In that sense, when a field recording is played back on this outdoor system, it does not appear

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Raviv Ganchrow, *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014. Overview of the site.



Raviv Ganchrow on the site for *Long-Wave Synthesis*, installation, work-in-progress, Kirkenes, Norway, *Dark Ecology*, 2014.

as a mimetic copy (as field recordings often do in indoor situations), but rather as a mediating element that permits points of entry into aspects of the immediate surroundings that we wouldn't be able to access otherwise.

Empirical experimentation is a crucial component in the development of this work. There is a whole experiential side to it that is very hands-on. There are theoretical interests driving the project, though the practical development really has to do with a long trial-and-error process. What you hear now on-site is, I hope, just the foretaste of what is yet to come. To explain the technical challenges a bit more: I'm trying to figure out how to transport large amounts of air. I have discussed this with several engineers. The primary frequency band for *Long-Wave Synthesis* is below 20 Hz. Those are physically long waves. 20 Hz is often mentioned as the lowest frequency that we humans can hear as a continuous tone. Below that, sound is still audible to a certain extent, but it is mostly perceived as pulses or tactile pressure. The initial plan was to be able to go down to around 4 Hz, in other words, frequencies in a range of roughly 10 to 85 metres long. But the deeper I immerse myself in the subject of infrasound, the more I realise that some of the tones in our immediate environment are much, much longer than that. Through this piece I am developing an awareness of a vast territory that I didn't know existed. *Long-Wave Synthesis* started with a question about the perception of landscape in relation to long-wave vibrations, and has now grown into this incredible, and mostly inaudible, world of colossal acoustic waves. This brief talk will reveal only a fraction of that world, as there are many aspects to it. Much of it has to do with discoveries in the nineteenth century that sparked fields of research that are still being pursued today.

The sound that we're hearing in the installation now was recorded just a few weeks ago, on 12 September, on an array in Bardufoss. 'IS37', as it's known, is an array of infrasound sensors that stream these sounds to a facility in Vienna, along with 49 other synchronised locations around the globe. And this is where it starts to get interesting in terms of the scale of the sonic events that are being addressed. An attention to the scale of such vibrations unravels particular perceptions of the surroundings. In simple physiological terms, the frequency band the human organism is oriented towards is roughly at a scale that interacts with small-

to medium-sized objects in our environment. In contrast, the scale of infrasound interacts with the scale of topography or even of the atmosphere itself. In other words, the landscape, the globe and its gaseous surroundings impart aspects of their properties to the propagating waves.

Part of my research involves investigating the acoustic properties of land – not in terms of some abstracted soundscape but rather in terms of the concrete transmissive properties of local materials and geo-activity. The higher terrain here in Norway is covered with a very specific kind of tundra lichen that Kirkenes-based curator Hilde Methi has told me is called 'lav'. The reindeer 'luv' it. It's their favourite food and in fact is generally known as 'reindeer moss'. What's interesting is that it provides a kind of anechoic layer on the ground that creates very specific outdoor acoustics where direct sound is accentuated and ground reflections are diminished. Part of the reason you can hear the fine details in these clicks so clearly (sounds from the installation at the site) is because of the vegetation on the ground. Sound is able to travel horizontally unobstructed, while angular surface reflections are absorbed in the vegetation. During the research residency we tried to record a variety of infrasound sources with experimental methods using ground transmission as well as really large-scale transducers – which were actually loudspeakers that were being used as microphones. We visited a reindeer herd that was being tagged. There's something interesting about the sound of hooved animals moving through a landscape that may go back to some latent prehistoric form of attention. There is currently an attempt in the archaeoacoustics community to rethink certain ritual activities in early societies. Take petroglyphs, for example: Steven Waller proposes a hypothesis that the act of image-making is not only an act of drawing, but is also an act of drumming. Pre-literate cultures didn't have this kind of separation of the senses or the separation of disciplines that we have grown accustomed to. The suggestion is that in such cultural contexts there is no clear division in ritual activity between acts of painting, sculpting and sounding. The boundaries between such activities were more fluid.

For instance, the Hall of Bulls in the Lascaux Caves is thought to be a ritual site for re-enacting the sound of herds moving through the landscape. Interestingly, only hooved animals are depicted in the

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Hall of Bulls. It's also the most resonant cavern in the Lascaux Cave complex. The suggestion is that drumming, painting, and landscape are connected. I don't know if you've ever had a chance to hear a wild herd, like the Tibetan kiang, in full gallop. Even in this day and age, with our modern tuned ears, these wild donkeys, galloping across dried salt flats, create a powerful sonic impression that stays with you. We were out there making recordings of reindeer as they move across dense ground. Some of the sensors available nowadays are sensitive enough to pick up these vibrations. It would be interesting to make recordings like this in every season, particularly in winter when the ground is frozen and vibrations transmit differently.

In prehistoric Scandinavian cultures there is a curious artefact named *brummer* – or 'bullroarer' in English. It consists of a large stick or a flat piece of stone, attached to a string, which is twirled and rotated. No one really knows exactly what purpose this simple tool served but it does produce a very low drone, which travels very well over long distances. It's thought to be a kind of Stone Age precursor to wireless communication. Here in northern Norway they found a *brummer* in Tuv that is at least 5000 years old. In other words, attention to large waves, and their role in perceptions of the geo-physical, extend quite far back in time.

Humans, in fact, occupy a rather quiet zone in air. There is tranquillity in our bandwidth. An interesting thing happens with the introduction of audio amplification – it spawns an idea of zooming into materials, listening-in on vibrations of matter itself. Such preoccupations appear in works of John Cage but also in texts of the Futurists; it has to do with an awareness that arises from the experience of amplifying small sounds. Nowadays there are even molecular microphones where you suspend a small glass bead in a laser beam to record tiny movements. This method has made Brownian motion audible – interestingly, it sounds just like Brown noise. But sonic activity also occurs when zooming out. If you scale things up to these larger sound events, you enter a bustling bandwidth. Infrasound is continuously roaring, although we can't hear it, and is filled with an astounding variety of events.

One central aspect of this spectrum is that it literally connects the solid earth to oceans and weather, as well as to modern industrial practices. At a particular point in the project I suddenly realised that infrasound is actually the bandwidth of the Anthropocene.

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If there is a bandwidth in which the Anthropocene registers, it's in infrasound. We generally tend to think of it in terms of chemical and mineral evidence, if we consider these large-scale transformations in spectral terms instead, then environmental infrasound exhibits an intermingling of large-scale human industrialised activity with these other earth- and atmosphere-related frequencies.

To give you an idea of the diversity of events that occupy infrasound: you can hear exploding meteors. The Chelyabinsk meteor that fell in 2013 is the largest infrasound event recorded to date on the global infrasound-sensing network. They were able to trace its trajectory and pinpoint its location and the magnitude of the explosion based on infrasonic evidence. The meteor disintegrated about 50 kilometres above the Earth's surface. The air in the atmosphere is dense enough to cause friction that makes meteors glow and often explode. The friction and explosion produce ripples, which travel around the globe in the zone between the surface of the Earth and the upper atmosphere. In the atmosphere there is sonic activity up to an altitude of nearly 100 kilometres. Of course, we need a medium like air to transport vibrations, but the interesting thing about it is that it's still proper sonic energy even if we go much, much lower in tone. It's still about sound, at least in the acoustic sense of the word.

Collapsing arctic glaciers produce a lot of infrasound; volcanic eruptions have a typical frequency between 1 and 5 Hz, which is actually a rather fast fluctuation in that bandwidth. Auroras – which are another category of infrasound – move huge amounts of air tens of kilometres up in the sky that can actually transmit to ground level. There's still some mystery around aurora sounds. Some researchers in Helsinki, as well as here in Norway and in Canada are studying this phenomenon. There is recorded evidence of aurora-related infrasound propagation. But there's another sound phenomenon, reported in aurora sightings, of much higher frequency. No one knows exactly what could be causing it and indeed if it really exists at all. The sounds are apparently very subtle and are only rarely heard. There's a lot of anecdotal information about them – one study from the 1970s collected nearly 200 anecdotal reports of aurora-related sounds, though to my knowledge no recordings have managed to capture them yet. There are many theories of likely causes for such effects, for example,



Raviv Ganchrow, *Long-Wave Synthesis*, installation, work-in-progress, Kirkener, Norway, *Dark Ecology*, 2014. The concrete structures were enclosures for planes during World War II.

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Raviv Ganchrow, on-site research presentation, Kirkener, 12 October 2014.

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infrasound friction activating ions in the air that then discharge at ground level. My personal favourite though is called 'Electroponics', which proposes that immense amounts of electromagnetic radiation emitted by these auroras project down into the ground and charges plants and the materials in the surroundings with electrical potential. So what you would be hearing is locally produced material vibration caused by the discharges in the surrounding environment. Small-scale versions of this phenomenon have been recreated in the laboratory, but there is scepticism about whether auroras can produce such an amount of electromagnetic transmission. Nonetheless, the theory proposes that in certain conditions the environment itself behaves like a loudspeaker, and that is exactly what interests me: that this technical device so ubiquitous in man-made environments, with its basic coil and cardboard cone construction, may also manifest elsewhere naturally. Maybe there's a natural history of loudspeakers as much as there is one for radio.

In terms of anthropogenic contributions to the infrasound spectrum, we have mine explosions propagating in the ground and the air, such as the weekly detonations from the local Kirkenes mine that I haven't managed to record yet. Re-entering space debris (almost daily), aircraft sonic booms, oil refinery gas flares, and of course nuclear testing are all part of that spectrum. Particularly nuclear testing created a spike in man-made infrasound that also catalysed research into this bandwidth.

There's a difference between just making sound in a room where a certain amount of acoustic pressure can build up, and interfacing with the shifting surroundings of the open atmosphere. The strange thing about low frequencies, especially those below 15 Hz, is that they no longer obey the inverse-square law for loss of energy that the rest of sound adheres to. The physics of long waves is therefore a special case in acoustics. In the spectrum we do hear – from 20 Hz to 20,000 Hz – sound energy tends to decay rapidly as the distance from the source increases. Infrasound doesn't have that problem; it just continues to propagate. The lower the frequency, the less the resistance from the environment – in effect some of these sounds can travel thousands of kilometres. It also has to do with the fact that certain sounds in this bandwidth deliver massive amounts of energy at magnitudes greater than those we are used to in the audible spectrum. That level of energy along with the

near lossless propagation even allows these sounds to circumnavigate the globe. Other factors that help infrasound propagate are differences in atmospheric temperature and prevailing winds. If you look at the atmosphere in sections, it's really interesting to see what happens up to the thermosphere in terms of these various hot and cold zones. The polar jet stream, which is a continuous movement of wind between a pole and the equator, and is exploited by airplanes that surf on it to increase speed and save fuel, acts as a kind of refractor for ascending sound, bending it back down again. Sounds that manage to get beyond the jet stream travel along a different atmospheric layer. Physical properties of the atmosphere, with its prevailing temperature and wind conditions, are like a vast ductwork through which these large waves travel.

The specific part of the spectrum and the prevailing temperature inversions create different conditions for the propagation of long wave frequencies. Interestingly, there does seem to be a lower limit to the bandwidth. Láslo Evers, an infrasound researcher in the Netherlands, mentioned that the highest sampling rate for recordings at the Royal Dutch Meteorological Institute (KNMI) infrasound array is 40 Hz. In other words 20 Hz waves are the highest pitches they want to bother with. When I asked 'What's the lowest tone of interest?', he said 'It's 500 seconds'. That's one cycle of a sound every 500 seconds. We would need to wait more than 4 minutes for one half of the phase of the tone to pass by. We're talking about a sound wave that is 171 kilometres long. Apparently this is the frequency cut-off of the atmosphere itself, bounded by the thickness of the atmospheric level through which long waves travel. At a certain moment I realised this was no longer sound as we know it. The *Long-Wave Synthesis* project had crossed a threshold where it interfaces with weather, with barometric pressure. When pitches slow down they resolve into pulses. When pulses slow down even further, they sustain in barometric conditions. When you go below 0.01 Hz, the amount of air that is occupied in one cycle of the sound becomes so heavy, that gravity starts to interact with the sound. There's a phenomenon called acoustic-gravity waves, and gravity waves in physics, where the force of air-mass displacement is counteracted by a restoring force of gravity, sort of like the ripples at the edge of a pond. Below 0.002 Hz, gravity waves take over from acoustic waves, and that is incidentally the 500-second cut-off frequency of the infrasound array at KNMI.

What all of this means is that the Earth's physical features start to interact with, and even create, such sounds. One example is mountain ranges. A mountain range of a certain height, coupled with a prevailing wind direction, can generate eddies that produce standing wave patterns. In certain areas of Germany and Switzerland, for instance, people have complained about what they call the 'hum'. The hum is a really interesting phenomenon. There are numerous conspiracy theories around such phenomena: one idea is that HAARP or other large technical facilities are somehow responsible for these sounds. One possible explanation is that mountain ranges interact with sound, producing very low, continuous sounds that can last up to three hours. Still other explanations point towards thermal and electromagnetic activity in our upper atmosphere that may produce very low drones. But the explanations don't interest me as much as the fact that people are expressing a particular kind of awareness of environmental sounds and that infrasound is summoned to provide the answers. At the very lowest end of the infrasound scale is the Earth's rotation itself: the friction between it and the atmosphere apparently also creates a tone.

Another interesting thing about infrasound is that it comes out at night. Why at night? It's because of differences in air temperature. During the day, the ground is warm, and the hottest part of the air is just above the ground, becoming cooler and cooler the higher you go. In the evening there's a temperature inversion that acts as a refractive layer for infrasound that produces a kind of waveguide that animals tend to exploit. For instance, lions, wolves and particularly elephants use infrasound for communication and they seem to be aware of this environmental characteristic. Elephants can produce deep tones on the infrasonic scale. They make their territorial calls at sunrise and sundown because they seem to know that their calls will travel much further. They can hear sounds from another herd up to ten kilometres away. At night it is possible for an elephant to have a calling territory upward of 300 square kilometres; during the day it's roughly half that.

This 'dark side' of infrasound also has other manifestations. If you type 'infrasound' into a search engine, you'll get a slew of hits linking physiological discomfort and even haunting with infrasound. An often-cited example is that of Tony Lawrence and Vic Tandy who proposed that standing waves of particular frequencies induce an



Raviv Ganchrow, custom-made *speakers* for *Long-Wave Synthesis*, installation, work-in-progress, Kirkener, Norway, *Dark Ecology*, 2014.



Raviv Ganchrow, *Long-Wave Synthesis*, prototypes for the installation, 2014.



Raviv Ganchrow, custom-made *speakers* for *Long-Wave Synthesis*, installation, work-in-progress, Kirkener, Norway, *Dark Ecology*, 2014.

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equally specific range of affects in people. More precisely, they were trying to link the sense of the uncanny to a specific bandwidth and the resonance responses of the body. They found that a strong sense of discomfort, perspiration and even breathing difficulty is apparently connected with kinaesthetic immersion in 19 Hz. There could be different interpretations of such an idea. Evolutionists will argue that it has to do with some latent attention to the sounds of predators and that we fear deep tones because only lions and elephants produce such sounds, and therefore to us they represent an immediate threat. Tandy and Lawrence took a slightly different angle by citing a study where 18 Hz was also identified as the frequency at which, apparently, the eyeball starts vibrating in resonance, causing visual smearing. They suggests that exposure to low-frequency standing waves not only provokes psychological responses, but that physically shaking the eyeballs could account for visual aberrations associated with supernatural phenomena. Whether or not either of these explanations is feasible is still up for debate, but I'm more interested simply in the fact that in this contemporary moment of sonic awareness, we seem comfortable drawing correlations between enumerated fluctuations, material notions of the body and physiological categories of perception.

There is also ample online discussion of the supposed negative effects of exposure to very low frequencies, particularly with groups such as wind turbine opponents. Vladimir Gavreau, the Russian/French robotics engineer, whose name you might know if you're familiar with the history of sonic warfare, is an example. He applied a physiological hunch to develop an infrasound weapon. Gavreau's research group stumbled across the effect when the team mysteriously fell ill due to infrastructure anomalies in the workspace. The source of their illness, described as recurrent bouts of nausea, was traced to exhaust fans in the building. Apparently the rotation of the fans was causing a resonance in the ducts that subsequently produced a 7 Hz standing wave pattern in their workspace. Gavreau's experimental sonic weapon, an infrasonic whistle, was designed to produce and enhance such tones.

Our awareness of infrasound dates back to the eruption of Krakatau in Indonesia in 1883, where the eruption was recorded in weather stations around the globe on barographs, which are barometers that trace lines indicating air pressure fluctuations

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onto graph paper. The eruption was recorded in Washington, Toronto, Aberdeen, Mumbai, Melbourne and South Georgia. The sound was powerful enough to circumnavigate the globe seven times, in some places continuing to register on barometers five days later. Before this, no one had any idea that pressure waves could travel such long distances.

Intensive research into infrasound detection truly started in the trenches of World War I and had to do with attempts at long-range artillery gun detection. The first primitive infrasound 'microphones', constructed from Helmholtz resonators and electrically heated wires, were developed at that time. Part of that history resonates with this site in Kirkenes. It used to be a shrapnel hangar from the Luftwaffe's Ice Sea Fighter Wing. During World War II, Kirkenes was one of the main staging grounds for air raids on Murmansk in Russia. If bombardment threatened, the planes were moved from the airstrip and parked between these walled enclosures. Each enclosure is oriented in a slightly different direction, such that if a bomb exploded, pressure waves and shrapnel dispersing horizontally would only take out one plane at a time. In other words, if the bomb exploded on the open side of the enclosure, only that one aircraft would be destroyed, but the three others in adjacent enclosures would still be operational. By the end of the war, there was a very specific awareness of pressure waves, their effects and how they propagate in a landscape. Paul Virilio has pointed out that Atlantic wall architecture, extending all the way up here to Kirkenes, is designed to deflect shock waves not only spreading in the air but also rippling through the ground. The sheer force of wartime bombardment was such that it sometimes made the soil more liquid than solid. The invention of high explosives and developments in aviation are central protagonists in the human component of the infrasound spectrum. Detection techniques in World War I involved cross-referencing data from scattered monitoring stations. But the major advances in such detection methods occurs between 1945 and 1958, with developments in nuclear technology and the detonation of more than 250 atomic devices.

Nuclear blasts were among the first man-made events that caused infrasound to circumnavigate the globe in a similar way to large-scale volcanic explosions. The Tsar Bomba nuclear weapon detonated in 1961 in the eastern Barents Sea region

created infrasound that travelled around the globe several times, mimicking the Krakatau explosion. If a nuclear device explodes in the atmosphere, everyone knows about it, you can register it, you can even hear it over great distances. Pressure waves from the Tsar Bomba were strong enough to shatter windows in Norway and Finland. Explosions underground are much more difficult to detect, however, unless coordinated sensors are placed at multiple locations around the globe. Underground detonations transmit over such long distances that if recordings made thousands of kilometres apart are cross-referenced, the exact location, time and even the magnitude of an explosion can be determined. The idea for an extensive sensing network has its roots in the Cold War but the technology is still being improved and expanded. In other words, these interests are not relics from a bygone era. For example, the NORSAR Bardufoss microbarometer array was set up last year and officially inaugurated only a few weeks ago. Other large-scale arrays – components of the same global monitoring system from as far away as Chile – stream back data via radio and satellite to Vienna's Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) headquarters. The Comprehensive Nuclear-Test-Ban Treaty, only adopted by the UN General Assembly in 1996, provides nuclear test monitoring guidelines for an International Monitoring System (IMS) that is still under development. The IMS recorded nuclear testing as recently as 2013 beneath North Korea. Currently, 50 infrasound stations are operational; this number is expected to rise to 60 when the network is complete. It's interesting to see how this technology continues to develop in tandem with the culture of fear. At the same time, simply the existence of such a global network is an invitation to investigate our atmosphere in new ways. Researchers analysing this data are discovering all kinds of things about the behaviour of the atmosphere, the ocean, and volcanic activity.

I'd like to conclude this talk by describing some aspects of the two prototype 'loudspeakers' and the sounds that are incorporated in the work. The high frequency that you can hear, the kind of pulsing sound, is simply a real-time playback of the Bardufoss recording of infrasound that is directly converted to air pressure. Instead of outputting gradual waves, the pneumatic mechanism simply outputs an on-off signal. The resulting polyrhythmic pattern you hear, which is a kind of skeletal structure of the infrasound waves, is a record of all

the raw infrasound as it passes through that geographic location. The second rotary transducer exploits variable pitch impellers to push large quantities of air. The drone sound it's producing, which seems quite low, is in fact playing back at 80 times the rate of the original recording. I've sped it up exactly to the point where you can just start to hear 'microbaroms'. Microbaroms are affectionately known in the scientific community as 'the voice of the sea'. In early low-frequency research, they couldn't figure out why this part of the spectrum of infrasound was always saturated on barometric registers, regardless of their location on the globe. In 1939 two scientists in Pasadena figured out that it was caused by large-scale oceanic behaviour. Specific weather conditions create a very slow rising and falling of the entire surface of the water, which acts as an enormous drum producing infrasound that can propagate for thousands of kilometres and penetrates the upper reaches in the atmosphere. What you're hearing here is likely to be storms off the coast of south-west Iceland. If you tune in to this particular bandwidth – even if you're in the middle of the Sahara desert – you will hear these sounds. Láslo Evers mentioned that if I build an infrasound sensor and I don't hear this drone, then something is wrong with my sensor. This is apparently one of the most pervasive sounds in our atmosphere.

My aim for the *Long-Wave Synthesis* project is to continue developing one of those two sounding strategies and expand them into a larger array, capable of generating sonic territories that can then be explored through walking.

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Long-Wave Synthesis for

pneumatic compressor, 10 bar pneumatic hose, pneumatic transducer, birch plywood compression, motor-vehicle pistons, auroral air displacement, barometric pressure, Barents Sea offshore rig gas flares, wolf howls, relative humidity, Lord Rayleigh, pressure waves, travelling waves, Atlantic Ocean standing waves (microbaroms), wind speed, wind shear, wind orientation, kinaesthetic orientation, air mass, skin pressure, meteorographs, stomach resonance, ear-canal depth, woollen hat transmission, frost, fungus, rusted metal, concrete walls, mobile listeners, weather suits, shrubbery absorption, discarded wooden panelling, assorted gravel, distance between air molecules, mountain range turbulence, pond oscillations, moss, rock surface texture, thickness of atmosphere, Earth circumference, 15" transducer, jet stream shear, stratosphere circulations, troposphere temperature inversion, Earth rotation drag, space debris re-entry, asphalt friction, reindeer hoof impacts, soil conduction, shoe-to-heel transmission, shock-wave reverberation, impact engineering, iron ore mining, calving arctic glaciers, TNT, WWI gun-sound ranging, Icelandic volcanoes, chemical explosions, nuclear proliferation, CTBT nuclear-test-ban monitoring, long-range communication, XLR signal cables, speaker cables, 240 V power cable, 24 V signal-multiplication circuit, 400 Watt amplifier, power phase inverter, 1200 Watt power supply, 4.5 kW diesel generator, thunder, jet engines, meteor explosions, supersonic flight, Krakatau, Kirkenes Airport, Luftwaffe's Arctic front, impeller acoustics, 1440 rpm rotor transducer, 2.4 GHz laptop computer, 5000 year old *brummers* (Scandinavian bullroarer), 500 sec waveforms, 4 AM snow crystals, 24-hour recording from Bardufoss' IS37 array 12 September 2014.

Acknowledgements

Long-Wave Synthesis is a collaborative project. Any project of this scale – my initial intention was to create an installation that would cover an area of one square kilometre – is necessarily collaborative. There are logistical aspects such as negotiations with the Norwegian military to use the site, there are regional issues such as the local sonic context, contact with the scientific community of infrasound researchers, and institutional dialogue with research facilities, all of which are important components in the project. In this respect I would also like to thank the Royal Dutch Meteorological Institute (KNMI), where I've been in contact with Láslo Evers, one of the foremost experts on infrasound, as well as Jan Fyen, Svein Mykkeltveit and Michael Roth at NORSAR, the Norwegian research foundation that runs and maintains infrasound and seismic arrays at locations around Norway. I really have to thank Hilde Methi, Guro Vrålstad, Eivind Sæthre, and the people in Kirkenes in general for their assistance in realising this work and trying to figure out what the Kirkenes context is all about. The municipal woodshop allowed us to construct some prototypes to test out here at the site. And finally I would like to thank the people from Sonic Acts for the commission and especially Annette Wolfsberger for her assistance throughout, as well as the Mondriaan Fund for supporting the project.

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Trying to
Understand
Things that
are Bigger
than Yourself

Interview with Mario de Vega

Carsten Seiffarth

In October 2014 German curator Carsten Seiffarth interviewed Mexican artist Mario de Vega. De Vega had just completed a new installation entitled *NODE* for Braunschweig University of Art that he developed during his stay there as an artist in residence. Just before the exhibition opened, the university decided that the work was too dangerous to show to the public. In his works De Vega explores different forms of radiation and electromagnetic pollution, and uses infrasound to probe the relation between sound and architecture.

Carsten Seiffarth To start with, could you say something about your background as a sound artist?

Mario de Vega I am an autodidact, and I'm interested in using sound and vibrations as my primary sources. This is probably also related to the fact that I grew up in a city of 25 million people. I'm not talking about the social aspect; I'm talking about the imposition of force, authoritarianism, capitalist structures, social disorder... I'm angry at what is happening in our time. And I think we should be angry at what is happening now. So that's how I use my work: to speak louder about certain things.

CS To enter your solo exhibition *SIN* (2013) at Laboratorio Arte Alameda in Mexico City, visitors had to sign a consent form.

MdV One piece in the exhibition in Mexico City used high voltages that could be dangerous for visitors. By the way, I must stress that it is not my intention to produce a violent act against anybody. It's a confrontation with existence. I provided information about what could happen and visitors could choose to enter the exhibition or not. The exhibition was in an old church that the Spanish Inquisition used from 1571 to 1820. It has a very intense history - people were tortured and killed there. Even though the space is used as a museum now, it's still a church, with all of the acoustic qualities you would expect. Another piece consisted of a low-frequency amplification system that was designed around the fundamental resonant frequency of the room where it was installed. The main idea was to try to make the eyeballs vibrate, which theoretically can occur with amplified 18.9 Hz signals. If you can do this, you can produce an image that isn't there.



Mario de Vega, *Absentia*, sculpture, video installation, photography and an editorial project, 2012-15. Bell cast with 550 kg of bronze that will remain silent until its destruction. Laboratorio Arte Alameda, Mexico City, 2013.

CS You worked with infrasound?

MdV One of my intentions was to amplify an infrasound signal. The problem was not producing the signal because one can be generated digitally or with an analogue source. The problem is amplifying it. After reviewing the possibilities, I decided to do it with membranes. The design of the speaker cabinets and the system that activates the membranes were crucial. Everything in this installation is analogue, and the system is modular, so one, two, five, or even eight modules can be used.

CS One of the installations in *SIN* had eight loudspeaker cabinets set up on the second floor of the nave. All the speakers were projecting 39 Hz into the space – the second overtone of the resonant frequency from the main nave – and it was a truly space-related, site-specific intervention. You could see a sound wave in the church going down towards the ground and coming back up again. And then another one. And the walls start shaking again. It was like a huge sound organism, a sonic whale moving around the space.

MdV By approaching sound as material, I think you can make sound visible somehow. You can see how the wave moves, how it reflects, how it collapses. You are there, confronted by this presence. This approach is about trying to understand things that are bigger than us. When you're in front of something that is larger than you, what you perceive doesn't have to mean anything. It's just there. It's stronger than you and it's bigger than you. And somehow, this confrontation produces an experience.

CS For the exhibition in the University of Braunschweig you wanted to use

eight or sixteen custom-built speaker cabinets because this work, *NODE*, uses pitches as low as 2Hz. Normal subwoofers cannot reproduce much below 28 Hz; frequencies lower than this usually break them. So special amplifiers have to be used. You made a modular system where each double sub(woofer) had its own analogue sine wave generator...

MdV Developing the work was a long and complex process. I'm not an electronics engineer, but I've had great help from Manfred Fox who advised me on the speaker cabinet design, and from my colleague Victor Mazón Gardoqui with whom I have developed several projects related to the threshold of perception. Victor and I have developed the technology to amplify and materialise signals at the edges of our perception. You can also tune the system, so that each speaker has its own voice. But you can send the same signal to the whole system if you want to. And rather than just having independent signals, each signal can also feed the others. So it's like a modular synthesiser, but simpler. To build all that wasn't easy.

CS What was the idea behind *NODE*?

MdV The piece explores psychological manipulation, fear and invisibility. First, to enter the exhibition visitors had to sign a consent form, which informed them of some of the symptoms that being exposed to amplified low frequencies could produce. After agreeing, visitors entered a pitch-dark space – it's important to me that the interface is not visible. It felt like an empty space. The reflection of the acoustic phenomenon in this room is very peculiar and I wanted to use these acoustic limitations. Once the system

had been tuned to the room, the room's acoustic reflections of the signal fed back into the signal again. It's similar to a feedback loop between a microphone and a speaker. The sound starts to behave like a living organism, it changes constantly, and there is continuous tension. Of course, the room starts vibrating and this movement is used to control different parameters, for instance, by using seismological devices. A voltage-controlled amplification system allows me to use various kinds of sensing devices to control, for example, the amplitude of the oscillator. It's more or less like the Ouroboros, the serpent that eats its own tail. This work provides a phenomenological experience by exploring how we perceive vibrations and how vibrations affect us.

CS Is it related to the conditions of contemporary life?

MdV I follow a phenomenological approach when developing my work. You have to experience the work yourself because it can't be documented. It connects to the human body and living systems. As living systems, alive in our time, we're exposed to plenty of danger. We are literally exposed to radiation. This is something that I'm particularly obsessed about. So when I speak about the limits of perception I am speaking about electromagnetic radiation. It surrounds us and has been steadily increasing for the last 25 years. It's mainly produced by wireless telecommunication. All these signals float in the air. It's quite possible that there are all kinds of diseases we don't know of yet – or viruses even, and variations of cancer – that are all associated with electromagnetic radiation and electromagnetic pollution. I can use art to speak about these things. An

artist can take an ethical position, and my ethics bring this topic to the table.

CS Can you tell me something about your new piece, *Dolmen* (2014)?

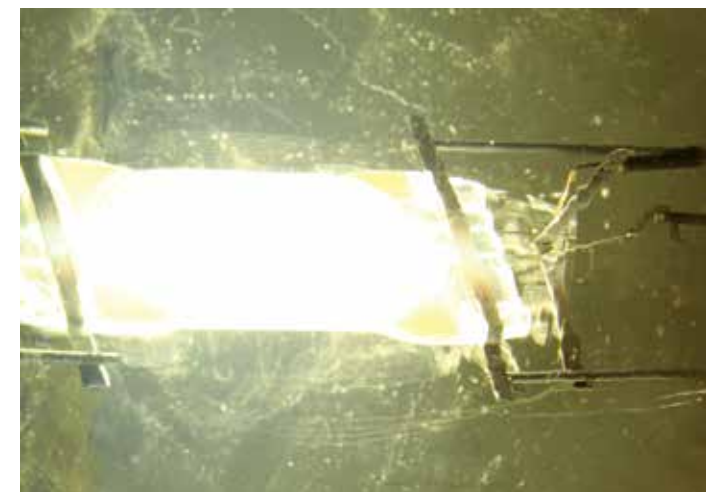
MdV *Dolmen* is an intervention that explores the boundaries of human perception as well as the social, political and physical impact of telecommunications technology. *Dolmen* makes people aware of the presence of wireless signals around us – the radio signals that are the carrier waves of our digital communications. It is the result of an interest in radio signals but it also aims to promote the discussion about the possible negative influence produced by overpopulating these bandwidths, and by what one could call electromagnetic pollution. There are many testaments to these possible negative influences. For instance, a certain Jean-Luc who lived in the vicinity of Geneva's airport reported that when a cellular base station was installed on his building, he started suffering from dizziness, nausea, tachycardia, fever, trembling hands, ringing in the ears. He also lost his appetite, and suffered from poor concentration and memory loss. It escalated into a heart attack and his girlfriend miscarried twice. Several other people who lived in the same building reported strange symptoms as well. Health problems are more frequent in neighbourhoods near mobile phone and wireless airport installations. It is likely that the powerful signals from airport installations such as radar require an amplification of the power of relay antennas. This could be extremely unhealthy. I am very interested in how wireless technology affects us in ways like these.

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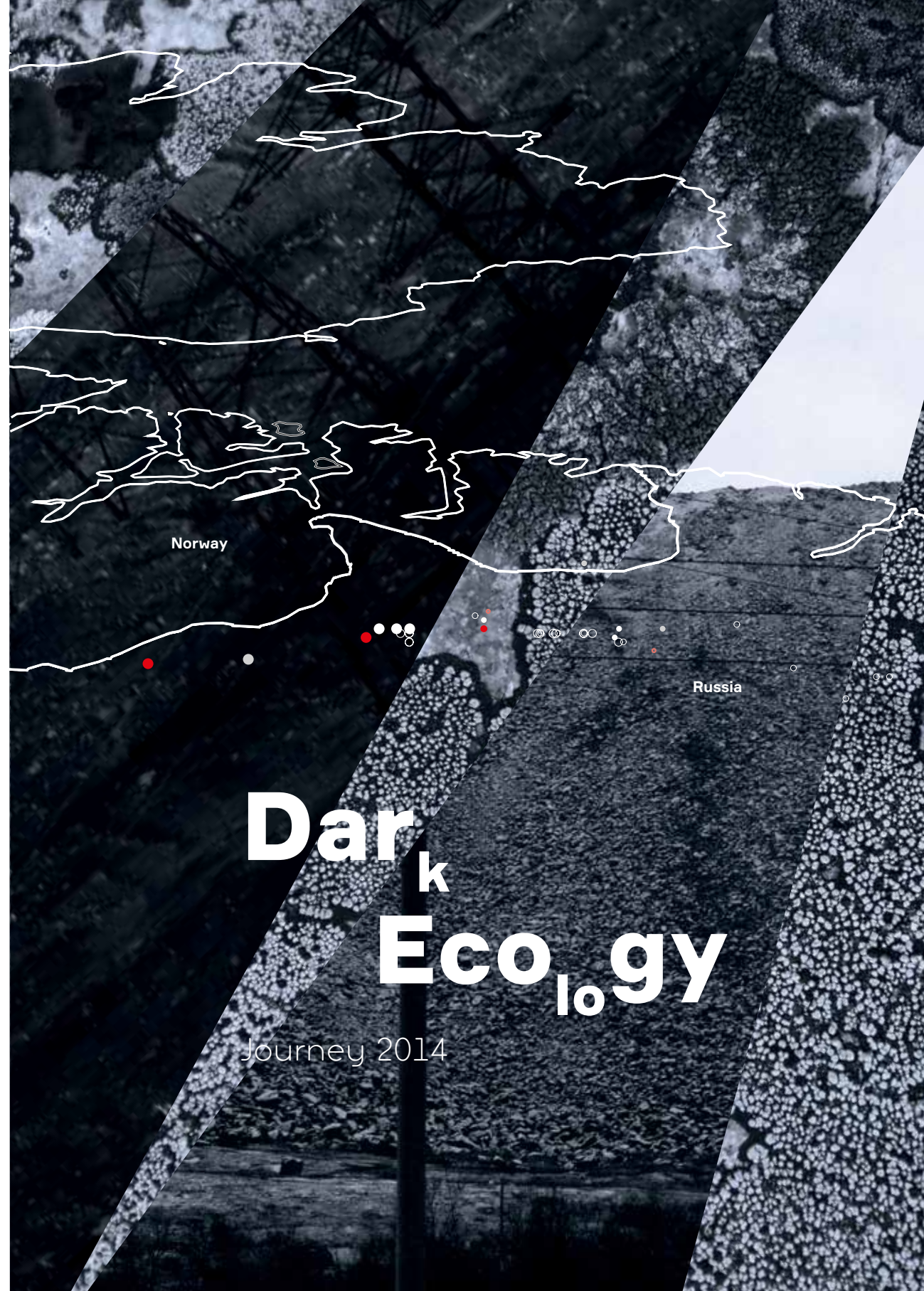


Mario de Vega, IV, site-specific installation, 2013. Galvanized wire electrified with 7000 volts using the power lines of the exhibition space. Laboratorio Arte Alameda, Mexico City, 2013. Electrocution can result from touching the wire. After negotiations with the Civil Department of Mexico City it was agreed to not put up a 'Do Not Touch' sign.

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Mario de Vega, V, site-specific installation, 2013. Installation composed of an array of 30 modified industrial lamps consuming 12 kilowatts. Access to the exhibition was restricted, and because of possible harmful side effects, visitors had to sign a consent form before entering. Laboratorio Arte Alameda, Mexico City, 2013.



Norway

Russia

Dark Ecology

Journey 2014





Ro_{bo}tic Ar_rms, Cra_bs a_and Algo_s

**The Arctic Ocean Floor as
a New Financial Frontier**

Femke Herregraven



Financial markets quantify and price everything: future hurricanes are compressed into catastrophe bonds, bets are made on the spreading of the Ebola virus, endangered species are vaporised into speculative financial products. Melting polar ice has also sparked great interest among financial traders, as it will allow access to the Arctic Ocean floor. This virgin seabed hosts a bounty of natural resources and offers new routes for trading algorithms. Femke Herregraven visited Murmansk to search for and document the projected landing point of the submarine cables carrying the financial world's data traffic.

The Arctic Fiction

Financial investors describe the Arctic as 'the best investment opportunities in the last 12,000 years' and ask us to imagine the North Pole as an undiscovered continent with untapped resources:

It would be easy to think those with a thirst for exploration were born too late – to assume that humanity has already reached every corner of the earth there is to discover. But one region – the Arctic – still contains uncharted mysteries. ... Imagine waking up one morning and finding that an entirely new ocean has been discovered – a frontier, ready to deliver shorter and more efficient shipping routes. Imagine exploring a continental region rich in oil, gas and other natural resources – one that is becoming increasingly accessible as the world's best innovators develop breakthroughs that enable us to use natural resources more responsibly. Imagine this taking place among developed, first-world economies with the highest standards, established laws, and unprecedented security. The Arctic belongs not only to the Arctic nations but to the world. Yet, it is the Arctic nations and those who seek to avail themselves of the opportunities there, of this New World, to safeguard the region as the stewards of this global asset.¹

Framing the Arctic as an unexplored global financial asset is not something new. In 1890 Jules Verne wrote about the selling of the Arctic by a company called The North Polar Practical Association:

It is natural to expect that opinions were very varied when the news spread that the Arctic region was going to be sold at auction for the benefit of the highest and final bidder ... To use the Arctic region? Why, such an idea could 'only be found in the brain of a fool,' was the general verdict. Nothing, however, was more serious than this project.²

And indeed, today nothing seems more serious than this project. The eight Arctic nations – Canada, Denmark, Finland, Iceland, Norway, Russia, Sweden and the United States – all stake their claims in the region and on its resources. American investment groups, China and others claim however that the Arctic is 'the inherited wealth of all humankind'.³ Making deeds of words, China sent the Snow Dragon icebreaker and scientists on Arctic expeditions, and supports Chinese businesses that have already purchased Arctic land two-and-a-half times the size of Manhattan. According to a Chinese professor of law and politics, 'China's exploration of the continent is like playing chess. It's important to have a position in the global game. We don't know when play will happen, but it's necessary to have a foothold.'⁴ Based on a large underwater mountain chain in the Arctic Ocean that starts on Russian territory, Russia has claimed sovereignty over the ocean floor and its resources. On 2 August 2007 a robotic arm from the

1. Scott Miner, 'We Must Avoid Seeing The New Arctic Through an Old World Lens', 26 October 2013, published on the site of Guggenheim Partners, investment firm headquarters in New York, <http://guggenheimpartners.com/news/we-must-avoid-seeing-the-new-arctic-through-an-old>
2. Jules Verne, *The Purchase of the North Pole* (orig. *Sans dessus dessous*), 1889.
3. Elizabeth Rosenthal, 'Race Is On as Ice Melt Reveals Arctic Treasures', in *New York Times*, 18 September 2012, <http://www.nytimes.com/2012/09/19/science/earth/arctic-resources-exposed-by-warming-set-off-competition.html>
4. Nicola Davison, 'China Eyes Antarctica's Resource Bounty', in *The Guardian*, 8 November 2013, <http://www.theguardian.com/environment/2013/nov/08/china-antarctica-trip-icebreaker-snow-dragon>

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Mir-1 mini-submarine planted a titanium Russian flag on the Arctic Ocean floor at a depth of 4261 metres. 'The Arctic is ours', declared oceanographer Artur Chilingarov. A conservative Russian think-tank proposed renaming the Arctic Ocean as the Russian Ocean.⁵ In the scramble for the Arctic the region is presented as an uninhabited no-man's land ready for investment and capital. This ignores the fact that indigenous people have lived there for 5000 years, and also have declared sovereignty over valuable natural resources. This fictionalisation of a geopolitical zone simply functions as an economic tool.⁶ Today the Arctic is a new frontier of imagination, with opportunities for financial markets that cater to their need for expansion. Obviously, the reality of investing in the Arctic is way less romantic and is accompanied by massive ecological, financial and political risks. Yet, financial markets thrive on risk. The Arctic boom has sparked a new generation of frontier gamblers.

Frontier gamblers emerged halfway through the nineteenth century in the American West. Before the American Civil War gambling flourished on the banks of the Mississippi, but with the discovery of gold in California in 1848 many gamblers moved westwards to new San Francisco mines. Professional gamblers were the aristocrats of American society – gambling was not controversial; as a profession it was regarded as being equivalent a lawyer or doctor, and gamblers were a lot more respected than dentists. Today, frontier gamblers are once again well-respected people. The new generation is even so highly respected that they receive bonuses of millions and almost endless credit to speculate with our biosphere. The great age of Western gambling ended with the closing of the frontier;⁷ the great age of Arctic gambling begins with the opening of the Arctic frontier. From Gold Rush to Cold Rush.

Today's frontier gamblers have outgrown the card games of the Old West: faro cards have been replaced by natural resources

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Russian mini submarine about to dive beneath the ice at the North Pole to plant the Russian flag into the Arctic Ocean floor.

5. 'Will the Arctic Ocean become Russian?', in *The Voice of Russia*, 2012, radio show, http://sputniknews.com/voiceofrussia/2012_07_25/Will-the-Arctic-Ocean-become-Russian
6. Andrea Phillips, *Making It Up: Aesthetic Arrangements in the Barents Region*, in Hilde Methi and Kristin Tarnesvik, eds. *Hotel Polar Capital*. Kirkenes: Sami Art Festival, 2011, pp. 55–68.
7. See <http://www.frontiergamblers.com>

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The Russian flag is planted on the Arctic Ocean floor by a robotic arm from a submersible vehicle.



Artur Chilingarov, Russian oceanographer and head of the Russian expedition Arctic-2007, showing a picture of Russian flag in the Arctic Ocean floor.

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and unexplored territories, card playing tables by trading screens. Game dynamics are driven by climate change: rising weather volatility creates opportunities for speculation. Although it's complex to predict how and where it will become colder, drier, wetter, stormier, or where it will flood, the expectation is that the number of events will increase. More events means more changes to invest in and gamble on, more opportunities to win and lose. An investor says about the Arctic: 'Your choice is to either take advantage or let them pass by. This isn't going to be a political discussion. This isn't about politics, this is about investing.'⁸

Arctic Infrastructure Space

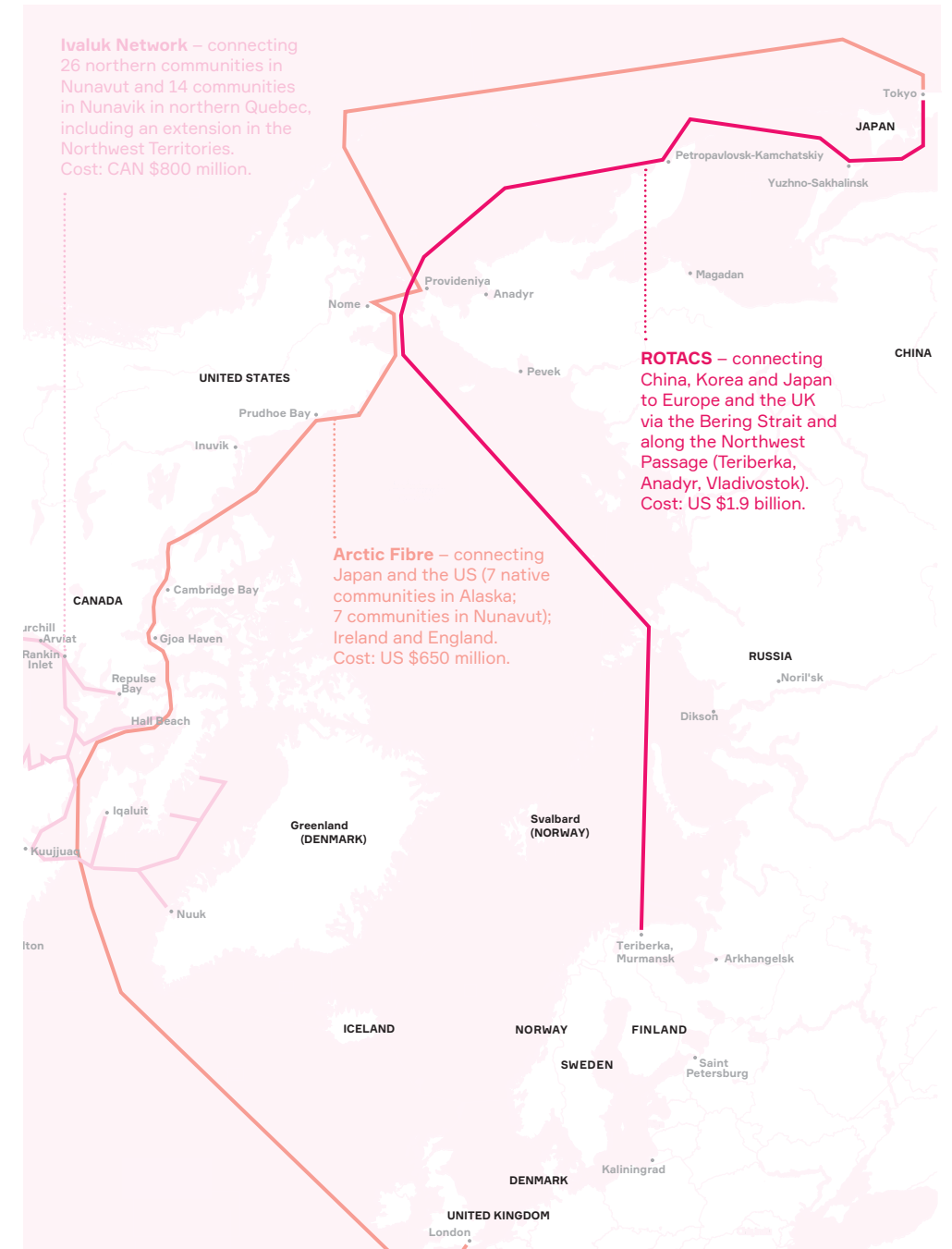
The Shtokman gas field beneath the Arctic Ocean floor shows that investment is – of course – all about politics. Although the partnership between Gazprom, Total and Statoil has been put on hold, new business models for exploiting gas and oil will emerge. After all, the melting ice makes the Arctic bounties more accessible than ever before. The frozen tundra will become suitable for agriculture, valuable minerals – zinc, iron, gold and nickel – of which the Arctic has massive reserves, will be easier to mine, and the Northern Passage will be open for much longer every year, offering faster and shorter routes for container ships. Yet, the least visible though most powerful consequence of the melting ice is the possibility of laying submarine cables across the Arctic Ocean floor. Yearly approximately 250,000 kilometres of new submarine cables are laid on ocean floors worldwide (the cables last a maximum of 25 years). About 95 per cent of all intercontinental data traffic is conducted through submarine cables. The so-called *cloud* is in fact more like ever-expanding underwater spaghetti. Today, submarine cables connect all the continents, with the exception of the Arctic and Antarctica. The Arctic Ocean floor offers a new horizon for expanding broadband. Even though there are obstacles in terms of financing, Arctic submarine cables will be realised in the near future. As of today three submarine cables are planned.

8. Barry Ritholz, 'The Losing Bet on Climate Change', in *BloombergView*, 23 June 2014, <http://www.bloombergview.com/articles/2014-06-23/the-losing-bet-on-climate-change>

Whereas the Ivaluk network aims at connecting communities, hospitals, and schools in the Canadian North with the rest of the world, Arctic Fibre and ROTACS will be constructed for the sole purpose of increasing speed. Arctic submarine cables will shorten the data connection between the financial markets in London and Tokyo that are presently linked via the Middle East and the Pacific. Latency – wasted time in financial terms – is expected to drop substantially by 62 milliseconds, data traffic is expected to be 30 per cent faster. No wonder the melting ice is so interesting to (high frequency) traders. Global warming is literally opening up the Arctic Ocean floor to trading algorithms. Less ice means more money in less time.

The never-ending race to reduce latency and maximise speed is also accompanied by the need to find less vulnerable routes. Cable systems providers are constantly searching for newer, safer ways to cross the ocean floors and avoid choke points. Nearly all submarine cables follow the old geography of early telegraph telecommunication that was largely constructed by the British Empire. Today, many fibre-optic cables come ashore in the ports of former British colonies such as Singapore, Alexandria, Hong Kong, Lisbon, Mumbai, et cetera. As strategic locations these ports are vulnerable to accidents, political instability and attack. Alexandria (Egypt), for example, is a major cable landing point but because of the current political instability is considered a choke point. If a cable linking the US and London is severed, the data can be rerouted almost instantly through any of the eleven other cables. But a cable cut in Alexandria could block data traffic between Europe and financial centres in the Middle East. Data would have to be rerouted through land-based networks or via Asia and then via the US back to Europe.⁹ Singapore, another strategic port, is also considered a major choke point because of its many (18) cable landings that puts a lot of stress on the infrastructure. Currently there are three designated landing sites (Changi North, Tanah Merah, Tuas) that are all high security zones.

9. Samantha Bookman, 'Submarine Cable Operators Hunt for New Routes to Counter Congestion, Political Turmoil', 18 April 2013, <http://www.fiercetelecom.com/special-reports/submarine-cable-operators-hunt-new-routes-counter-congestion-political-turm>



The All Infrared Line, map, 2014. Three planned Arctic submarine cables.

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The quest to avoid such vulnerable choke points brings cable system operators to the Arctic. It is a perfect location for submarine cables: there is hardly any marine traffic that could damage the cables and landing points are far away from densely populated areas. The US Department of Homeland Security points out that 'critical infrastructures' such as submarine cables and cable landing stations are essential assets on which international banking and financial markets are highly dependent.¹⁰ These critical deep-sea infrastructures carve out new controlled zones worldwide. Infrastructural zones are often discretely hidden in remote areas, but they are increasingly visible in major ports like Changi North in Singapore. New protection zones for submarine cables are introduced in the oceans. Australia declared a submarine cable protection zone off the coast of Perth to protect the SEA-ME-WE3 cable connecting Australia to South East Asia, the Middle East and Western Europe. Marine life and submarine cables meet each other in underwater nature reserve zones around the world.

Deep-sea infrastructures produce a new space which, following Keller Easterling, we could call *infrastructure space*. She argues that infrastructure is often considered to be a hidden layer of reality, but that today's infrastructure has become the public point of contact and access for all of us. Special Economic Zones (SEZs), broadband and global standards all give form to that space, and consequently regulate the space of everyday life. Keller describes *infrastructure space* as a medium of information, and as an operating system that shapes the city in which information 'resides in invisible, powerful activities that determine how objects and content are organised and circulated'.¹¹ She writes:

Contemporary infrastructure space is the secret weapon of the most powerful people in the world because it orchestrates activities that can remain unstated but are nevertheless consequential. Some

10. Protective Security Division Department of Homeland Security, 'Potential Indicators of Terrorist Activity Infrastructure Category: Cable Landing Stations', January 2004, <http://publicintelligence.info/DHS-UCL-PI.pdf>

11. Keller Easterling, *Extrastatecraft: The Power of Infrastructure Space*, Verso: London, New York, 2014.

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of the most radical changes to the globalising world are being written, not in the language of law and diplomacy, but in these spatial, infrastructural technologies – often because market promotions or prevailing political ideologies lubricate their movement through the world.¹²

In that sense it isn't surprising that Brazil – in its effort to control its *infrastructure space* – just announced plans for a \$185 million fibre-optic cable. The Brazilian firm Telebras has teamed up with IslaLink from Spain to lay a new cable across the Atlantic Ocean to Portugal that excludes US technology in an attempt to prevent NSA surveillance.¹³ The issues here are how the *infrastructure space* the submarine cables will produce in the Arctic will be organised and who will set the rules.

During my *Dark Ecology* residency I visited two locations that could possibly become part of that Arctic infrastructure space: Murmansk and Teriberka. In Murmansk I wanted to research the Special Economic Zone that ironically had closed one day before my arrival due to lack of success. No companies had established themselves in the zone since its opening and Murmansk as an SEZ turned out to be a failure. Murmansk's Special Economic Zone was what Keller Easterling calls the urban equivalent of MS-DOS: a relatively dumb piece of spatial software, quickly circulated in a world addicted to intensified urbanism.¹⁴ Besides its brief SEZ adventure, Murmansk is also often mentioned as a cable landing point for the Arctic submarine cable ROTACS – following the old geography of strategic sea ports. Yet, its crowded harbour seems an unlikely location. Cable landing points are usually carefully located in areas with hardly any marine traffic or strong currents, and with a gently sloping, sandy seabed so that the cable can be buried. The tiny village Teriberka 100 kilometre north-east of Murmansk is perhaps a better

12. Ibid.

13. Anna Edgerton and Jordan Robertson, 'Brazil-to-Portugal Cable Shapes Up as Anti-NSA Case Study', in *Bloomberg*, 30 October 2014, <http://www.bloomberg.com/news/2014-10-30/brazil-to-portugal-cable-shapes-up-as-anti-nsa-case-study.html>

14. Keller Easterling, *ibid.*, 2014.

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The All Infrared Line, film still, 2014. Potential Russian ROTACS cable landing point in Murmansk harbour.

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The All Infrared Line, film still, 2014. Potential Russian ROTACS cable landing point in Teriberka village.

candidate. This village recently became accessible, as it is no longer part of the Russian military border zone. Standing on Teriberka's remote seashore I was reminded of how the inscrutability of financial markets and the mysteries of the deep ocean floors are tied together by a single cable: a physical cable that allows light to travel across global ocean floors to connect people and financial markets. Rudyard Kipling already described the spellbinding activity of sending signals through cables on the ocean floor in a poem from 1893:

The Deep-Sea Cables

*The wrecks dissolve above us; their dust drops down from afar—
Down to the dark, to the utter dark, where the blind white
sea-snakes are.*

*There is no sound, no echo of sound, in the deserts of the deep,
Or the great grey level plains of ooze where the shell-burred
cables creep.*

*Here in the womb of the world – here on the tie-ribs of earth
Words, and the words of men, flicker and flutter and beat—
Warning, sorrow and gain, salutation and mirth—
For a Power troubles the Still that has neither voice nor feet.*

*They have wakened the timeless Things; they have killed their
father Time;
Joining hands in the gloom, a league from the last of the sun.
Hush! Men talk to-day o'er the waste of the ultimate slime,
And a new Word runs between: whispering, 'Let us be one!'¹⁵*

In the poem wrecked ships float above the submarine cables. At the time some scientists believed that shipwrecks floated in deep water and did not sink to the seabed because the deep water was supposedly denser than the materials from which the ships were made. Today we know that the density of deep seawater doesn't increase, yet when

15. The poem was first published in the English *Illustrated Magazine*, May 1893, as one of the six sub-sectional poems to 'A Song of the English'. It was collected in *The Seven Seas*, published simultaneously in London and the US on 30 October 1896: London, Methuen & Co. New York, D. Appleton & Co.



The All Infrared Line, photo, 2014. Barent Sea coastline in Teriberka village.



The All Infrared Line, photo, 2014. Barent Sea coastline in Teriberka village.

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The All Infrared Line, photo, 2014. Collapsed building in Teriberka village.

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The All Infrared Line, photo, 2014. Shipwrecks in Teriberka village.



The All Infrared Line, photo, 2014. Derelict pier in Teriberka village.

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The All Infrared Line, photo, 2014. Shipwrecks in Teriberka village.

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you walk around in the village of Teriberka it can seem as if the surrounding shipwrecks – straight from Kipling’s poem – have floated up from the depths. A remote fishing village, Teriberka was once famous for its shipyard and shark fishing industry, but fell into decline after the Soviet Union collapsed. It has seen dramatic decreases in population and prosperity: only 950 of a population of 12,000 remain. Of the 52 buildings still inhabited in the village, 39 have officially been confirmed as unsuitable for living.¹⁶ Yet, in Teriberka there is a contemporary *infrastructure space* at work that has created a boom in property prices and the price for the only Airbnb room is equal to one in Oslo. Why?

A massive natural gas field 550 kilometres from the coast was supposed to turn this tiny village into the natural gas capital of the world. The developers of the Shtokman field thought that Teriberka would become the site of a liquefied natural gas plant, after which Gazprom declared the village as its first onshore transit point for Shtokman gas. The agreement between the Shtokman partners, Gazprom, Total and Statoil, expired in 2012 without the development getting off the ground at all.

Teriberka’s population is disillusioned: after all they had been promised jobs and prosperity. Still, it is likely that huge amounts of wealth will arrive in the village, though not as long-term investments in the community but as financial data travelling at the speed of light through the proposed ROTACS submarine cable. Plans for Teriberka as a strategic landing site for gas pipes and submarine cables shape a new infrastructure space that its population will have to adjust to. This infrastructure space is made up of booming real estate prices, Airbnb room rates, shipwrecks, broadband, a cable landing station, investment portfolios, an imported skilled workforce, a border casino and new global standards of different sorts. The decaying shipwrecks in Teriberka perhaps project a nostalgic picture of a collapsed society, a place disconnected from global trade and capital. Yet, these shipwrecks could also symbolise the new infrastructure space.

16. ‘Russian Village Loses Faith in Arctic Gas Bonanza’, *Reuters*, 21 April 2014, <http://uk.reuters.com/article/2010/04/21/russia-village-shtokman-idUKLDE6310G020100421?irpc=932>

With regards to the physical architecture of cables that will be laid on the Arctic Ocean floor, it is good to mention submarine cables and gas pipes are actually not that harmful to ocean life. They only disturb the seabed habitat temporarily during construction, but provide a solid substrate for a variety of species in the long term. This 'reef' effect creates new habitats and attracts non-local fauna.¹⁷ A marine biologist from Murmansk told me that the Red King Crab and the Snow Crab are originally not from the Barents Sea. As an invasive species they came here on ships from other places. If we, like financial investors, consider the Arctic Ocean floor as a new frontier in our imagination it's easy to see these crabs co-existing with other invasive species like a trading algorithm that goes by the name 'Sniper' and colony of robotic arms planting national flags. Global warming isn't bad news for everyone.

This text is part of the ongoing work *The All Infrared Line*, which researches the historical and contemporary construction and geography of the telecommunications infrastructure that serves as the backbone of today's financial markets. This part of the research and this text were commissioned by *Dark Ecology*.

17. Olivia Langhamer, 'Artificial Reef Effect in Relation to Offshore Renewable Energy Conversion: State of the Art', in *The Scientific World Journal*, (2012), Article ID 386713, <http://dx.doi.org/10.1100/2012/386713>

**It Takes
a Lot
to
Articulate
an Object**

Interview with Noortje Marres
Arie Altena

As a sociologist Noortje Marres is concerned with the role of objects, technologies and environments in social and public life, and especially in the enactment of participation and social change. Her work is part of a shift in our thinking, which is informed by an awareness of environmental problems like global warming, and pays more attention to nonhuman entities, seeking to understand their contribution to politics and sociality.

Arie Altena The theme and title of our book and festival is *The Geologic Imagination*. Among other things it focuses on events that occur on timescales that are so large that they elude our perceptions. We're interested in this expansion of the dimension of time. The theme obviously connects to the idea that we live in a new geological age, the Anthropocene. It also resonates with many ideas that are tossed around by philosophers and theorists associated with Object-Oriented Ontology and Speculative Realism. On the one hand at *Sonic Acts* we are very interested in the attempt by object-oriented philosophers to rethink ontology, and think outside the human perspective. But sometimes I get the impression that it leads to 'stories' - fascinating stories certainly - that relish in the horror of a totally nonhuman approach. Compared to the history of planet Earth, we're totally insignificant.

Noortje Marres One way to clarify a problem is by telling a story. Such stories are likely to involve simplifications, but I would like to start with the story of the feminists of the 1970s and 1980s. They formulated quite compelling critiques of a science that so often locates its object of fascination in the far away. There is a deep-rooted presumption that to go on an adventure of knowledge requires turning away from ordinary settings and displacing oneself to exotic times and spaces: the astronomical constellations of cosmology, the extreme environments of other planets, exotic natures and faraway tribes. The feminists of the 1970s and 1980s questioned the implicit devaluation of what is close by, routine, habitual, and intimate. What worries me about some of today's speculative realist philosophers is their inensitivity to

what is close by, their lack of interest in practices and settings that bear the marks of human intervention. Here we return to the notion that the truly significant, spectacular entities are huge and far away, and that everything we have an intimate experience with is mundane and insignificant. In revaluing the everyday, the approximate and the intimate, feminists did not just dismiss that broad horizon of time and space. What they did instead is re-orient our temporal-spatial awareness. They suggested that things that seem close may contain elements of the exotic, and things that are very far away may turn out to be profoundly normal.

AA Could you provide an example?

NM Some especially clear examples can be found in the environmental awareness movement that has close ties with feminism. For this movement, the toxicity of everyday environments showed that industrial production made itself felt in the very fabric of our lives. It demonstrated that some of the new synthetic components developed with the aid of science and technology had actually entered our bodies. By drawing attention to such things feminist thinkers said, 'Look, the industrial scale is not just a scale that transcends the everyday'. Many things that are associated with the big scale of industrial production, but also the scientific issue of the composition of natural substances, happen equally close by, in everyday spaces and in close intimacy with our own bodily practices. The disruption of the linear scales of ontology is one of the important accomplishments of feminist thinkers like Donna Haraway.

AA Timothy Morton, the theorist who coined the term 'Dark Ecology', and who was with us on our first *Dark Ecology* journey in October 2014, often stresses exactly this intimacy with industrial pollution and the mundane aspects of it. He connects this to a 100 per cent object-oriented approach...

NM There are lots of people today who are figuring this out, and much of their work is very interesting. Another example is Nigel Clark who works on the history of the furnace - on a geological scale. He writes about the ways in which different forms of co-habitation became possible when fire was encased in the furnace, and was brought into communities, villages and other human habitats. The taming of fire is a fundamental event that seems very far removed from our post-industrial ways of life. But Clark places ways of living, ways of doing - cooking, heating - at the centre of his account. He shows that the relations between humans and environments and world dynamics become clear in those very practices. The material practices of everyday life are sites where we continuously enter into relations with entities and practices that have very long trajectories through space and time.

AA Characteristic of your position is that you are quite close to object-oriented theorists in your insistence on the participation of things in social life, yet, in contrast to them, you mostly write about concrete social and political situations.

NM Insofar as object-oriented metaphysics is tied to a rejection of social theory and social perspectives on knowledge and politics, it does often result in a discrimination against the mundane and the

everyday. In a sense, I lean the opposite way, as I extend concepts that are used to understand human practice to nonhumans. For example, I've argued that everything needs to be 'equipped' in order to make itself felt. For anything to have effects or to express its existence, it needs to be equipped. This obviously applies to humans. Humans need shelter, we use tools. But I think it also applies to a very great extent to nonhuman entities. How can the ocean make itself felt, or how can the air get its due, how can the bees in South London, where there are far too many given the limited green space, speak out? The question of how they are equipped is absolutely crucial with regard to how they can assert and possibly express themselves in relation to some problem. If we want to broaden the awareness and appreciation of environments, nature, nonhuman entities, and objects we have to appreciate their need to be equipped and gain the capacity to affect others. I'm pro-equipment of things.

AA Can you explain your use of the concept 'equipment'?

NM For me equipment is not just about technology. I think there are two things to explain. One is that I use a really broad notion of equipment. Heidegger has used the word equipment - *Gezellt* - in relation to the roles of objects. I give a much more positive spin to it. Equipment is the extent to which things can serve as instruments for other things, or can sustain them. It can be a garden where bees are staged as natural beings that matter. A garden can be equipment for the air. Filters can be equipment if it means that certain toxic elements stay inside a machine. Equipment is about the reliance of entities on other entities

in order to assert their existence. The other point is that there is a tendency to think about equipment as technology, and therefore as a way of specifying human culture. Humans use hammers, therefore the use of tools characterises human culture. It's not wrong to treat technology in that way. But it's just one of many approaches.

AA How does this connect to art and to environmental issues?

NM Some environmental artists have a very powerful grasp of these possibilities. Take for instance the work *Nuage Vert* by the artist duo HeHe (Helen Evans & Heiko Hansen), in which they project laser light onto the smoke emitted by a power plant. To bring to life the particular environment in which the plant is situated, they use the emission cloud as equipment. By introducing this artistic intervention in a setting, they enable this environment to capture people's attention. In the Parisian version of *Nuage Vert* there were ongoing controversies about the role of the power plant in the local community. By projecting laser light onto the emission cloud, the work drew attention to the plant, thereby participating in the articulation of the problem of the power plant in that setting. These problems were discussed in community meetings (including the problem of environmental health), and journalists started taking an interest. As an artistic intervention, *Nuage Vert* brought to life issues in that environment, it enabled the articulation of the setting. The neighbourhood gained expressive capacities, and this facilitated different kinds of engagement.



HeHe - Helen Evans & Heiko Hansen, *Nuage Vert*, Saint-Ouen, 2009.

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HeHe, *Nuage Vert*, Ivry-sur-Seine, 2010.HeHe, *Nuage Vert*, design sketch, Helsinki, 2008.

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AA There's one passage in your essay on *Nuage Vert* that struck me. Maybe it's simply because it relates to what we've been doing with the *Dark Ecology* project. You write that in the Parisian version of *Nuage Vert*, it became clear to people living in the shadow of the plant that industry and nature are not disconnected. Usually in political controversies, industry and nature are played out as opposites: industry is polluting; nature should be pristine.

NM To undo pre-established thought patterns takes a lot of work. The idea that sustainable technology comes after industrial regimes of living, and therefore that to believe in sustainable technology, we also need to believe that industrialisation has come to an end, is a firmly entrenched set of assumptions. The investment in post-industrialism is also connected to the idea that fossil fuels and their extraction are at the heart of the pollution problem. It's really important to realise that these kinds of conceptual schemes are deeply ingrained. It's not as if a philosopher can say, 'Oh, actually, the opposition between nature and industry is a problematic conceptual scheme; let's get rid of it.' At the same time, it's extremely important to question these assumptions. This is where artistic interventions and maybe intellectual work can contribute. In the case of *Nuage Vert*, the artistic intervention suggested 'factories are here to stay', i.e., the health implications of the factories in our midst are likely to continue to be a problem. In this instance, this also meant: we need to move on from a one-dimensional fantasy of sustainability – whether in the form of the recycling bin or the allotment garden plot – to one that requires us to ignore or bracket the factory for this fantasy to seem viable.

To be able to make this critique is very important. In this case, it was achieved through an artistic intervention.

AA But it's very difficult to present these critiques in the news, or in activism...

NM Of course, in many ways fossil fuels are our principal problem and accordingly it is the ideals of the fossil fuel lobby that we need to challenge. In that respect, saying 'the factory is here to stay' is like shooting ourselves in the foot. Besides, in many situations, it's also a silly observation. But if you want to operate environmentally and do justice to the complexity of environmental issues, it may become very important to recognise that the factory is here to stay. The accomplishment of this artistic intervention is then profoundly contextual. The possibility of articulating the critical point really depends on that particular setting, that particular neighbourhood...

AA Is that why you have a reservation about the capacity of intellectual work to make these kinds of articulations?

NM I feel that sometimes philosophers aren't good environmentalists. If you say 'it's contextual, it depends on the setting', you could come across as shrinking the frame, and reducing everything to a small scale. It may seem that you're not ambitious enough as a philosopher in establishing a broad spatial and temporal frame. But I think you can address the deep-seated assumptions and express the broader, more long-term problematic issues precisely by being hyper-contextual.

AA That relates somehow to my experience of visiting Nickel in

northern Russia, one of the most polluted places in Europe. An enormous nickel smelter looms over the town. The earth is scorched. The air tastes of sulphur. But one is impressed not just by the 'sublimity' of this industrial landscape and the pollution, but also by the mundanity and the human face of the place. Nikel is full of young children, there are playgrounds everywhere between the flats. So when you go there, it immediately becomes a very complex place. Also, that factory isn't going anywhere.

NM In many respects, the practice of living in such an environment expresses what is at issue more sharply and more convincingly than a general account with statistics that wants us to see the broader picture. By mentioning kids playing in playgrounds you already manage to invoke something of the enormity of what's at stake there.

AA Timothy Morton rejects the idea of an environment. Instead he urges us to think of the world as a set of objects where 'object' by the way is not just an object in the classical sense - instead, everything is an object. (To the extent that what others would call a network or a phenomenon, is conceived of as an object). Morton also comes up with the idea of 'hyperobjects'. I don't want to go into the whole ontological discussion, but I wonder how you look at that criticism of the concept of environment.

NM Because we all come from different backgrounds, these words take on a different relevance. For me words like 'environment' and 'setting' are important for a number of reasons. I'll mention two. What I really like about environment and setting is that they are composed

of many different entities, in ways that we don't fully grasp. In that sense environments and settings are open-ended. We don't know where the environment ends. It could extend really far. It implies that we don't really know who or what participates in what is happening in a certain setting. That's the main reason why I'm an environmentalist, I guess, or continue to want to be one. In that sense, I'm not an object-oriented thinker. I think it takes a lot to articulate an object. For the most part things are in an under-articulated or entangled state. But it's not just humans who do the work of articulation; it's also events. The twentieth century cured us of the idea that we can author ontology, that ontologies have a singular author, and I think we should hang on to that. It's important that we continually recognise and remind ourselves that events, happenings, and environments participate in articulating what makes up the world.

AA And what is the other reason?

NM Another reason why I care about setting and environment is connected to the history of the social sciences and social methods. Society has classically been taken to be something that exists above and beyond the particular contexts and settings in which life unfolds. Social methods have therefore been designed to enable the disembedding of social phenomena from their settings and environments. When you conduct a survey, the idea is that answers should not be informed by the setting - like the temperature in the room. In sociology, political science, economics, and to an extent also in psychology, a citizen tends to be imagined as a disembedded

character. A citizen is supposed to form opinions on the basis of evidence or reasoning, and not be influenced by the particularities of the setting. I think the ecologically minded should prioritise addressing this discrimination toward settings and investigate how we can make allowances for settings to be participants in the making of issues, opinions or decisions. It's a very tricky thing that we're talking about here. Because, of course, I don't want my hours to decide for me how I should feel. And I'm not saying that we should stop being critical about projects of environmental conditioning. I think we need to be very critical of those kinds of interventions, but at the same time we should stop discriminating against environments, and envision more constructive ways for material settings to participate in the doing of awareness and in the articulation of what are rightly called environmental problems.

The **Sh**_{ad}**ow** Cast
by the **Lu**_{mi}**no**_{us}
Scr_{ee}**n** that We
H_o**ld** in our **Han**_d**s**
Str_{et}**ch**_{es} Across
the **Pla**_n**et**

Interview with Liam Young
Tim Maughan

Run by speculative architects Liam Young and Kate Davies, the Unknown Fields Division describes itself as 'a nomadic design studio that ventures out on annual expeditions to the ends of the Earth exploring unreal and forgotten landscapes, alien terrains and obsolete ecologies'. Their purpose is to trace the lines and maps of the contemporary, distributed city; to find and observe the structures and landscapes that exist behind the scenes – that remain invisible to most people living in the West, but on which we depend to maintain not just our standard of living but increasingly our very existence. In turn what they record and collect is turned into something beyond mere documentary, with the gathered material being used to create speculative fictions that aim to motivate audiences to consider, relate to, and discuss these forgotten topics and territories. Previous trips have taken the studio to the mines of Madagascar and the Australian Outback, and to the new wildernesses of the Chernobyl Exclusion Zone and secret US military bases. In the summer of 2014 Tim Maughan joined the Unknown Field Division as an embedded writer as they trekked back up the global supply chain of consumer electronics, via the vast container ports of Asia, the factories, wholesale markets, and the underpopulated, freshly built 'ghost cities' of China's Special Economic Zones, all the way to the toxic lakes, refineries, and vast open-cast rare earth mines of Inner Mongolia. They started the trip with seven days as guests on a huge Maersk line container ship as it made stops at mega-ports along the Korean, Chinese, and Taiwanese coasts, where they attempted to comprehend and capture the scale of the vast unseen infrastructure that keeps the engines of global capitalism turning. Late one night, far from land after leaving Kaohsiung port, Tim Maughan sat down with Liam Young to try and get a better grasp of what he was trying to achieve.

Tim Maughan So what are we doing here? Why have you dragged me out onto this ship?

Liam Young We're interested in exploring behind the scenes of the contemporary city. We hang out in London and for most people an experience in London is a singular point on the map. But London is not a singular point on a map; it's this atomised set of places that's constructed by a huge array of distributed landscapes and systems. In order to understand London, in order to understand what it is as a contemporary mega-city, you've got to ride the supply chain. You've got to unpick and unravel the infrastructural systems and travel through the territories that we talk about as being behind the scenes of the city, the hidden or invisible landscapes that are fundamental to shaping and constructing our cultural experiences and relationships. We're in a privileged enough position to be able to go out and see them. Most people don't have access to the stuff that we get to see. Part of our role is bearing witness, bringing back stories, and representing them in a way that people who don't have the opportunity to see them, can meaningfully connect to these territories. Hopefully we start to engender new kinds of cultural relationships with what these landscapes might be; because I don't know what the end game ultimately is, but I think there's something critical in revealing them. On a previous trip we went to a nickel and cobalt mine in Madagascar. The mining company refused us permission to take pictures, so we all took photographs secretly, shooting through our bags and stuff like that. The earth in and around the cobalt nickel mine is really red. On Madagascar, you have this amazing, rich green landscape, the most precious rain forests on the

planet, ninety per cent of the animals don't exist anywhere else on Earth. And there's this blood red scar cut into it. You sit there and think, 'How the fuck could we let this happen?' Click, click, click. Take the photo. At a certain point you realise that your camera is battery-powered, and the minerals that make that battery work most likely came from the same ground that you're standing on. That landscape is complicit in both its own redemption and destruction. We're all wrapped up in this massive network of industry and infrastructure and it's important to talk about our complicit nature in it, because then you might start to relate differently to it. You might start to think about it in new ways. You might be able to engineer these infrastructural systems and use them for something positive or productive.

TM What about wind turbines?

LY That's one of the greatest ironies. The landscape that we're going to in Inner Mongolia is the world's largest raw earth mineral mine. One of its biggest outputs is neodymium, which is also refined there and manufactured into the magnets that make wind turbines possible. The whole process is hugely destructive to the surrounding environment. So when a wind farm pops up somewhere in Denmark, we talk about Denmark as an extraordinarily forward thinking country for using this form of energy. But the shadow that wind farm casts stretches from Northern Europe all the way to a hole in the ground in China. That's why you have to go to these territories and unravel the stories. All these things are only presented to us through very particular media narratives, if at all. Most of the time they're invisible, part of a hidden system that lies behind the scenes and bubbles beneath

the surface. When we do hear about them it's always through very obscured and tinted lenses.

TM And we've got people in the UK complaining that wind farms are spoiling their view

LY People complain wind farms spoil their view of a pristine landscape. That landscape isn't natural or pristine at all. It's conditioned by centuries of farming and manipulation. It's just as constructed as the wind farm is - that's the condition of the anthropocentric world we live in. Nothing is natural, but this goes well beyond issues like wind farms spoiling the view. I'd like to add to the analogy of the shadow. The shadow cast by the luminous screen that we hold in our hands stretches across the planet, it stretches from the wind farm, stretches across to this area of mineral mine in China, and to a toxic lake in Batou. That's quite extraordinary, but you can't preach about this stuff. You can't be utopian about it, nor can you be pessimistic about it. All we're doing is exposing complications and complexity. Hopefully, we're developing work and writing and telling stories that cut through that complexity.

TM First, I've been impressed by the scale of everything. It's the 45th anniversary of the Moon landing, right? I keep hearing people saying that we don't do any big engineering projects anymore; we don't go to the Moon anymore. The truth is we do, we just don't see it. It's moonshot-scale engineering to solve the problem of one country selling things to another country. Secondly, I'm horrified by the obvious environmental impact. Thirdly, I find myself going, 'I wish I had a better camera. I wish I had a better phone, as I keep running out of space on the one I've got. I wish I

had a GoPro because they look like fun. I wish I'd brought a digital JLR. I wish I had a MacBook Air; I could've brought it with me, because it's lighter'. Do you know what I mean?

LY Yes. Our generation had no great war to fight. Our generational project was the acquisition of wealth and objects. We've gone about that with exactly the same fervour as soldiers went into the Great War. We've invented technologies. We've created systems. It's all about globalised production, which is about outsourcing labour and maximising costs and beneficence. We've ended up creating this super-scale planetary infrastructural system, which is so big that it ceases to be visible. That's our great work. It is amazing. What this does is really quite incredible. At the moment, the system is engineered purely for efficiency and profit. But you could imagine co-opting the same system to do other things.

TM It could feed people, I guess.

LY It could feed people, yes, but I think what we'll see in the next phase, is what outsourcing production really does. An economist would argue that this system distributes wealth, and that distributed production means that someone who would otherwise be working in a little village - on a farm, on subsistence - now has a job in a factory and is making enough money to live in the city, and also sends money back home to the family in the village. To a certain extent that could be productive. They can be paid much more than they were before. Still, someone is taking a massively unfair cut of that process. You can imagine engineering the supply chain of a particular object to really redistribute wealth globally. Let's say that I'm going to make a computer, and that computer consists



Batou in Inner Mongolia is the largest Chinese source of the most sought after minerals that are essential for advanced technology. The world's largest rare earth mineral refinery pumps toxic and radioactive tailings into an adjacent artificial lake, 2014.



The lake of radioactive waste at the world largest rare earth mineral refinery, Inner Mongolia, 2014.

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Immense Inner Mongolia coal mines fuel the furnaces of nearby steel and rare earth mineral refineries, 2014.



Inside a rare earth processing plant, bags of refined minerals are stacked before being transported to electronics manufacturers, 2014.

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of components that are produced in 50 countries around the world. All these components come together via the infrastructural network. This one computer is a world object - through this object we're connecting all these disparate communities all over the planet, and we're distributing wealth. If you engineer it for those ends, you don't engineer it because labour costs in Bangladesh are way lower than in India. (China is outsourcing to Africa now. China is slowly moving up the tier, from being a manufacturing nation they become a management nation.) There must be ways to make this infrastructure work in fairer ways for everyone. It's naïve to say we will go back to only consuming local food, and all that. It's naïve to think we will grow crops on our roofs and manufacture locally, like these co-op movements do that are popping up in San Francisco.

TM I just wonder if you see an end to this system at all, further down the line. There's still all the buzz about 3D printing. There's still all the buzz about molecular engineering...

LY I wrote about 3D printing from the perspective of the raw materials that go into producing 3D printed objects. With 3D printing you still need a supply chain. It needs bulk carriers full of rubber from India. It needs grain and limestone from quarries in Africa. With 3D printing we move even more shit around than we do at the moment. It's just changing the resolution of the material. It's no longer an object that you move, it's the pixels that object is made from. It changes the nature of how we relate to objects. The form of something becomes just a very temporary moment in the life of material. We'll figure out a way to make something, to recycle it, make something else again. But still this stuff is shifting

all around the planet. And we still need an infrastructural system. 3D printing isn't going to change all that. It will probably accelerate the system. We're going to need more stuff coming out of the ground. Huge areas of the Earth will become raw plastic manufacturing plants. Most 3D printing uses oil and petroleum products as a base. Take an iconic 3D printer, like the Makerbot, and explode it into all its bits and see where they all come from. This thing, which is supposed to be this extraordinary teleportation device, which is going to destroy global manufacturing, is produced in 18 different countries on the planet. That's it.

TM Where are we going next? When we get off the ship what are you going to show me?

LY We started this trip at the point of distribution where all these objects land, and then are atomised around the world. We're going back to Yantian, a district of Shenzhen, where these objects leave China. Then we're going to go to the point where they're assembled. So we're going to Shenzhen, which is a special economic zone set up to encourage international companies to produce and make all their stuff there. Shenzhen and the area around it is the largest manufacturing and production zone on the planet. Every electronic object you can imagine somehow touches and passes through Shenzhen in one form or another. So we're going to visit a TV factory and a GPS factory. Then we'll hit the electronics market where a lot of these items are sold to wholesalers and to people coming for cheap electronics. Afterwards we head off into the landscape for the raw materials. Chinese companies make a lot of money because they

get tax breaks and tax-free raw materials if they can prove that they're making objects solely for export. So everything is sourced from China. Everything is put in a box on a truck, it's put on a ship, and sent off. You can't actually buy cheap name-brand goods in China. You can't get a cheap iPhone in China, because none of the Chinese iPhones are made for the internal market. You can go to Shenzhen, stand outside the Foxconn factory where they make the iPhone, walk into a phone shop, and you're buying an iPhone that comes from Hong Kong. That's the cheapest way to get it. Everything is made for export. You can get a knock-off iPhone really cheap, because whenever the people who are trained to make normal iPhones leave their jobs, they go to another factory next door where they're making the dodgy ones using the same machines, the same tools, the same raw materials, with the same staff. So you can buy dodgy versions of everything. But the actual ones, they get sent out for export. What that creates is a whole series of other secret economies. The way you get an iPhone in China is that all these people buy them from Hong Kong, because that's the first point of call. They ship them from China, they ship them into Hong Kong, and Hong Kong's sales are tax-free. So all these people go across the border from Shenzhen to Hong Kong. They buy a whole bunch of iPhones. They take them out of the box, they strap them to their bodies, and they come back over the border. Obviously, carrying big bags full of iPhone boxes doesn't really work so they discard the boxes. What you've created then in the electronics market isn't a market necessarily for high-end electronics, it's a market for the boxes for the electronics that were made in Shenzhen, exported out of Shenzhen,

then smuggled back into Shenzhen, and re-boxed. So there are pirate box manufacturers throughout the electronics market.

TM There are people in China printing fake iPhone boxes for real iPhones?

LY Fake iPhone boxes, with fake authenticity holograms, to put real iPhones in. That's what Chinese people who can't afford a 'legit' iPhone buy. They're not buying clones and copies; they're buying real iPhones in fake boxes. They're labelled as 'Hong Kong iPhones'. There's an Apple store in Shenzhen. They're selling legit shit. They're selling iPhones that have been shipped out of the country and back into it at a really high cost. It's no cheaper than buying it at the Apple store on Oxford Street. But, then, next door in Shenzhen there's another phone shop selling Hong Kong iPhones.

TM How much are they?

LY They are twenty per cent, fifteen per cent less or something. They're still not that cheap, but they're real iPhones in fake boxes. Because you can sell them for a bit more if they're in a box. There's the consumer desire: you want to get the box. So there are massive floors of people selling rolls of iPhone authenticity holograms. There are people folding up boxes, folding up the little white insert that makes the iPhone sit at the top of the box without the bottom falling out. That's one of the dominant industries in the Shenzhen iPhone market. It's pretty amazing when you think about it. I think part of our work is to find the stories, unpick the systems, and try to talk about and present them in new and interesting ways.



Guiyu e-waste recycling village in Guangdong Province, southern China. The city is often referred to as 'the electronic graveyard'. It is the location of the largest electronic waste dump on Earth, 2014.

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Container ship *CMA CGM Blue Whale* arriving in Kaohsiung port, Taiwan, en route to China, 2014.



From the deck of the Maersk cargo ship the vast container fields of Ningbo Port, China, stretch to the horizon, 2014.

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Kaohsiung port in Taiwan, 2014.



Unknown Fields explorers are dwarfed by a Maersk cargo ship loading containers at Shanghai port, 2014.



In a Christmas decorations factory in China, young girls, paid per unit, feverishly glue and stitch decorations to red felt Santa's hats and tree ornaments before they are exported to an American department store, 2014.



Hundreds of electronics assembly line workers have left their villages to live in these dormitories beside their factory in Shenzhen, China, 2014.



Scores of workers line the continuously moving conveyor belts of a microwave oven factory in China, 2014.

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Kn_ow
Dark_ness

Paul Bogard

Since the Industrial Revolution our world has become ever more brighter. The Anthropocene is bright, so bright that we now suffer from light pollution. Paul Bogard explains how brightness endangers our environment, and how light pollution takes away one of the defining experiences of our culture, an experience that connects us to the world and the universe. He also argues that we should not ignore or avoid the metaphorical darkness, and instead face it head-on.

We are afraid of the dark, and that's OK. What isn't OK – at least for our physical, mental and spiritual health, and the health of the ecosystems on which we rely – is the way we try to overcome this fear of darkness with ever more lights, washing away as we do the 'holiness and beauty of night' from our experience of life, as Henry Beston wrote in 1926. In the process, we are polluting our world with light in ways that impact nearly every living being on Earth, waste billions of dollars worldwide, and actually make us less safe at night.

This last point is particularly important, because whenever you talk about light pollution and its many costs, you hear the objection that we need all this light for safety and security. The impulse has possibly been with us forever: if we could light the night as brightly as the day we would be safe, we would all be better off, or at least we would keep ourselves safe from crime. I think of two famous examples, though thankfully neither was built. The first is Jules Bordais's 1889 idea for a 'sun tower' in the centre of Paris that would light up the city, a tower that wasn't built in favour of a certain Tour Eiffel. The second is the suggestion by American politician Newt Gingrich that we rocket into orbit giant mirrors that would reflect the sun's light back down upon our cities all night long, to eliminate the need for streetlights and reduce crime by brightening shadowy neighbourhoods.

The reason why light at night can improve our safety is that it aids our vision. But ever-brighter lights make seeing at night more difficult. As the man responsible for lighting one of London's toughest neighbourhoods told me, 'Too much light would have a negative effect, because if you look into the light, you can't see anything, you can't see beyond it'. Gazing from behind his desk, he

paused, 'You know, a bright enough light between us and we can't see each other, and we're sitting across from each other!' The widely accepted idea that because some light can help improve our safety and security at night, more light will improve it even more is simply not true. The connection between light, night, crime and darkness is a complex subject that we too often reduce to the bumper-sticker belief that light is good and dark is bad. In truth, sometimes light is good, and sometimes light isn't good. The same can be said of darkness. Meanwhile our world grows ever brighter.

Light pollution, the overuse and misuse of the light at night, is increasing. Artificial light itself is not the problem. On the contrary, light at night is a miracle, a transformative invention that enriches our lives in many ways. It's our overuse and misuse of light that is the problem. No one is saying let's not have light. But what growing numbers of people are saying is let's not have light that pollutes; instead, let's have light that is used thoughtfully, responsibly, and intelligently. Let us light only what we need to, and nothing more.

There are three primary versions of light pollution: sky glow, glare, and light trespass. Sky glow is that pink-orange glow lighting the clouds over any city of any size. It's that dome of light on the horizon ahead, even though the road sign says you've still got half an hour to drive. Glare is the bright light shining in your eyes that you raise your hand to block, the bright lights that make it hard to drive at night. Light trespass is light that is allowed to cross from one property to another. It's your neighbour's security light shining through your bedroom window. It's the lights on the brand-new science building that also illuminate the sororities across the street. In a country like the US, so obsessed with property rights, light is allowed to cross property lines with ease.

People often ask what can be done. The first step is simply to become aware of the problem. To understand that the darkness we know and fear is not natural darkness, it's not darkness as it used to be before electric light. Many of us have grown up in a world swamped with light. Depending on where we live, our nights may still seem dark, but few of us have experienced natural darkness. On the *World Atlas of the Artificial Night Sky Lighting*, a world map of light pollution produced in 2001 by two Italian astronomers, virtually no place in Western Europe or the eastern US has natural darkness. Even west of

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Image of the night sky polluted by light. At left, the constellation Orion, as seen from a dark place, and at right from Orem, Utah, 2009.



The Bortle Scale was originally published in *Sky & Telescope Magazine* in 2001. It classifies the darkness of skies from the point of view of an astronomer, ranging from 1 ('an observer's Nirvana') to 9, in which 'the only celestial objects that really provide pleasing telescopic views are the Moon, the planets, and a few of the brightest star clusters'.

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the Mississippi River bisecting the US, only scraps of true darkness remain. The story is the same in every city across the globe: because of our over use and misuse of artificial light at night we no longer experience naturally dark night.

Astronomers often use something called the Bortle Scale to give us a sense of the darkness we have lost, and the darkness we still have. There are two things about this scale that are worth noting: first is that most Americans live most of their lives in levels 5 and above, rarely or never experiencing anything darker; second is that there may be no level 1 darkness remaining in the US.

When I first began my research for the book *The End of Night*, I called Chad Moore of the National Park Service's Night Sky Team and asked him where I could travel to experience level 1 darkness. Chad laughed and suggested the Australian Outback. But as much as I would love to go to the Outback or any number of other naturally dark places around the globe – the Amazon, Mongolia, the middle of the ocean – this wasn't the focus of my book. I wanted to know the darkness that most of us know or could know without much effort. I wanted to know what night is like in the 21st century. What I found is that it's getting brighter almost everywhere, and that almost nowhere is becoming darker. And I found that few of us understand the consequences.

We know that all this light is bad for our health. Scientists are discovering that light at night negatively affects us in three primary ways. First, it disrupts our sleep and contributes to the sleep disorders that are tied to every major disease that we are dealing with now, including diabetes, obesity, and cancer. Second, it confuses our circadian rhythms, those 24-hour natural rhythms that orchestrate our body's health. Third, and perhaps most worrying, it impedes the production of the hormone melatonin, which is only made in the dark – a lack of melatonin in the bloodstream has been linked to an increased risk of breast and prostate cancers. In fact, the World Health Organization now considers working the night shift as a probable carcinogen, akin to inhaling diesel fumes.

All this light endangers the environment as well. Consider that life on Earth evolved with bright days and dark nights. We know we need light for optimal health, but we need darkness as well, and this is true for the creatures with whom we share the planet. More than 60 per cent of invertebrates – primarily insects – and 30 per cent of

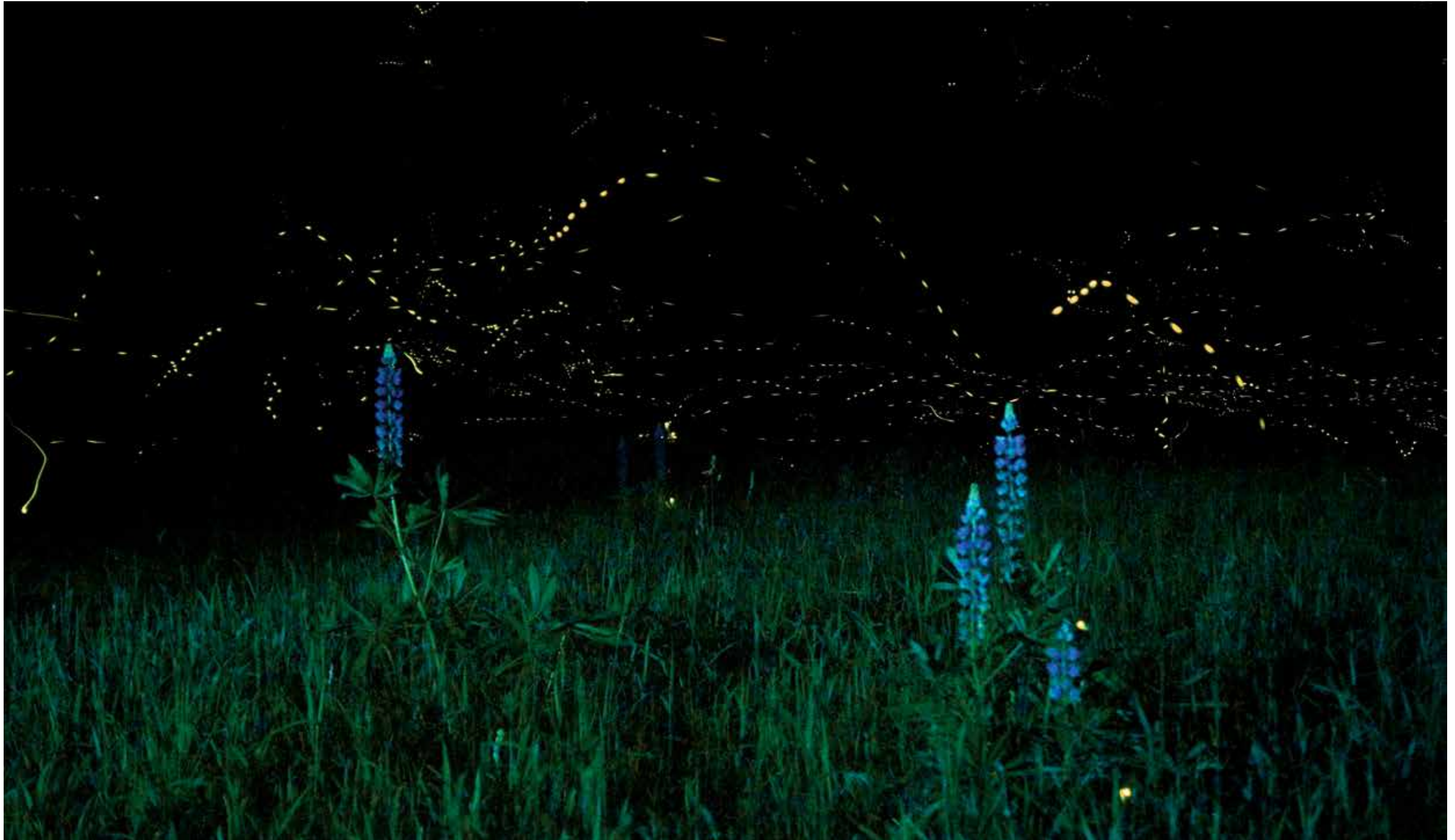
vertebrates are nocturnal, and many other creatures are crepuscular, mostly active at dawn and dusk. For them, night and its natural darkness is a time for mating, eating, moving, it's a time for living. When we flood their habitats with our light at night we impede this living, destroying a habitat like a bulldozer does. Examples? Hundreds of species of birds migrate at night around the world, and our lights draw them off course and often to their demise. Sea turtle hatchlings that have evolved over hundred of millions of years to scurry toward the brightest lights on the horizon – for hundreds of millions of years the moon and stars reflecting off the ocean – now scurry toward hotels and parking lots, streetlights and condominiums. Moths swirl around lights until dying of exhaustion or being devoured: the lights essentially vacuum this critical source of protein from the entire food chain. Research into the effect of light at night is very new, and we don't know exactly how light at night affects Earth's creatures, but it would be foolish to think it wasn't affecting them in a major way. At a time when our fellow creatures face so many serious threats, yet another resulting from our irresponsible and wasteful light at night is one they don't need.

The good news is that using light at night in ways that reduce light pollution can actually increase our safety. The second step in solving light pollution is ensuring that all our lights only shine when and where we need them, and that especially means that they only shine towards the ground. The photographs from space of the Earth at night are beautiful, but they are also photos of waste. The light we see in those images is light that shines straight up into the sky or horizontally. It's light that doesn't make anyone any safer.

In *The End of Night* I use the Bortle Scale as the structure for my chapters. And the third chapter – number 7 as I move down the scale – is titled 'Light that Blinds, Fear that Enlightens'. I knew that 'safety and security' is our justification for light at night, and I wanted to show that this connection – that ever brighter lights will make us ever safer – just isn't true. Bright light can actually make us less safe by shining in our eyes, making it harder for us to see, casting shadows where the bad guys can hide, and – maybe worst of all – creating the illusion of safety. We see bright, unshielded lights shining in all directions and we feel safer. But feeling safer and being safer are two different things. Lights alone don't make us safe. But I also recognise that our fear of the dark – and in this case, our fear of violent attack



Infrared image of a ghost bat in Perth Zoo, 2002.



Lupines and fireflies, 2014.

by a stranger – is still a very real feeling. I don't deny that. I especially don't deny that for women in our society.

If we are truly interested in safety at night, we would utilise light with more regard for light pollution. We would have low levels of uniform lighting, rather than extremely bright splotches that blast into our eyes, making it harder to see.

One would think that any of the costs I have mentioned already – monetary, energy waste, human health, environmental health – would be enough to inspire us to stop wasting light. But there are other costs as well, costs harder to qualify but vital nonetheless. What I would like most of all is that we learn to respect darkness. We have taken what was one of the most widely shared human experiences – stepping outside and coming face-to-face with the universe – and have made it one of the most rare. In the US and Western Europe, eight out of ten people born today will never live where they can see the Milky Way. Entire generations are growing up without knowing what true darkness is, without knowing how important darkness is, how beautiful is the night.

For thousands of years the experience of coming face-to-face with the universe has inspired religion, philosophy, science, astronomy, reflection, meditation, art. I am always amazed by the letter from Vincent to his brother Theo from the south of France in 1888, explaining that the stars in this southern sky were even more colourful than the stars over Paris. No one has seen more than a few dozen stars – let alone coloured stars – over Paris since before the Second World War. For *The End of Night*, I was excited to visit Arles, to see where Van Gogh had painted his wonderful night-time scenes. But all the electric light swamping the area means we can never see what van Gogh saw.

Along with having lost the experience of real darkness, we shy away from the experience of metaphoric darkness as well. We live in a culture obsessed with artificial light, and this includes metaphorical artificial light. We honour celebrity and money, we're told 'don't worry, be happy'. We want to be wealthy by the time we're 30, and we don't want to have to work too hard. But life is full of natural darkness, difficult times, loss, tragedy. I found in writing my book that traditional cultures all over the world understood the connection between life and darkness. Native Americans, for example, did not

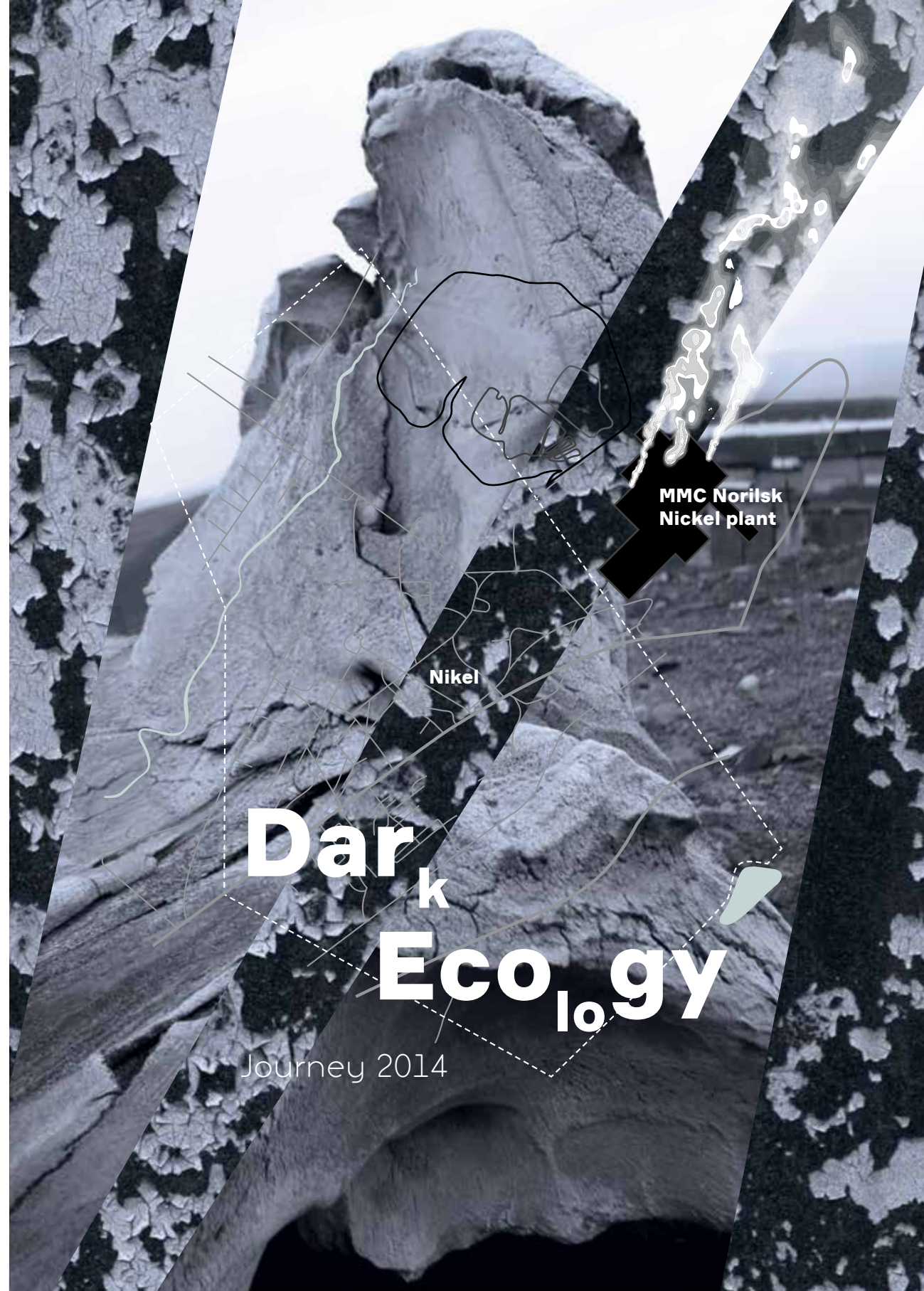
have the same understanding of light as good and dark as evil. As one Cheyenne elder said, 'Life is supposed to be hard. Otherwise, we wouldn't appreciate it at all'.

And what of the value of melancholy? Maybe my favourite moment in *The End of Night* is when Eric Wilson, author of *In Praise of Melancholy* talks about life being so beautiful it makes him cry. 'I think that when we're truly moved by something, it always feels sad', he told me. He said he'd recently been at a concert and during a few of the songs he felt himself tearing up. 'It was really this sense of, life is large and marvellous and weird and I don't even come close to getting it. And I love that', he said. 'It's a darkening, but a darkening that suggests there's more. It's like terra incognita, the blank spaces on the map. I think that's what the darkness is: there are places within us that can never be mapped.' Melancholy is natural darkness.

In my country, the US, we seem unable to take action on global warming. Many people want to ignore it, and many claim to not 'believe' it. But we know its real, and understanding the way it could harm the world I love is for me the most powerful darkness. But rather than hide from this darkness or try to keep it at bay with artificial light, the question is how to live a joyful life while engaging with it. The answer cannot be to ignore this darkness or avoid it. The answer has to be to face this darkness head-on.

I remember telling a good friend about my fear of this metaphoric darkness, about my sadness at knowing what is happening to this beautiful world. He said, 'You can survive being that vulnerable. You really can. I think sorrow and sadness are at the heart of being human. It's certainly an essential component of loving. If you don't want to cry, then you don't love anything'.

I love that we are afraid of the dark. I love it because I think it's a natural fear that can grow into a respect for the dark. We don't need to rule the world day and night. Let us respect the dark and leave most of it for the wild to come alive in. I mean the wild world around us, animals, birds, reptiles, but inside us as well, the wildly reflective and meditative, the wildly soulful, the wildly beautiful and creative. What I would like most is for us to fear the dark as we always have, and to let it be. To leave behind the old human urge to dominate and control, and push away the darkness in and around us. Let us instead see that natural darkness is one half of a human life, one half of life on Earth, one half of each of us.



MMC Norilsk
Nickel plant

Nikel

Dark Ecology

Journey 2014





ОГНЕОПАСНО

Abot Time

Mirna Belina



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Mirna Belina compiled a visual essay, a programme of experimental films, that in various ways take on the idea of a geologic imagination, deal with long timescales, and provide a view of the Earth in which humans are no longer at the centre.

Deep time is geologic time that unfolds on a scale of millions of years and in which changes invisible to human perception occur: the formation of continents, mountain ranges and oceans, the evolution of species. Its history is buried in fossilised remains and lakes of fossil fuel beneath our feet. Human beings are not the central character of deep time – deep time is not human time – although the impact that ‘we’ have had on Earth over the past two centuries far outstrips the influence of any other species. This catastrophic and irreversible impact is characterised by the term ‘Anthropocene’, the era in which human activity is affecting the planet with the same force as erosion, glaciation or tectonic movement. When exactly this human-made epoch began is not clearly defined. The onset of the Industrial Revolution in the early 1800s, with the invention of steam power, and the Atomic Age in the 1950s, are among the most likely contenders for having initiated the Anthropocene – but on a scale of millions of years, it has all happened in a blink of an eye.

In her book *Minimal Ethics for Anthropocene*,¹ Joanna Zylinska proposes a use of the term that can be useful from a non-scientific perspective, ‘as an ethical pointer rather than as a scientific descriptor’. The Anthropocene is about an obligation humans owe to Earth, it is about rethinking the structural changes in the world and the (new) ethical relations they imply. The current human perspective, says Zylinska, has to be challenged with a post-anthropocentric ethics of thinking about the world in which humans are decentred and where not everything is arranged for our benefit. It forces us to think about humans as not being evolution’s glorious crescendo. Evolution is a contingent progress. Our consciousness usually places us at the

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top of the hierarchy; it gives us the opportunity to reflect. But that doesn’t mean human consciousness takes the position of absolute power. It means trying to occupy a ‘nonhuman’, decentred point of view, and then rethinking scale, nature, Earth, landscape – everything that we are and that is around us.

These questions are the focal point of the mini film programme compiled here to tackle the imagination from a different angle. The films are presented in a linear way, as in the cinema, rather than in a problematic analysis that draws on their comparisons or explores seriously grand topics such as ‘machine’ or ‘nature’. It is a film programme that proposes some ideas and tries to make an impression on the viewer. It is also about time.

Geologic time and human time meet in the Anthropocene as the movements of glaciers, the formation of mountains or the disappearance of lakes become evident in human visualisations of deep-time processes. The tools we use to see are being improved constantly with technology’s advance, and processes that once unfolded deep in the realm of imagination emerge on the surface. Art has the ability to test our values and examine the workings of space-time in its own domain and on its own terms. The medium of film, for instance, exposes objects by presenting their imprint in the movement of time. It also illuminates its own intrinsic properties, possibilities and limitations. Both can work together, as in the film *Alaya* (1976-87) by Nathaniel Dorsky, in which atoms of sand intermingle with the film grain. It is difficult to tell them apart and to imagine the world without the optics through which we observe them. *Alaya* was mostly filmed in Death Valley, one of the driest places in the US, but it disregards the hostile and overwhelming desert terrain, diving instead straight into the very material from which the desert is made. It also evokes the main interest of the structural filmmakers and their studies of the essential formal characteristics of the film. In *Alaya*, Dorsky sheds light on grains of sand in about 80 meticulously framed shots, playing with time, scale and perspective, and making us wonder if we are watching a few grains of dust or spectacular

1. Joanna Zylinska, *Minimal Ethics for Anthropocene*. Ann Arbor: Open Humanities Press, Michigan Publishing University of Michigan Library, 2014, pp. 19, 20, 72. <http://dx.doi.org/10.3998/ohp.12917741.0001.001>

2. Annette Michelson, ‘Toward Snow’, in *The Avant-Garde Film: A Reader of Theory and Criticism*, ed. P. Adams Sitney, New York: Anthology Film Archives, 1978, p. 172.

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sand dunes – or the wonderful dance of 16 mm film grains. Part film, part sand, *Alaya* (in Sanskrit ‘universal soul, source of all beings and things’) is a mystic meditation on the universal qualities of the world – not a representation of the world, but a portal into its very essence. Nathaniel Dorsky frames it in one meaningful sentence: ‘Sand, wind, and light intermingle with the emulsions.’

‘There is a recurrent metaphor in contemporary discourse on the nature of consciousness: that of cinema.’² Annette Michelson wrote this almost 40 years ago in one of her texts dedicated to Michael Snow, in which she also articulates her phenomenological approach to structural cinema. In his monumental film *La Région Centrale* (1971), Michael Snow challenges ways of seeing and perceiving imposed by traditional artistic practices, notably narrative cinema and classical visual art. The landscape is a desolate Canadian polar wilderness filmed from a mountain peak 160 kilometres north of Sept-Îles in Quebec’s *région centrale*. In this barren land, a large remote-controlled machine – constructed and designed by engineer Pierre Abbeloos – served as a mount for an extremely mobile 16 mm camera that could rotate 360 degrees. The camera’s constant panning, zooming and circling at various speeds mapped a humanless, primeval land in a dizzying three-hour *tour de force*. In his proposal to the Canadian Film Development Corporation, Michael Snow articulates what he wants to do with his film:

The film will become a kind of absolute record of a piece of wilderness. Eventually the effect of the mechanized movement will be what I imagine the first rigorous filming of the moon surface. But this will feel like a record of the last wilderness on earth, a film to be taken into outer space as a souvenir of what nature once was. I want to convey a feeling of absolute aloneness, a kind of Goodbye to Earth which I believe we are living through. In complete opposition to what most films convey, this film will not only present only human drama but

3. From a proposal by Michael Snow to the Canadian Film Development Corporation, March 1969, in *The Collected Writings of Michael Snow*, ed. M. Snow and Louise Dompierre, Waterloo, ON: Wilfrid Laurier University Press, 1994, p. 56.

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mechanical and natural drama as well. It will preserve what will increasingly become an extreme rarity: wilderness. Perhaps aloneness will also become a rarity.³

La Région Centrale challenges human perspective: gravity vanishes, the horizon is erased, North doesn’t exist anymore, the notion of down and up is shattered. This observing eye – the one we usually identify with the camera – cannot be attached to a human body. It can’t be our perspective. As the laws of physics disappear (as if they have never existed), the only view left is a disembodied ‘machine vision’. But a strange paradox slowly develops. No matter how unhuman these movements are, or how much the camera twirls and rotates with its robotic, viewing-without-seeing glass eye. It all revolves around the viewer, the invisible centre (it is after all, the *central* region), or as Annette Michelson states in her essay ‘About Snow’: the spectator becomes a ‘lone center’ and ‘transcendental subject’.

La Région Centrale was conceived and shot during the two years which followed the most intensive period of America’s space program, culminating in the fulfillment of the Apollo Mission, itself the most extensively filmed and televised event in history. Snow’s film conveys most powerfully the euphoria of the weightless state; but in a sense that is more intimate and powerful still, it extends and intensifies the traditional concept of vision as the sense through which we know and master the universe. This film, in its circling, spiraling, rising, sweeping movements, crossing the distances between peaks, creating, in imperceptible loops through empty skies, reversals of direction which disorient the riveted spectator, seems to question, through kinetic counter-example and disorientation, the ‘ground’ of the Kantian ‘view’ which founds the modern sense of ‘place’ (...) *La Région Centrale* gives new meaning to the notion of science fiction.⁴

4. Annette Michelson, ‘About Snow’, in *October*, vol. 8, (Spring, 1979), pp. 121, 123.

As in other films by Michael Snow (especially *Wavelength*, a 'monument of time' according to Snow), the focus is on the constant movement of film-time and the properties of the apparatus. The dominant format of cinema (with its Renaissance perspective) is challenged and classic narration is redefined. *La Région Centrale* follows such structural explorations: there is no edge to the film frame or any kind of traditional composition; no central object (meaning) imposed on us by the author, no centre to the image or implied values... In other words: there is nothing to see but the seeing itself.

Research into absolute vision and a universal language of film was begun by avant-garde filmmakers in the 1920s, and perfected in the oeuvre of Stan Brakhage. His 'hypnagogic vision' is situated on the eyelids (closed-eye vision), and it reveals a world before cognition or referentiality. The film *Landfill 16* (2011) by Jennifer Reeves continues this line of exploration, even to the point of painting on the surface of the film, but she operates from a slightly different ethical position. Re-using film images is a well-known practice in 'minor cinema'. Found footage or compilation films are made of snippets of existing films, appropriated to create new meaning while also transferring the aura of their original context. This type of recycling rewires images with new connotations but it also evokes the usual problem of the mass-production in industry and art. It becomes a comment on modern hyperproduction and wastefulness. *Landfill 16* provides a many-layered answer to these issues. The film is made from outtakes from other film by Reeves, materials that would usually be 'buried in a closet'. It was instead buried in Reeves' 'landfill' in Elkhart, Indiana. This forms the second layer, the layer of the earth itself. The enzymes, bacteria and fungi worked on the film in those few months underground, leaving their organic mark on the strip. The filmstrip was then optically printed and hand-painted, working around and together with the landmarks left by the soil. There is something deeply earthy in these pulsating abstract images (with only a few figures emerging from the chemical pool). It is like a window into the processes carried out in the soil. It is also an insight into the depth of the analogue medium and the possibilities of its unique physicality. Reeves makes a strong argument in her short text about the film: 'A meditation on the death of a film medium and "nature"

losing battle to decompose the relics of our abandoned technologies and productions.'

Inger Lise Hansen redefines geography by animating every single frame of her film *Traveling Fields* (2009) with a travelling upside-down camera. It creates shifts in perspective and turns the landscape into a disorienting country. An extreme motion parallax is used to elevate this illusion to the fullest: as we move, objects that are closer to us move farther across our field of view than objects that are in the distance. Depth perception allows us to see the world in three dimensions but one can argue that the context of the landscape occupies this 'third' dimension and gives the film an additional depth. The land that is turned on its head is the harsh and strange Arctic geography of the Murmansk region on the Russian Kola Peninsula, with its mining enterprises (like The Kola Mining and Metallurgy Company), and polluted industrial cities such as Nikel, Zapolyarny, Apatity and Monchegorsk.

Similar questions arise in *Reconnaissance* (2012), in which Johann Lurf fabricates geo-human-logic processes by showing earthy eerie throbs fused with the pulses of human involvement and history. The word 'reconnaissance' is used by the military for operations that ascertain an enemy's intentions by collecting relevant data. This certainly frames the target of the film and prepares us for the voyeuristic game of detection that is being prepared. The site is the Morris Reservoir, Azusa, California, used for decades as a military torpedo testing site and water source. It is filmed with a long-distance lens and presented in silence, as in an intelligence-gathering operation, but it is also clear that this is as close as one is allowed to get to the site. What we see is all but a static operation of observation: uncanny shifts soon start to challenge our perception, and play tricks on our senses. A ghostly presence is revealed. The marks of the past linger around the site and expose deep deposits of human and geologic time. Is there a humanless space left on Earth or is it all saturated with meaning? Earth pulsates, moves. Nothing is fixed.

Reign of Silence by Lukas Marxt (2013) is a sharp piece of 'transcendental cinema' that shows how interventions in the landscape confront us with our own transience in time. In one static shot we are confronted with a calm polar lake. Suddenly a boat enters the scene, to the sound of the filmmaker's voice off-screen. As a

seemingly witty homage to Robert Smithson's *Spiral Jetty* (1970), the boat creates a spiral and then leaves as the ripples disappear. The same image from the beginning slowly returns. There is a touch of optimism about this piece, suggesting that the world might move in cycles – the end of the film mirrors the beginning – but there is also a feeling of incredible anxiety and a dread of facing our own mortality and our insignificance in the greater scheme of things. Marxt's film *High Tide* presents another powerful image: before us are a great mountain and grey sky, below is the dark pounding sea. The view seems timeless and surreal. Nothing moves except the elements. As the camera suddenly starts panning and we begin turning our head towards the ominous endlessness of the landscape beyond the image, we become uncannily aware of the place from which we are observing this estranged and powerful exterior. It is an anxious gesture, like looking over your shoulder. *High Tide* is a film of pure objects. It reveals a nervous realisation that this gaze we point towards 'nature' is returned to us, that we too are observed by our own interventions in the world.

Slow Action (2010) by Ben Rivers is a mocu-ethnographic science fiction experimental film about imagining societies that might evolve on faraway islands characterised by severe climate, isolation, and addiction to natural resources. Slow action, evolutionary time, time for the species to change. In isolated systems, islands or habitats surrounded by hostile conditions, isolated populations follow different evolutionary trajectories, as shown by Charles Darwin's observations of finches on the Galapagos Islands. In *Slow Action* we roam the Earth of the faraway future or past in post- or pre-apocalyptic landscapes, 'when sea levels have risen and created new islands and archipelagos, which have developed as idiosyncratic societies'. The film studies micro-utopian cultures that have evolved on four very different islands in terms of geography, climate or vegetation. The society of the fictional island 'Eleven' was filmed on the volcanic island Lanzarote, one of the driest places on the planet; 'Kanzennashima' on Battleship Island, a rocky island off the coast of Nagasaki once exploited for its rich coal reserves, densely populated

by mining families, and abandoned when the coal ran out; the land of 'Hiva' (The Society Islands) was filmed on Tuvalu, one of the smallest countries in the world, a tiny strip of land barely above sea level in the middle of the Pacific Ocean; and finally, 'Somerset' – 'cut off and drifted apart from the rest of Britain somewhere in the very distant future'.⁵

There is an interesting narrative running through *Slow Action*, written by science fiction author Mark von Schlegell. Somewhere in the vast emptiness of the Pacific Ocean, the narrator makes a statement that should be remembered: 'An islander is self-consciously aware of the possibility of other islands and the limitations of his world. Everywhere new utopias are possible.'

5. Ben Rivers – *Slow Action*, interview by William Fowler, [http:// www.vdrome.org/rivers.html](http://www.vdrome.org/rivers.html)

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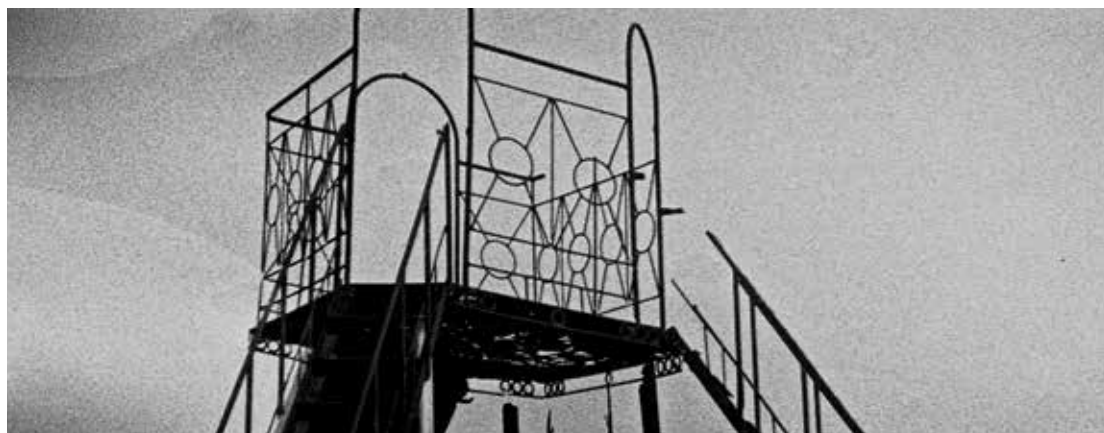
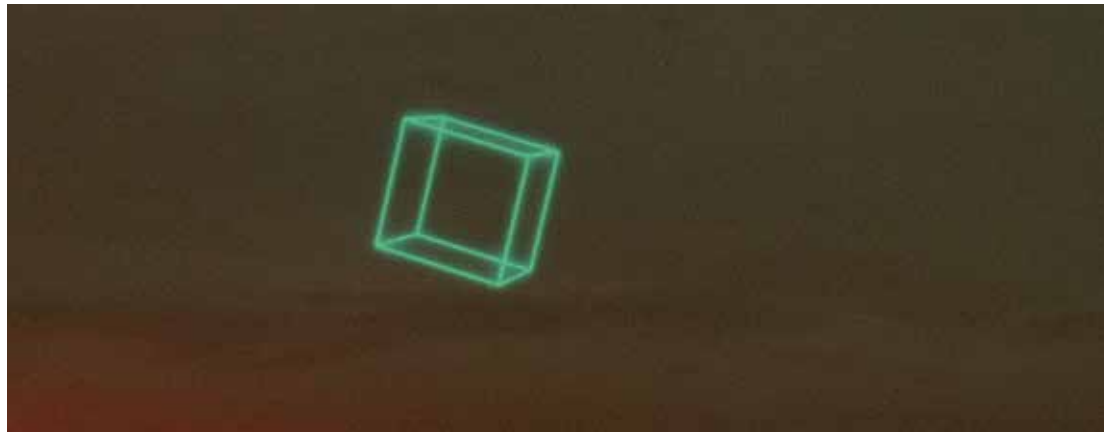


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Ben Rivers, *Slow Action*, 2010, 16 mm anamorphic, 45', colour/black & white.

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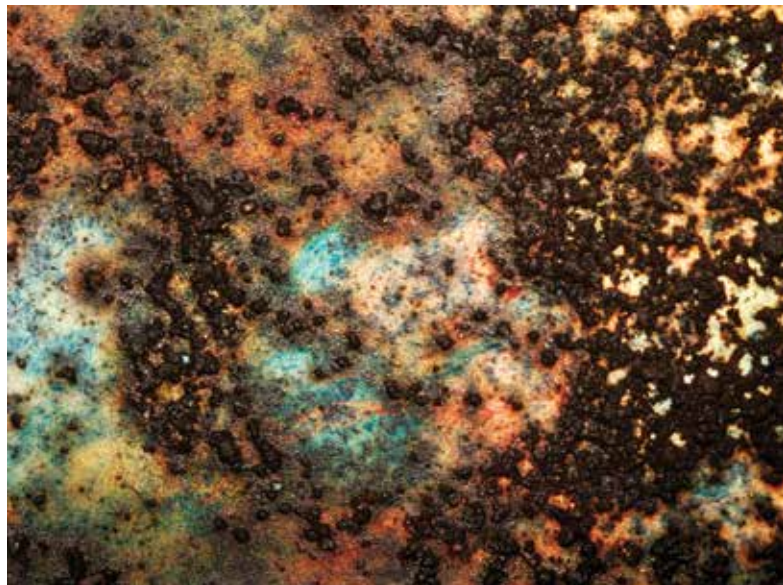
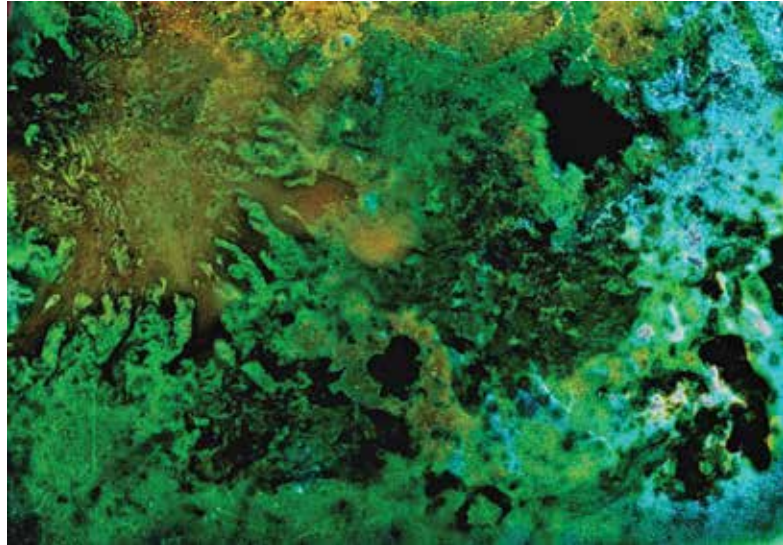


Ben Rivers, *Flow Action*, 2010, 16 mm anamorphic, 45', colour/black & white.

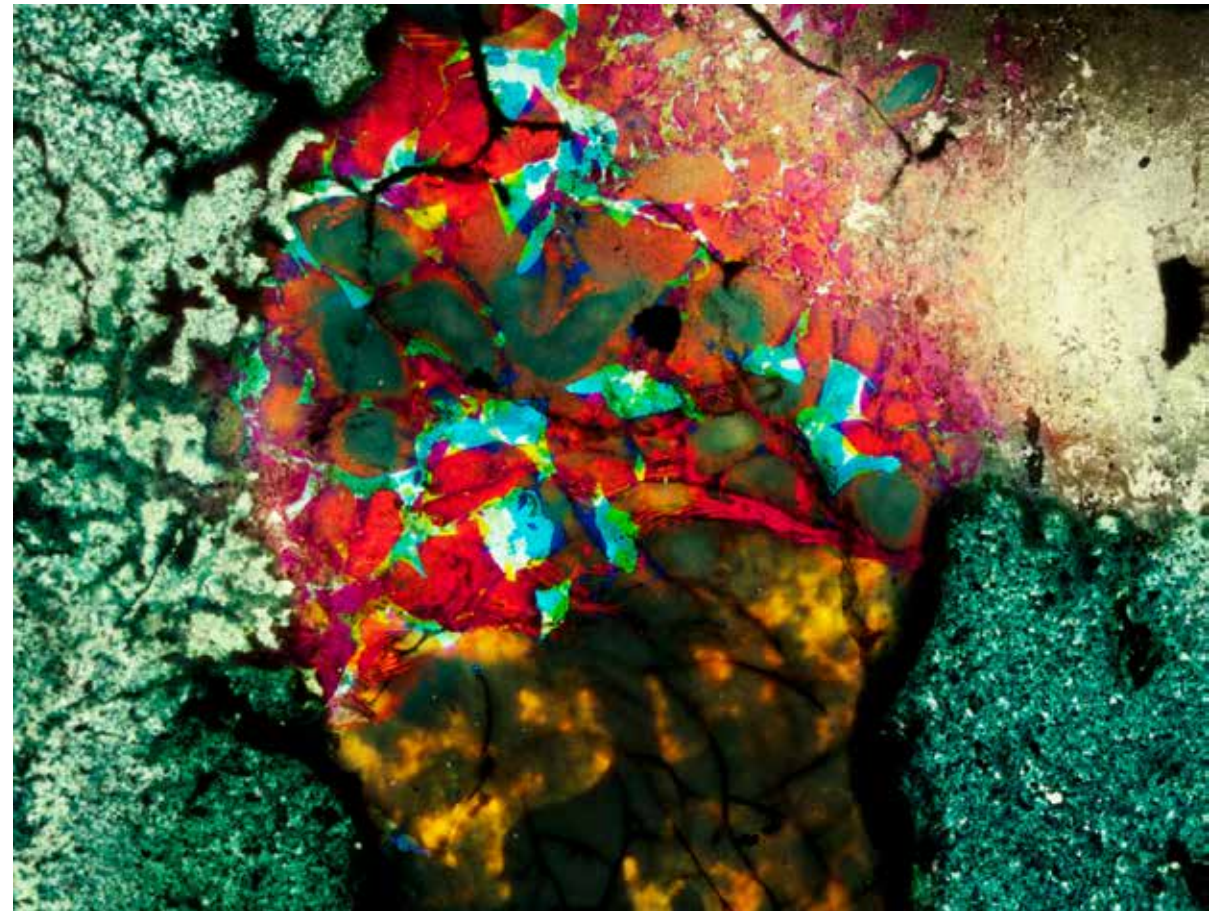
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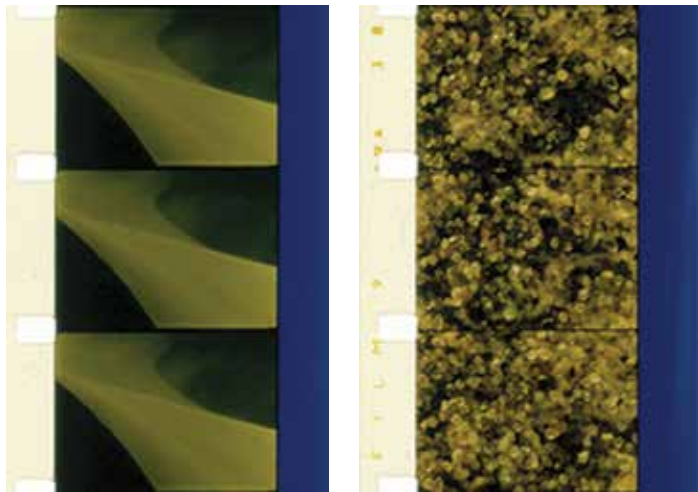
Johann Lurf, *Reconnaissance*, 2012, HD, 5', silent.



Jennifer Reeve, *Landfill 16*, 2011, 16 mm, 9'.



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Nathaniel Dorrky, *Alaya*, 1976-87, 16 mm (18 fps), 28'.

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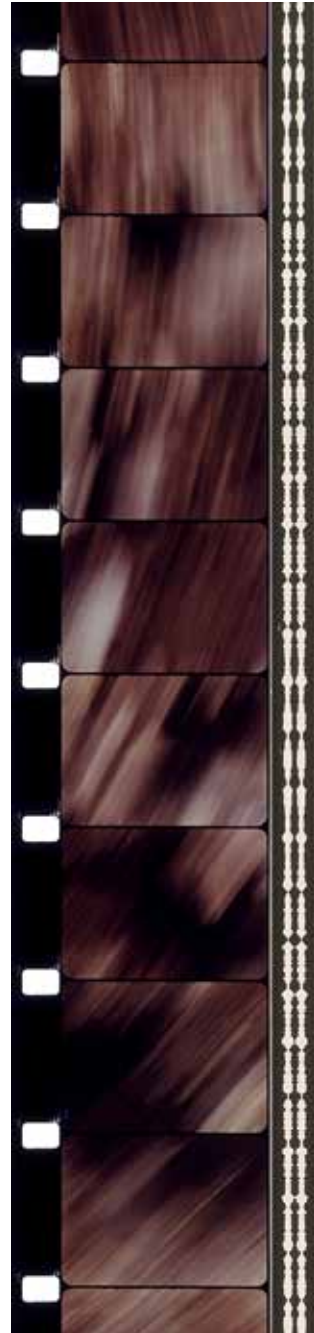


Lukas Marxt, *High Tide*, 2013, HD, 7'20''.



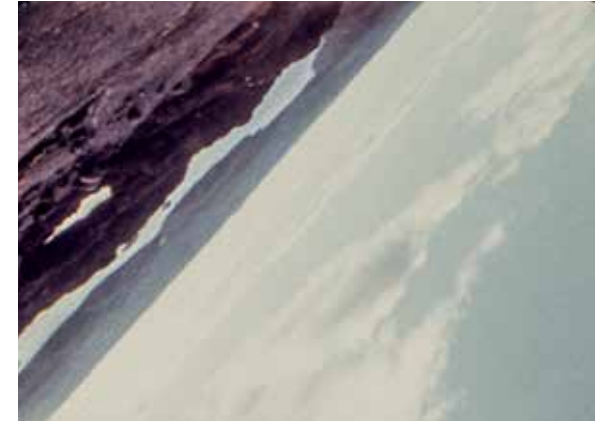
Lukas Marxt, *Reign of Silence*, 2013, HD, 7'20".

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Michael Snow, *La Région Centrale*, 1971, 16 mm, 190'.

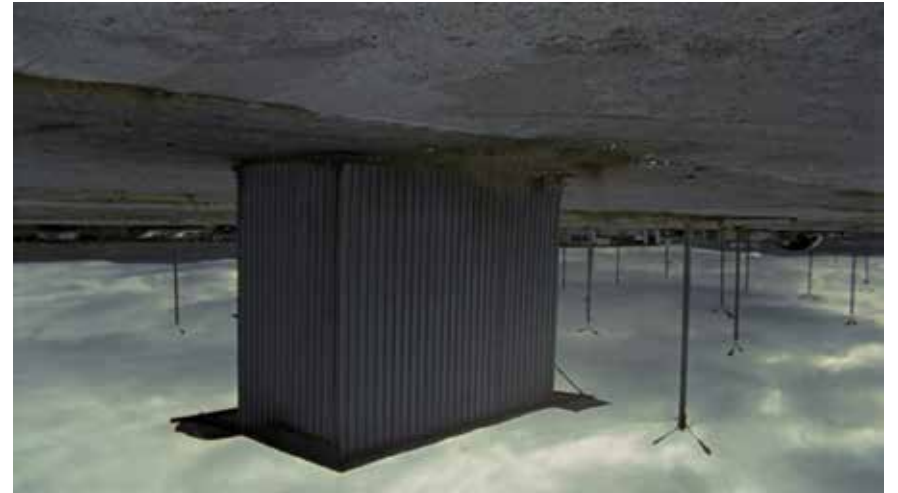
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Inger Lire Hanren, *Travelling Fieldr*, 2009, 35 mm, 9'.

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Karl Lemieux & BJ Nilren

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Sound recordist BJ Nilssen and experimental filmmaker Karl Lemieux travelled to Kirkenes in Norway's northern extremities and across the Russian border to the mining towns Nikel, Zapolyarny and Prirechny in Murmansk Oblast. They made field recordings for a new collaborative audiovisual performance. A diary and visual impression of their travels supplements the sound composition *unearthed* that is included with this publication.

9–17 October 2014

We are in Kirkenes, a small town in the far north-eastern part of Norway adjacent to two fjords: Bøkfjorden and Varangerfjorden.

About 70 years ago, the Soviet Red Army overran this town, expelling the German Wehrmacht. Because of its strategic location it was one of the most heavily bombed cities during WWII and it was systematically razed towards the end of the war as the German forces fled. The landscape seems wounded and exhausted, but now not from bombing raids; instead, weathering, mining, and recent land excavations have left their scars. Minerals have been mined here since 1866, when ore was first discovered. What is unearthed here has hidden beneath the surface for at least 1800 million years.

Upon arrival, I am stunned by the many colours and seemingly clean air. The temperature is dropping fast now. It's only a matter of days before the first snow falls. Here, the changing of the seasons is very apparent. Later that night we witness the rapid bursts of the aurora borealis. This place certainly has a special energy that could be related to the residues of war, extreme nature, or the magnetite that is brought up to the surface.

Although working mainly as a sound recordist, I cannot ignore visual information. I often imagine a sound before hearing it. While observing the majestic structure on the hill that is the building of the Sydvaranger iron ore mine with its distant but ever present hum, I cannot help but wonder how it sounds close-up, and even more so from the inside.

As it happens, the following day a small group of us are invited to visit the mine. I tell Karl and since both of us have been attracted to industrial landscapes for a long time, neither of us hesitates about signing up for the trip. Once we step inside the mine everything changes. The interior and ground are covered with a thick black

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coating. Puddles of black water reflect the light like mirrors. The light is dim and we now realise the importance of the extensive safety instructions we were issued before entering the mine. We had to fill in a form and provide a relative's contact details in case of accident or death.

A wall of sound greets us. The machines do most of the work, while the humans supervise, paying little or no attention to our presence. In the main hall, a radio blares out top-ten hits, but the music is barely audible – the sound of the machines is so immense and overwhelming, a massive background of noise blending with the shrieks of alarm signals. We stop at a huge washing machine with handball-sized boulders that are tossed around inside, crushing whatever is in there. I record the metal on metal sounds with great enthusiasm. As we walk further into the mine, the sounds seem to become more discernible, details are revealed with less static noise. I decide to linger behind the group to avoid recording our guide, who shouts over the machinery to explain every step of the production.

I wish we could stay here longer, but we have to move to the next section. We are slowly approaching the deepest point in the mine, the temperature is rising, and the air is becoming significantly hotter. The helmet, headphones and other protective gear complicate the recording work even more. The heat fogs up my spectacles and safety glasses. Equipment that is supposed to protect me is starting to work against me. All I can see is a blurry haze. I can only navigate with my microphone.

Suddenly, we are out in the open, back on the hill where we started. The air is cold and damp. We are surrounded by black hills of mined ore. The sun has almost set and the dark blue sky blends beautifully with the soot and moisture. Out in the open, we can hear the lush drones of machinery bleeding through the tunnel. I do a bit of ambience recording as we make our way down the slopes back into town.

A few days later in the early morning we get into our car and set out for the Norwegian–Russian border. The weather is wet and foggy, the air is dense and still. At the border post, we present our paperwork and visas. Only the sound of passports being stamped reverberates around the otherwise silent hall as we are cleared to enter Russia. Because of the thick fog we are travelling at a very slow speed. We cannot see much of the landscape beyond the barbed

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wire fence that runs alongside the road. I am told that they just recently installed a CCTV system alongside the road, so we are being monitored and expected on the other side. As we travel through this no-man's-land with its uninhabited zones, I imagine I'm on the set of an old Mosfilm movie.

The fog accompanies us all the way to Nikel. It will be a couple of hours before it clears up and the sun comes out. We join a guided walk around the town that begins on Lenin Square, and returns via the factory site to the town centre. Nikel's red and white chimneys hiss and growl as they spew out clouds of smoke. The air is difficult to breathe today. With little wind, the acoustics are more noticeable and sound travels in unexpected patterns between the blocks of buildings. There is also an interesting short echo effect in some open-air locations, perhaps resulting from the reflective façades on the buildings and the lack of vegetation.

The dirt roads and ditches around the area are filled with litter. One of the oily puddles exposes a bloated dead black cat.

Standing on a small gravel road somewhere between Nikel and Zapolyarny, one realises how vast this country is. The landscape stretches eastwards almost endlessly into the Russian void. The first snow of the year has fallen, a layer an inch thick. The landscape is talking to us. No sign of wildlife. This first snow is a warning; in a few months the temperature could drop well below minus 25 degrees with up to a metre of snow. The distant sound of cars from a nearby road fades in and out with the cold wind.

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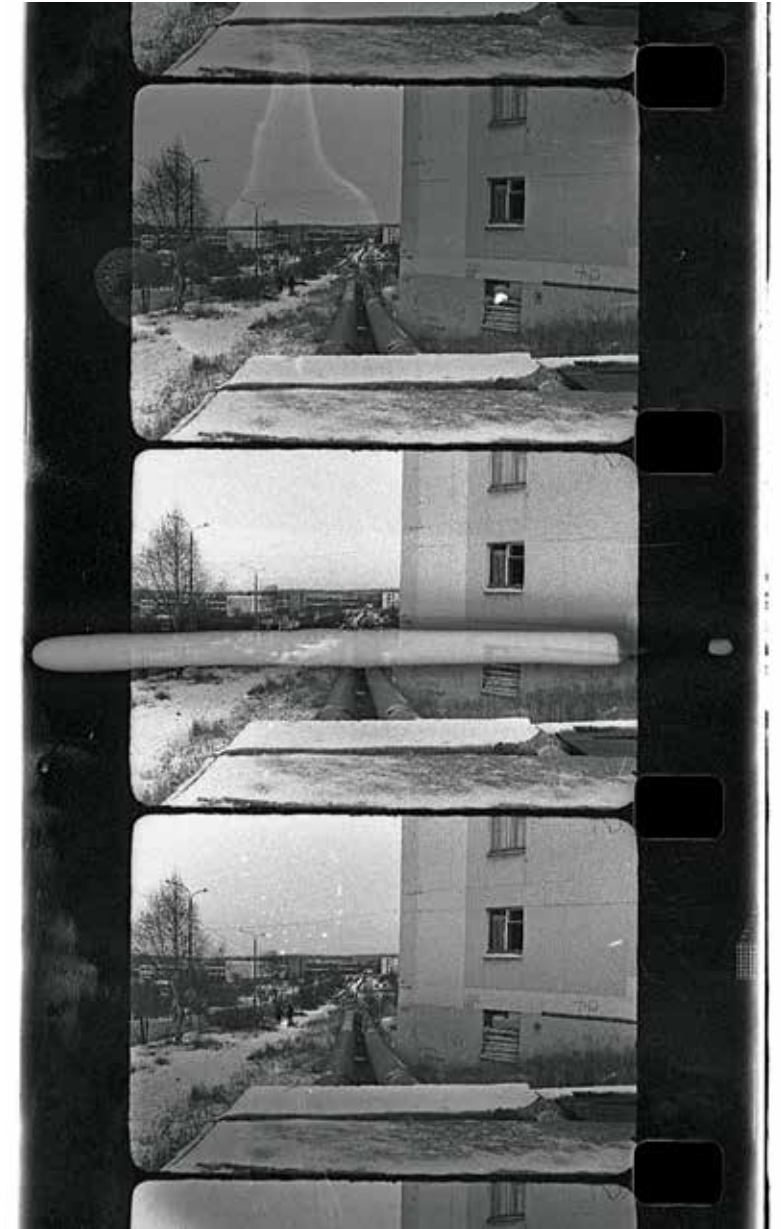
BJ Nilren walking in Nikel.

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Prirechny



Nikel

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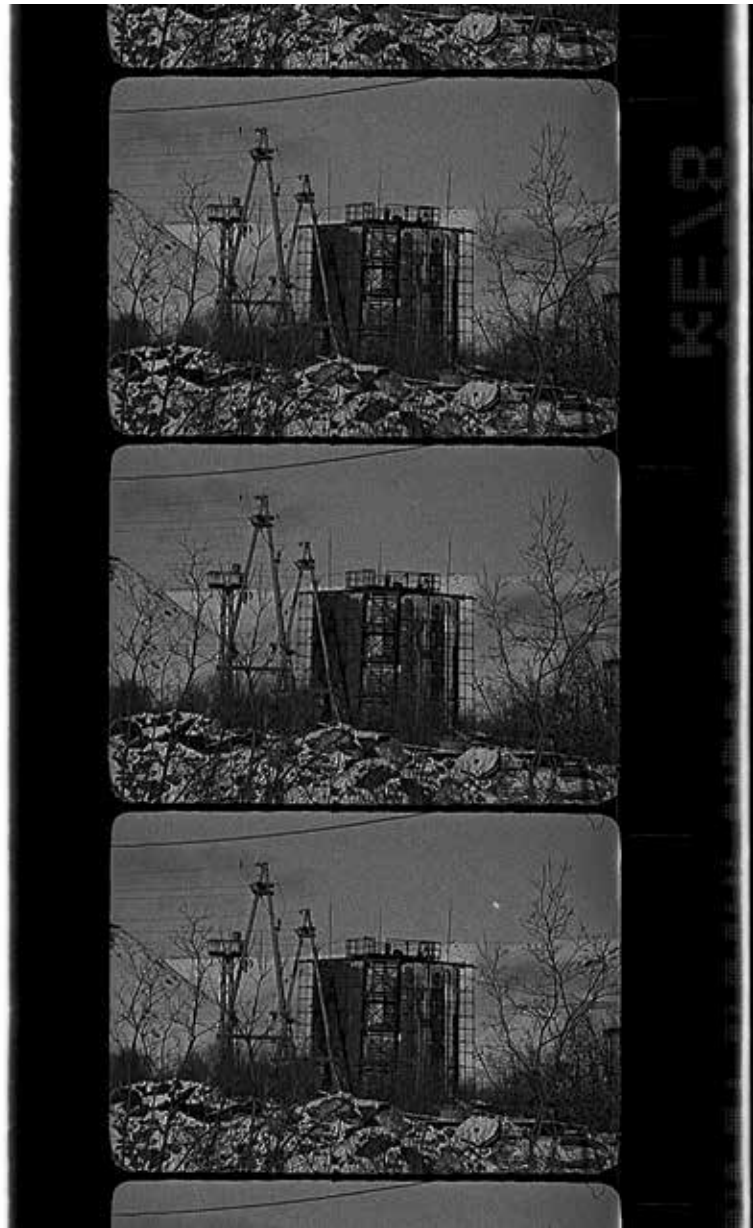
Factory in Nikel



Line valley

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Nikel



Prirechny

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Prirechny



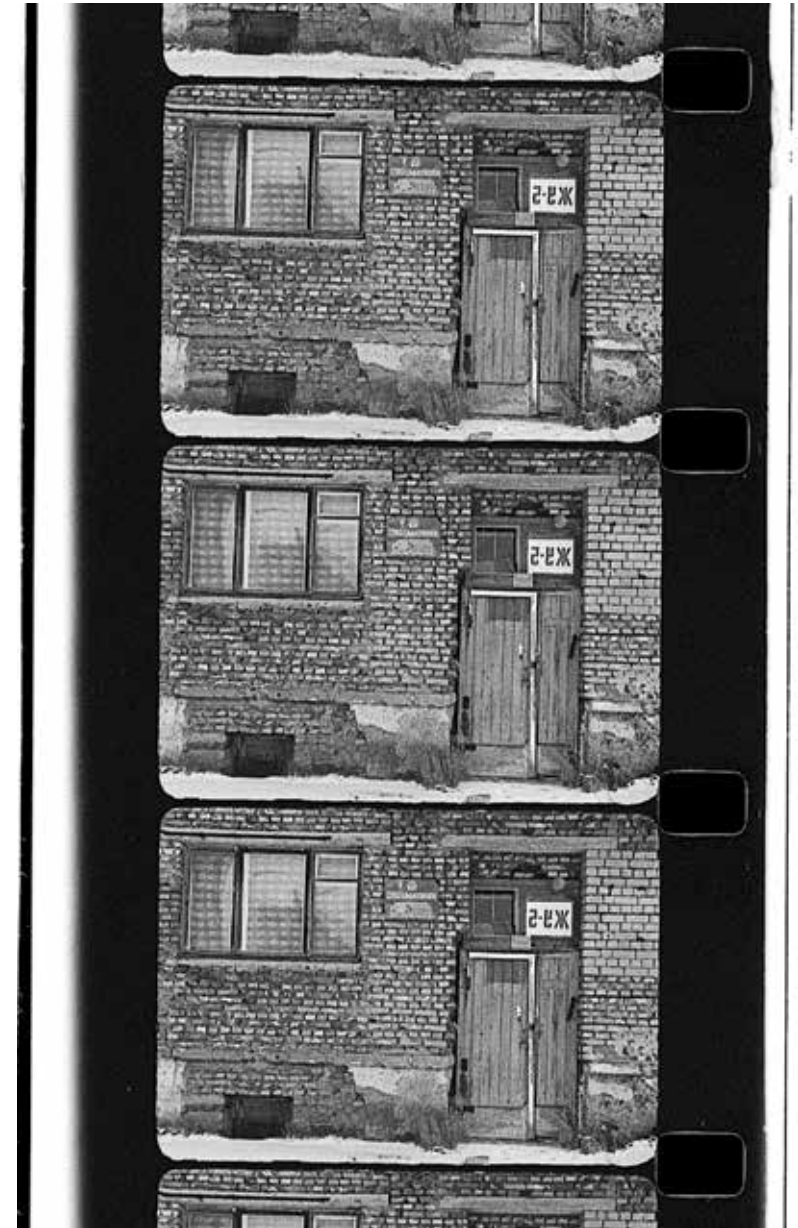
Prirechny

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Zapolyarny

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Prirechny

Arie Altena (NL) is a curator and editor for *Sonic Actr*. He studied literary theory, and writes about the interrelations between art, media and technology.

Mirna Belina (HR) researcher, writer and curator in the fields of experimental film and new media art. She has co-edited several books about experimental film and expanded cinema, and has curated many short film programmes for international festivals and venues. She studied literature and philosophy at the Faculty of Humanities and Social Sciences, Zagreb University, where she is currently doing a PhD in the field of film.

Paul Bogard (US) is the author of *The End of Night: Searching for Natural Darkness in an Age of Artificial Light* (2013). He is also the editor of the anthology *Let There Be Night: Testimony on Behalf of the Dark* (2008), a collection of essays by 28 writers on the value of darkness and the costs of light pollution. His writing has appeared in print and online in *Slate*, *Salon*, *Los Angeles Times*, *Outside*, *Audubon*, *Conservation*, *Reader's Digest*, *National Geographic*, *Creative Nonfiction*, and elsewhere. A native Minnesotan, Paul Bogard grew up watching the stars and moon from a lake in the northern part of the state. He has lived and taught in New Mexico, Nevada, Wisconsin, and North Carolina, and is now Assistant Professor of English at James Madison University in Harrisonburg, Virginia, where he teaches creative nonfiction and environmental literature.

The Centre for Land Use Interpretation (US) is an educational organisation established in 1994 to increase and disseminate information about how the US landscape is apportioned, utilised and perceived, to make Americans more aware of, and interested in the physical characteristics and cultural significance of the shared landscape of the US.

Dipesh Chakrabarty (AU/IN) is the Lawrence A. Kimpton Distinguished Service Professor of History, South Asian Languages and Civilizations, and Law at the University of Chicago. He is a founding member and editor of several journals, such as *Subaltern Studies* and *Postcolonial Studies*. He has just finished *The Calling of History: Sir Jadunath Sarkar and His Empire of Truth* (forthcoming). He is also working on two books provisionally entitled *The Climate of History: Four Theses and History and the Time of the Present*.

Matthew Coolidge (US) is the founder and director of the Center for Land Use Interpretation, an organisation established in 1994 that produces public programming about the built landscape of the US.

Elizabeth Ellsworth (US) is Professor of Media Studies at the New School, New York. Her research and teaching focus on the design of mediated learning environments; media, theories of becoming, and social change; and documentary media forms. She translates results of her research and writing into media forms, exhibitions and projects. She is co-founder, with Jamie Kruse, of *smudge*, and co-edited a collection of essays with her entitled, *Making the Geologic Now: Responses to Material Conditions of Contemporary Life* (2012).

Kodwo Eshun (UK) is a London-based British-Ghanaian writer, theorist and artist. In 2002, he co-founded the Otolith Group with Anjaliika Jagar, an artist collective that was nominated for a Turner Prize in 2010, exhibited internationally, and has curated film series and exhibitions on the Black Audio Film Collective and Harun Farocki. He is the author of *More Brilliant than the Sun: Adventures in Sonic Fiction* (1998), and has written for *The Wire*, *Frieze* and *The Guardian*. He studied English Literature at University College, Oxford University, and is now the Course Leader of the MA in Aural and Visual Cultures at Goldsmiths College, University of London.

Raviv Ganchrow (US/NL) is a sound artist and researcher. His work focuses on interrelations between sound and space, aspects of which are explored through sound installations, writing and the development of acoustic-forming and vibration-sensing technologies. He is currently a faculty member at the Institute of Sonology, The Hague.

Kurt Hentschläger (AT/US) creates audiovisual performances and installations. He works predominantly with time-based media, light and sound. The immersive nature of his work reflects on the metaphor of the sublime and the human condition in the 21st century. He investigates human perception and the impact of new technologies on individual and collective consciousness. Between 1992 and 2003 he worked collaboratively with Ulf Langheinrich as the artist duo Granular Synthesis. He is currently a full time Visiting Artist at the School of the Art Institute of Chicago.

Femke Herregraven (NL) is a designer and researcher whose work traverses global finance, information and geopolitics. Concepts that run through her work are the geographies of avoidance and the financial world's ability to carve out new geographies through spatial organisation. She is curator at *Sonic Actr*, part of the *Bitcaver* collective and has been a tutor of Design Research at ArtEZ Academy of Arts in Arnhem since 2011.

Marijn de Jong (NL) is a photographer from the Netherlands who specialises in landscape and portrait photography.

Douglas Kahn (US) is a historian and theorist of media, the arts and music with concentrations in the study of sound, electromagnetism, and natural media. He is Professor of Media and Innovation at the National Institute of Experimental Arts (NIEA), University of New South Wales, Sydney, and the author of *Earth Sound Earth Signal: Energies and Earth Magnitude in the Arts* (2013), and *Noise, Water, Meat: A History of Sound in the Arts* (1999). With Hannah Higgins he edited *Mainframe Experimentalism: Early Computing and the Foundations of the Digital Arts* (2012); with Larry Austin *Source: Music of the Avant-garde, 1966-1973* (2011), and with Gregory Whitehead *Wireless Imagination: Sound, Radio and the Avant-garde* (1992).

Lierbeth Koot (NL) holds degrees in dance, literature and philosophy. She writes about art and science, and predominantly about the intersection of the two. She is interested in making connections: between research and society, between art and audience, and between science and the humanities.

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Jamie Kruse (US) is an artist, designer and part-time lecturer at Parrons, The New School for Design, School for Design Strategies, New York. She co-founded *smudge*, with Elizabeth Ellsworth in 2005. She is the author of the Friends of the Pleistocene blog, (fopnews.wordpress.com) and co-edited a collection of essays with Elizabeth Ellsworth entitled, *Making the Geologic Now: Responses to Material Conditions of Contemporary Life* (2012).

Karl Lemieux's (CA) films, installations, and performances have been screened internationally in museums, galleries, music venues and film festivals. He is more widely known as the ninth member of Godspeed You! Black Emperor, a Montreal music collective for which he does live 16 mm film projections. His collaborators include sound artists such as Philip Jeck, BJ Nilren, Francisco Lopez, Roger Tellier-Craig and Alexandre St-Onger. Together with Daichi Jaito he founded Double Negative Collective, a Montreal-based collective dedicated to the production and dissemination of experimental films.

Noortje Marres (NL) is Senior Lecturer in the Sociology Department and Director of the Centre for the Study of Invention and Social Process (CSISP) at Goldsmiths, University of London. She is the author of *Material Participation: Technology, the Environment and Everyday Publics* (2012), which will come out in a revised paperback edition in January 2015. Noortje Marres has a background in the social studies of science and technology, and has worked on issues of democracy in technological societies. She has also contributed to the development of digital forms of social research, in particular issue mapping, and is

currently writing a book on Digital Sociology (forthcoming).

Tim Maughan (UK) is a writer who uses both fiction and nonfiction to explore issues around cities, art, class, and technology. His debut short story collection *Paintwork* received critical acclaim when released in 2011, and his short story *Limited Edition* was shortlisted for the 2012 BSFA short fiction award. He sometimes makes films, too.

Timothy Morton (US) is a professor and the Rita Shea Guffey Chair in English at Rice University, Houston. He is the author of *Hyperobjects: Philosophy and Ecology after the End of the World* (2013), *Realist Magic: Objects, Ontology, Causality* (2013), *The Ecological Thought* (2010), *Ecology without Nature* (2007), seven other books and 120 essays on philosophy, ecology, literature, food and music.

BJ Nilren (SE) is a Swedish composer and sound artist based in Berlin and London. His work primarily focuses on the sounds of nature and how they affect humans. His two latest solo albums, released by Touch, *Eye Of The Microphone* (2013) – based on the sound of London – and *The Invisible City* (2010), explore the urban acoustic realm. He collaborated with Chris Watson on *Storm and Wind*, also released by Touch (2006, 2001). His original scores and soundtracks have featured in theatre and dance performances and films, including *Microtopia* and *Tert Site* (2013, 2010, dir. Jesper Wachtmeister), *Enter the Void* (2010, dir. Gaspar Noé), and, in collaboration with Jóhann Jóhannsson, *I Am Gere* (2014, dir. Anders Morgenthaler).

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Julian Ross (UK) is an Amsterdam-based British-Japanese researcher, curator and writer. Recently completing his PhD on Japanese expanded cinema at the University of Leeds, he has curated film programmes for Anthology Film Archive, Eye Film Institute and Yerba Buena Center for the Arts. He has published articles in *Impure Cinema*, *Slow Cinema* and in *The Japanese Cinema Book*. He joined the International Film Festival Rotterdam as an advisor for IFFR Shorts in 2014.

Carsten Jeiffarth (DE) is the founder and artistic director of Berlin sound art gallery *singuhr – hoergalerie*. Together with Carsten Stabenow he is one of the driving forces behind DOCK e.V., an art and media initiative in Berlin that aims to create a backbone for production in the field of art and technology. As an independent curator Jeiffarth produces sound art exhibitions internationally.

Mario de Vega (MX) creates site-specific interventions, process-oriented projects, sculptures and actions. His work focuses on the perceptive capacities and incapacities of humans. He produces situations for specific spaces, using the context to explore the value of fragility and randomness. He leaves space for the exploration of the unknown, the uncanny, the unseen, the unheard, and the unpredictable. He lives and works in Berlin and Mexico City.

Lucas van der Velden (NL) studied at the interfaculty for image and sound at The Royal Conservatory and the Royal Academy of Art in The Hague. He is co-founder of the Rotterdam art collective *Telcosystem*. *Telcosystem's* work has been exhibited in galleries and museums around the world and the collective have received a

number of awards for their films. He co-founded *Baltan Laboratories* in Eindhoven. He has been the director of the *Sonic Act* Festival since 2003.

Michael Welland (UK) obtained a BA and a PhD in geology from Cambridge, an MA from Harvard, and went on to a career with the British Geological Survey in Oman, followed by university teaching and research in the US, and over 20 years in technical and management positions in the international energy industry. He set up his own consulting and training company, *Orogen Limited*, and his experience has involved travel and work around the world. He wrote the award-winning book *Sand – A Journey Through Science and the Imagination* (2009) and *The Desert – Lands of Lost Borders* (2015). Welland has given public lectures and radio broadcasts in the US and the UK, and writes a blog on all topics sandy and arid. He now divides his time between London, France, and international projects, most recently in Central Asia, Egypt, and Indonesia.

Liam Young (UK) lives and works in London as an independent designer, futurist, critic and curator. He is a founder of the think tank *Tomorrow's Thoughts Today*, a group whose work explores the consequences of fantastic, perverse and underrated urbanisms, and teaches around the world. His projects deploy fictional near-future scenarios as critical instruments for instigating debate about the social, architectural and political consequences of emerging biological and technological futures. He is part of *The Unknown Fields Division*, a nomadic design studio that explores unreal and forgotten landscapes, alien terrains and obsolete ecologies.

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Sonic Actr 2015 The Geologic Imagination

The Geologic Imagination is curated by Arie Altena, Nicky Assmann, Mirna Belina, Martijn van Boven, Femke Herregraven, Bronne Keersmaat, Gideon Kiers, Lierbeth Koot, Lucas van der Velden, Annette Wolfsberger, Juha van 't Zelfde.

Production

Eve Dullaart, Marianne Eerenstein, Sebastian Frisch, Erwin van 't Hart, Mark den Hoed, Julia Nüsslein, Jorg Schellekens, Annette Wolfsberger

Communication

Bar de Beer, Pleun Gremmen, Valentina Lisak, Janne Lohof, Rosa Menkman, Mark Poyrden

Design

Femke Herregraven,
Nina Støttrup Larsen / Bitcaver

Website development

De Gebroeders van Leeuwen

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Roman Khoroshilov, Hilde Methi, Julia Nüsslein, Guro Vrålstad, Annette Wolfsberger

Communication

Ivan Afanasyev, Fridaymilk, Janne Lohof, Mark Poyrden

Design

Femke Herregraven / Bitcaver

Website development

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Editors

Arie Altena, Mirna Belina,
Lucas van der Velden

Final editing

Arie Altena, Mark Poyrden

Design

Femke Herregraven / Bitcaver

Image research

Pleun Gremmen

Interview transcripts

Valentina Lirak

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info@sonicacts.com
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The receding Aral Sea has left huge plains covered with salt and toxic chemicals - the results of weapons testing, industrial projects, and pesticides and fertiliser runoff - which are picked up and carried away by the wind as toxic dust and spread to the surrounding area.



'It is clearly one of the worst environmental disasters of the world... It really left with me a profound impression, one of sadness that such a mighty sea has disappeared.' - Ban Ki-Moon, 'Shrinking Aral Sea Underscores Need for Urgent Action on Environment', in *UN News Centre*, 4 April 2010.

