ELE CARPENTER
RADIOACTIVE NON-SITES

Artists are increasingly visiting nuclear sites and directly engaging with the physical infrastructure of the nuclear economy. Although it is logistically easier to investigate historical sites that have already been decommissioned, where institutions are keen to document modernist nuclear heritage, there is also an urgency to respond to nuclear events as they unfold at a specific time and place. Engaging with nuclear installations and processes requires a long-term commitment to researching specialist knowledge and building relationships across disciplines. Artists also encounter nuclear materials in their locale, navigating the extreme dichotomies between pro- and anti-nuclear lobbies and their expectations of art. Often working collaboratively, through a process of dialogue, artists rethink the processes of mapping, reclaiming materials and vocabularies.

Power in the Land is an art project initiated by artist Helen Grove-White inviting artists to respond to the decommissioning of the Wylfa Nuclear Power Station, in Anglesey, Wales.[1] Wylfa was the last operating Magnox plant in the world, and will be decommissioned over the next few decades. The artworks capture the mythologies and materials of the site and reflect on the long timescales of building and decommissioning. Alana Tyson's quilt made from fabrics from the area, reveals how the nuclear has co-opted the language of health and safety whilst Annie Grove-White's films capture the naivety of building an industry without a waste-management solution. In the US smudge studio's *Only Follow the Movement*, tracking and mapping the transportation of radioactive waste across the United States of America highlights a complex network of nuclear sites and the circulation of nuclear materials between them.

In the northwest of England, the *Cumbrian Alchemy* project by Robert Williams and Bryan McGovern Wilson investigates deep time archives of past and future in response to the proposal to build a geological radioactive waste repository. The project includes an archive of the mythology of the landscape, its nuclear and anti-nuclear histories, along with a performance of Sebeok's *Atomic Priest*. In 1984 Thomas Sebeok was charged with proposing a semiotic solution for preventing human interference at nuclear waste sites for millennia. He proposed that an "Atomic Priesthood" of nuclear experts could hold secret atomic information and perpetuate "accumulated superstition" to lead people away from nuclear sites.[2] In contrast, the *Cumbrian Alchemy* project demonstrates the importance of an archive that represents a range of political and physical experiences of the nuclear with attention to the monuments of the past and future.

All of these projects attempt to get closer to the nuclear, rather than trying to escape or establish an alternative, they deal with the existence of nuclear materials and the way in which they shift the relationship between site and temporality. *Don't Follow the Wind* is a collective response to the Fukushima disaster by creating artworks inside the Exclusion Zone, inaccessible to the public.[3] Noi Sawaragi's essay about the *Don't Follow the Wind* Non-Visitor Center at the Watarium Museum of Contemporary Art, Tokyo, expands Robert Smithson's concept of the 'site' and 'non-site' to understand the relationship between the Exclusion Zone and the gallery. Here the nuclear site is configured as 'elsewhere' evidenced in the documents mediated by the gallery.

This concept of site and non-site is further investigated by Hilda Hellström whose vessels are made from soil collected in contaminated rice fields in the Fukushima Exclusion Zone. By creating unusable rice bowls from soil that can no longer grow rice, Hellström points not only to the loss of daily routines and agriculture in the area, but to the Exclusion Zone as a site removed from the ecology and culture of Japan.

Many artworks trace the relationships between sites, bringing the nuclear into a cultural field of vision. For the Aichi Triennale, Katsuhiro Miyamoto transposed the blueprints for the Fukushima Daiichi Sakae reactor building onto the interior architecture of the Aichi Arts Centre. The work collapses the distance between the reactor and the cultural centre of Nagoya. The impact of the disaster on Fukushima City has been extraordinary, where radiation plays a socially divisive role between those who are reassured by the clean-up operations, and those who are extremely concerned. Shuji Akagi has taken over 300,000 photographs of the decontamination of his home city of Fukushima, where the surfaces of public spaces have been scoured and the topsoil removed. His work documents the city as a site of radioactive decontamination, revealing the scale and detail of the operation. Sadly the high-level contamination of the sea is not so easily documented as the isotopes disperse into the 'elsewhere' of the Pacific Ocean, eventually to be detected on the West Coast of America and Canada.

Following the Fukushima nuclear accident, Finland was the first country to announce plans to build a new nuclear power station at Pyhäjoki, on the Gulf of Bothnia, northwest Finland. The proposal has been opposed by local people, and residents along the coast of northern Sweden who live downwind from the plant. Case Pyhäjoki: Artistic Reflections on Nuclear Influence was a trans-disciplinary expedition and production workshop that took place in August 2013, initiated by artist Mari Keski-Korsu. The participants created prototype events and experiments, including a DIY open hardware Geiger counter building workshop with Martin Howse and Erich Berger. In Umeå, northern Sweden, Bautafilm have made a documentary about Pyhäjoki, following Hanna Halmenpää's emergence as a Finnish anti-nuclear politician. Graphic designer Giuliano Garonzi has designed a page based on the Japanese paper *shide*, used to spiritually protect the Pyhäjoki site.

Radiation knows no boundaries. Its radioactive isotopes flow through water and air circulating the globe. Alpha and beta radiation enter the body interrupting cell function, mutating as they pass through. The visual arts describe the 'site-specific' as a response to the characteristics of a site, which in turn contributes or changes the site. Here art, like radiation, creates subtle shifts in the understanding of the relationship between time and place that changes knowledge of place and inheritance.

1 Power in the Land artists in this book include: Chris Oakley, Robin Tarbet, Annie Grove-White, Helen Grove-White, Bridget Kennedy, Alana Tyson and Jessica Lloyd-Jones.

2 Sebeok, Thomas, "Communication Measures to Bridge Ten Millennia", Technical Report prepared by Research Center for Language and Semiotic Studies, Indiana University, for Office of Nuclear Waste Isolation, 1984, p 24.

3 *Don't Follow the Wind* artists in the book include: Chim↑Pom, Shuji Akagi, Trevor Paglen, Franco and Eva Mattes, Grand Guignol Mirai, Kota Takeuchi, Taryn Simon and Nobuaki Takekawa.

WILLIAMS +
MCGOVERN WILSON

PRIEST AT CASTLERIGG

ı *Alchemy* is an art project by New York artist Bryan McGovern ıd British artist Robert Williams that explores the significant hips between the nuclear, mining and renewables industries of

British Atomic Nuclear Group design for Hollington and Kyprianou's *The Nightwatchman*, in Art & Radioactivity, Nicholls and Clarke building, Shoreditch, London, Arts Catalyst, 2008.

They called it the "happy 30s". An *annus mirabilis*, 1932 was the most exciting year in the history of twentieth-century physics. Harold Clayton Urey at Columbia University identified heavy hydrogen; James Chadwick at the Cavendish Laboratory in England identified the neutron; John Cockcroft and Ernest Walton, also at the Cavendish, achieved the first artificial nuclear disintegration by accelerating protons in a high voltage field; and Carl David Anderson at the California Institute of Technology identified the positive electron, or positron, as it is usually called. Each of these discoveries were later honoured by a Nobel Prize and the field of atomic physics came into its own.[1]

Around the same time, the cyclotron principle, of smashing open atoms by particles accelerated in a circular trajectory, was put into practice at a University of California Berkeley laboratory. The idea had been around for a while and found its way to Berkeley by way of a drawing in a publication by the Norwegian physicist Rolf Widerøe.[2]

Ernest Orlando Lawrence built his first cyclotron out of brass, wire, and sealing wax. Only 10 cm in diameter, it is said to have cost $25. The magnet for the next one, an 28 cm cyclotron, weighed 2 tons and this time the cost went up to $800.[3] Lawrence's original goal for the cyclotron was to be the first to disintegrate atomic nuclei to gain information about the structure of the atom, but Cockcroft and Walton had beaten him to it. One and one-quarter million-volt hydrogen ions were obtained with the cyclotron. This was the most energetic beam of particles ever produced in the laboratory. Describing the events of 9 January 1932, Milton Stanley Livingston, working with Lawrence on the cyclotron, remembered:

> I recall the day when I had adjusted the oscillator to a new high frequency, and, with Lawrence looking over my shoulder, tuned the magnet through resonance. As the galvanometer spot swung across the scale, indicating that protons of 1-MeV energy were reaching the collector, Lawrence literally danced around the room with glee. The news quickly spread through the Berkeley laboratory, and we were busy all that day demonstrating million-volt protons to eager viewers.[4]

As vital tools of nuclear physics, cyclotrons grew in diameter from 11 cm to 28 cm, 68 cm, 94 cm and 152 cm, and their cost grew from less than $100 to tens of thousands of dollars. A 465 cm machine was under construction by 1939, when Lawrence was awarded the Nobel Prize "for the invention and development of the cyclotron and especially for the results attained by means of this device in the production of artificial radioactive elements". At the award ceremony, the physicist Raymond Birge asserted: the progress of science is the progress of instruments.[5] In a radio show early on, Lawrence wanted us to know that the cyclotron would unravel the mystery of the universe and allow complete mastery of the physical world.[6]

The Berkeley Lab operated round the clock, seven days a week. "Lawrence will always be remembered", his colleague Luis Alvarez said,

1 Hughes, Jeff, "1932: the *annus mirabilis* of nuclear physics?", *Physics World*, July 2000, pp 43–50.

2 Livingston, M Stanley, "Early History of Particle Accelerators", *Advances in Electronics and Electron Physics*, vol 50, pp 2–85, 24; Close, Frank, Michael Marten and Christine Sutton, *The Particle Odyssey: A Journey to the Heart of Matter*, Oxford: Oxford University Press, 2002.

3 For a history and illustration of the cyclotron, see: Lawrence demonstrating the cyclotron principle: https://www.youtube.com/watch?v=cutKuFxeXmQ; for the cyclotron's relationship to other particle accelerators, see: https://www.aip.org/history/exhibits/lawrence/epa.htm. See also Heilbron, John L, and Robert W Seidel, *Lawrence and his Laboratory: A History of the Lawrence Berkeley Laboratory*, Berkeley: University of California Press, 1989.

4 Hauptman, John, *Particle Physics Experiments at High Energy Colliders*, London: John Wiley & Sons, 2011, p 97.

5 http://www.nobelprize.org/nobel_prizes/physics/laureates/1939/press.html.

6 Ernest O Lawrence Talks About the Evolution of the Cyclotron, Berkeley Lab, California, US. On *The National Farm & Home Hour*, television show broadcast formats from 1928 to 1958, produced by the United States Department of Agriculture. Published on YouTube, Berkeley Lab, US, 13 March 2013. Available at: https://www.youtube.com/watch?v=8tJrJ9dSLFg.

"as the inventor of the cyclotron, but more importantly, he should be remembered as the inventor of the modern way of doing science".[7] The Rad Lab, as the Berkeley Radiation Laboratory came to be called, offered an environment that was collaborative and stimulating: no closed doors, no private ownership of equipment or ideas. As the historian Robert Crease puts it, the only authority was the cyclotron. It was the theatre, the humans its stagehands.[8]

On 11 February 1939, the science journal *Nature* published Lise Meitner and Otto Frisch's Letter to the Editor on the "Disintegration of Uranium by Neutrons: A New Type of Nuclear Reaction". The letter was the first theoretical explanation for the splitting of the atom, interpreting experiments by Otto Hahn and Fritz Strassmann some months earlier, and offered a new term to explain this process: fission.[9] Later that year, Lawrence's Nobel Prize came within months of the outbreak of World War Two. By 1939, the one great possibility of the cyclotron now lay in unravelling information on the process of releasing nuclear energy. The atomic pile or what we might today call the nuclear reactor pushed further knowledge obtained from particle accelerators to obtain a controlled nuclear chain reaction. By the end of the war, the world witnessed the horror of the atomic bomb.

The bomb and reactors both became icons of the atomic age; cyclotrons and other particle accelerators never acquired that status.

If atom smashers were fundamental to our knowledge at the atomic level, why did cyclotrons and particle accelerators, also a part of the Manhattan Project, not become part of the popular iconography of the atomic age? Does that matter? And what does that tell us about the moral economy of science, especially atomic physics?

A moral economy of the atomic?

EP Thompson wrote about the moral economy of English peasants in the eighteenth century. We might find it useful to briefly extend this idea to the community of scientists who are engaged in exchange—of knowledge, skills, and artefacts and, crucially, maintain solidarities—as disciplines, fields, and as a community of practitioners.[10]

Moral economies are often presented as an entanglement of ideas and norms that legitimate shared practices. Science, as a potentially better belief system, the progress it affords humanity, and the recognition that the quest for knowledge is a good idea are offered as legitimating ideas shared and upheld by large majorities in modern societies. Performing its proper function in this scheme, the state provides reinforcement through patronage of science.[11]

It is possible to discern within the cluster of practices of science, a defence of the primacy of fundamental knowledge—a primacy that is socially upheld by the promise of progress. This primacy is conducted through a consensus on the nature of experiments, publishing, sharing knowledge and equipment, themes that sociologists of science have

7 Yarris, Lynn, "Ernesto Orlando Lawrence: The Man, His Lab, His Legacy", *Science Beat, Berkeley Lab*, 1 October 2001. Available at http://www2.lbl.gov/Science-Articles/Archive/lawrence-legacy.html.

8 Crease, Robert P, "Michael Hiltzik: Big Science", Sunday Book Review, *New York Times*, 13 July 2015. Available at: http://www.nytimes.com/2015/07/19/books/review/big-science-by-michael-hiltzik.html?_r=0. See also Hiltzik, Michael, *BIG SCIENCE: Ernest Lawrence and the Invention That Launched the Military-Industrial Complex*, New York: Simon & Schuster, 2015.

9 Meitner, Lise, and Otto R Frisch, "Disintegration of Uranium by Neutrons: A New Type of Nuclear Reaction", *Nature*, 143, 11 February 1939, pp 239–240.

10 Thompson, EP, "The Moral Economy of the English Crowd in the Eighteenth Century", *Past & Present*, vol 50, 1971, pp 76–136.

11 Robert Merton and Michael Polanyi, among others, have earlier described what a shared normative structure of science might look like. These are not our immediate references and their claims ought to be historicised. We might usefully begin with looking at shared practices as helping shape dispositions and arguments, but are not decrees or mandates or natural characteristics of a community. Merton, Robert K, "The Normative Structure of Science", *The Sociology of Science: Theoretical and Empirical Investigations*, Robert K Merton, Chicago: University of Chicago Press, 1973 [1942], pp 267– 278; and Polanyi, Michael, "The Republic of Science: Its Political and Economic Theory", *Minerva*, vol 1, 1962, pp 54–73.

been writing about for a while now. Together, they create the possibility of social order.

The notion of the moral functions in two registers for atomic physics: There is the moral economy of science where morality is a social commitment and agreement to norms of conduct; and there are the moral implications of the production and use of atomic weapons. Thompson argues that an outrage of the moral assumptions must provide the occasion for direct action or protest. In the immediate years after Hiroshima and Nagasaki, we saw protest and outrage expressed by many, including scientists and engineers. By the 1960s, this protest held the potential to disrupt the moral economy of science through questioning the assumptions about the politics of destruction it fostered.

Atomic physics was rescued from disruption in two ways: funding for research and weapons manufacturing continued uninterrupted for reasons of state in countries where they could afford expensive science. This is what much of our protest is directed against.

At one point early on in the Cold War, there was a growing sense of disquiet that originated in fear of growing distance from Europe as well as the increasing strength of the Soviet nuclear arsenal that resulted in President Eisenhower's "Atoms for Peace" speech. His government tried to shape a morality for nuclear research. The residues of this moment linger on in institutions with a global mandate, but did not change the course of weapons development.[12]

Another argument carefully realigned continuing atomic physics research with a commitment to a different moral arrangement: the pursuit of knowledge. A distinction between science and politics was produced and upheld to make this moral economy work by both the community of science and the state. High energy physics and particle physics came into their own as separate disciplines at some distance from nuclear research.

Atomic physics had to be rescued from the shadow of the bomb. Weapons and nuclear energy became a part of the Cold War dystopia. Bombs and reactors were rendered political, even as particle accelerators were upheld to maintain an image of neutrality if not innocence.

Historians have shown that this claim is far from defensible.[13]

The moral outrage caused by the use of the bomb did not dislodge the legitimising notion that it was good to have fundamental knowledge at the atomic and the subatomic level.

How do we address the move to bracket the commitment to knowledge from the moral responsibility that comes with the making and use of atomic weapons, and current unsustainability of nuclear energy?

What is this knowledge good for?

I am not going to be able to resolve the problem in this essay. But I might be able to hint at why it is important for us to take this claim seriously, and what the implications might be for our politics.

12 https://www.eisenhower.archives.gov/research/online_documents/atoms_for_peace.html.

13 Forman, Paul, "Behind Quantum Electronics: National Security as Basis for Physical Research in the United States, 1940–1960", *Historical Studies in the Physical and Biological Sciences* 18.1, 1987, pp 149–229.

The gift, and especially the obligation to return it.

Everyday science is routine work. Cyclotrons and particle accelerators, even when spectacular like CERN, do mundane work; mundane but not irrelevant; mundane but not insignificant.

Jeff Hughes, a historian of science, saw the physicists turn to atomic physics as a response to a modernist imperative. Particle accelerators, we could say, embodied this epistemology of the modern. They were part of the promise to deliver knowledge that created the possibility of a better belief system. But at the end of the day, the particle accelerators were made of materials that wear and tear: how does wear and tear bear upon the promise of the modern?

It might be illuminating to look at some of these machines that got tired. Looking at what happened to the tired ones might allow us to reexamine their promise. Given their energy potential, they could not participate in the new world of high energy physics. They remained with the world of nuclear physics.

Some of the earliest ones were given away. They were given away because newer and bigger and more powerful machines replaced them.

I am aware of four such gifts. The third cyclotron to be built in the United States at the University of Rochester is now at the Panjab University in Chandigarh, India. A Van de Graaff accelerator from Rice University, Texas, is now at the Universidad Nacional Autónoma de México. Rice University sent another to Ruđer Bošković Institute, Zagreb, Croatia; and parts from The Berliner Elektronenspeicherring-Gesellschaft für Synchrotronstrahlung (BESSY) in Berlin went to the SESAME Project in Amman, Jordan.

These particle accelerators came with a biography, a history. They are an archive as well as an attractive site for the archaeology of the atomic age. The laboratory systems, often running into hundreds of square metres, were transferred from their original setting and reassembled in their host locations in a different country with new buildings and, often, a new agenda.

The machines came with fatigue. They were perceived to inhabit a space that was far from cutting edge, they were a part of the old world of nuclear physics. The equipment was meant for research in nuclear physics and most have turned into training platforms and pedagogical devices. Their story is one of re-imagination and recreation of the laboratory space and its design. Crucially, it is noteworthy that their purpose could not be completely reinvented.

Anthropologists have thought a lot about gifts and their place in a moral economy. Marcel Mauss wants us to see that gifts are a part of social obligation to give, to receive and, most importantly, to reciprocate. Gifts help build not just wealth and alliances but social solidarity; "the objects are never completely separated from the men who exchange them". Because of this bond between giver and gift, the act of giving creates a social bond with an obligation to reciprocate. To not reciprocate means to lose honour and status. A gift that does nothing to enhance solidarity is a contradiction.[14]

What kind of solidarity is nurtured by the gift of particle accelerators? What is reciprocated by those that receive?

These atomic gifts cement the bonds of belonging: belonging to a powerful international community that continues to uphold the potential of these machines to manipulate the world in a certain way and to perform particular experiments. The reward for its recipients is their ability, at home, to possess and control such a machine. These machines give them the legitimacy to call themselves experimental nuclear physicists. Their moral justification comes, like their better-equipped counterparts, from the modernist imperative: the promise of fundamental knowledge.

As a university department possessing this machine, this also allows them to make, as in the Indian case, an argument against state control of equipment and all knowledge at the atomic level. Given the costs of owning and running one, most university departments in developing countries cannot own such equipment and have to rely on national laboratories, which are connected into the weapons and energy programmes, to allow them the use of such research facilities.

The particle accelerators do not remain the same, even if the argument for their possession springs from the same fount. Its modernist promise is not renewed as much as it is transformed when it is gifted away as technical assistance. The promise it now holds is in building capability. The particle accelerators are transformed in the first instance from research apparatus to teaching apparatus. They enable other transformations. Once trained on these machines, the practitioners are ready to build, acquire or work on more powerful machines. They are now ready to participate in the same world as the machine's donors. Outside this community, they can claim to be nuclear experts.

Therein lies the reciprocity that is characteristic of both the gift and the moral economy. Despite, as well as through, the hierarchies present within the science community, reciprocity is grounded in self-interest as a sign of shared moral values, conceptions of the future—a better future and upheld by rather many. Reciprocity also reinforces a specific rationality that is portrayed and expected of practitioners of science. These reciprocities of the world of science provide the underpinning for a description and an expectation of reasonableness that is expected of all of us collectively.

A moral economy that in this case took root in the 1930s, the camaraderie and the energy that we witness at the start of this essay, was never completely disrupted after Hiroshima and Nagasaki. It is only within this context that a gift, that is not merely an emblem of diplomacy, can uphold a sense of a global community of practitioners and become about participation across national borders.

We entered the atomic age at the end of World War Two. The fascination combined with dread and fear brought promises: even if the promises of radiant baths and face powder from the 1930s were not renewed, other

14 Mauss, Marcel, *The Gift: Forms and Functions of Exchange in Archaic Societies*, Ian Cunnison trans, London: Cohen and West, 1966.

aspects of the work set a-sail in the happy 30s took longer to unravel: radioactive elements in medicine, biology, and nuclear energy on the grid. We were promised nuclear powered cars, and vacuum cleaners. These promises never materialised and at least in everyday life, we could say that we have never been properly nuclear.

At the same time, we are committed to exploring the relationship between science and the political. We have convincingly condemned the politics of weapons, and raised questions about the safe storage of nuclear waste.

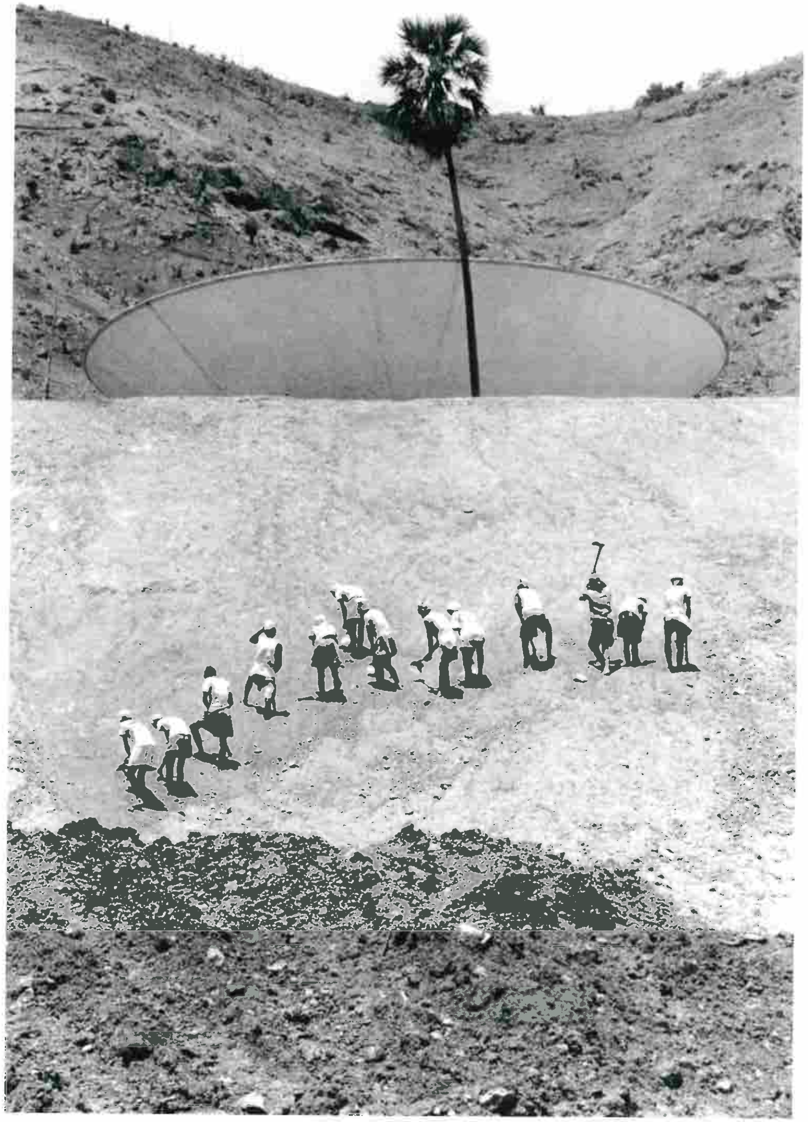
It is apposite but not enough to characterise the technical as embodying the moral, social and political. What is our relationship to the so-called fundamental knowledge and the equipment that enables its pursuit? What is at stake in the pursuit of fundamental knowledge and how do we wish to shape it or participate in it? How do we relate to the claim that scientific research holds the potential of profundity—of insight into the material nature of our very existence?

Following the stories of particle accelerators, at a remove from the spectacle of the bomb, the reactor and the grid, allowed me as a historian to unravel the nuclear not as sublime, but through the practitioners focused constancy and commitment. My struggle to understand this commitment to fundamental knowledge at the atomic level and the politics of its making is all the more difficult for it.

If these machines were not gifted away, they would have been cannibalised, I am told.[15]

15 To use (a machine) as a source of spare parts to repair or make another.

HENRI CARTIER-BRESSON
INDIA. 1966.



Henri Cartier-Bresson, *INDIA. 1966. INDIA. Maharastra*, 1966.
Trombay near Bombay. Atomic energy plant. © Henri Cartier-Bresson / Magnum Photos.

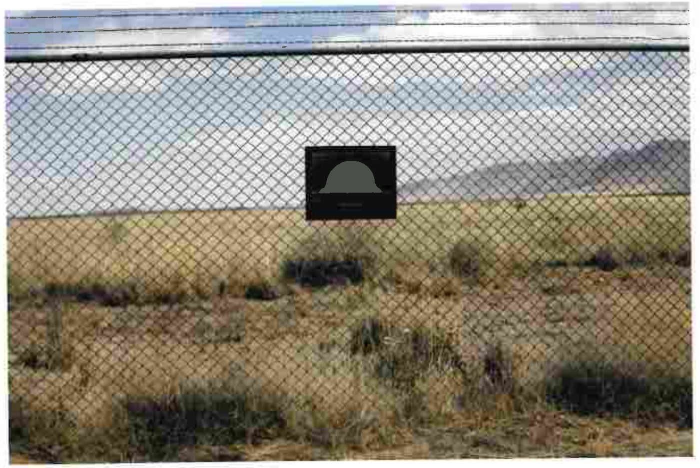


Photo of the circular perimeter fence enclosing the Trinity site, where the first atomic bomb, 19-kiloton Fat Man, was tested at 5:29:45 am Mountain War Time on 16 July 1945, White Sands Missile Range, New Mexico, US.

Inside the George McDonald-Schmidt ranch house where the master bedroom was turned into assembly room of the first atomic bomb core. The house is two miles from the Trinity site, White Sands Missile Range, New Mexico, US.

In 1945 the Gadget tested at Trinity New Mexico and the atomic bombs Little Boy and Fat Man begin to deposit a thin layer of radioactive materials in the Earth's crust. These marks contribute to what stratigraphic geology now calls 'the Great Acceleration' of the Anthropocene, the geological era in which human history intersects decisively with geological time.

What we now call 'Hiroshima', for instance, is an event that continues to play out, because radiation lasts and lasts. And it plays out not simply in the place called Hiroshima, and not simply in the physical distribution of radioactive particles and the psychic distribution of fear, but also in the experience of the stigmatised *Hibakusha*, the "bomb-affected people"; in dissemination of world media; and in art, not to mention in other cultural domains. The same applies to the events we call 'Chernobyl' or 'Three Mile Island', let alone the Manhattan Project and Pacific hydrogen bomb testing.... If distributed anthropogenic nucleotides had a name, what would it be? Would it constitute a thing? Such a thing would be very difficult to point to, with a single pointer aimed at a single spot in space and time. Despite the difficulty, we do need a term for such a thing, a thing so massively distributed in time and space that we can't point to it so easily. This is because such entities structure our world in a deep sense, and because they are showing up on the radar of modernity in increasing numbers.

I created the term "hyperobject" to describe these entities. Thanks to the way in which humans have become a geophysical force on a planetary scale, in all kinds of ways from nuclear bombs to fossil fuels, we have created hyperobjects, and contemporary science is able to observe and map them, often requiring enormous computational power to do so, power that far exceeds that of a human working alone with a pencil and paper.

So how do you represent hyperobjects? This became a problem for me personally, when it came time to choose a cover design for the book I had written about them.[1] Although I really love what the press chose, a very beautiful composite image of a glacier, I still have a soft spot for my idea, which was that since you can't directly depict a hyperobject, you might need to depict some kind of human 'reaction shot' to them, like the kind of shot in a film where a character is seen reacting to something we can't see at that moment. I started to wonder whether there were any 'reaction shots' in the realm of art, and I settled on the Japanese dance style Butoh. In this essay, I will sketch how Butoh could be considered a way of reacting aesthetically to nuclear materials as a hyperobject.

Steven Spielberg's movie of *Empire of the Sun*, 1987, adapts JG Ballard's novel in a way that strikingly brings nuclear materials into play. The lead character, Jim, sees Little Boy falling on Hiroshima from a distance. He remarks that the explosion is "Like God taking a photograph".[2] The very pinnacle of modernity, encapsulated in Robert Oppenheimer's "I am become death, shatterer of worlds", is the arrival of what Heidegger would have called "the last god" if he had been able to include non-humans in his view.[3] Heidegger simply was unable to ascertain how the "last god" would manifest in the very core of technological enframing.[4]

1 Morton, Timothy, *Hyperobjects: Philosophy and Ecology After the End of the World*, Minneapolis: University of Minnesota Press, 2013.

2 Spielberg, Steven, *Empire of the Sun*, 1987.

3 Heidegger, Martin, *Contributions to Philosophy (From Enowning)*, Parvis Emad and Kenneth Maly trans, Bloomington: Indiana University Press, 1999, pp 283–293. See also Stambaugh, Joan, *The Finitude of Being*, Albany: SUNY University Press, 1992, pp 139–144. Robert Oppenheimer's line is from the *Bhagavad Gita*, Swami Nikhilananda trans, New York: Ramakrishna-Vivekananda Center, 1944. The term "shatterer" rather than "destroyer" first appeared in "The Eternal Apprentice", *Time*, 8 November 1948). Available at: http://www.time.com/time/magazine/article/0,9171,853367-8,00.html.

4 Heidegger, Martin, "The Question Concerning Technology", *Basic Writings: From Being and Time to The Task of Thinking*, David Krell ed, New York: HarperCollins Publishers, 1993, pp 307–341.

This "last god" is the being that could save humans (and so all life forms on Earth) from their destructive logics and logistics. One way in which these logics play out in what Heidegger names as the metaphysics of presence: the belief that to be real is to be constantly present. Consider, for example, a reductionist philosophy in which Timothy Morton is made of atoms, and the atoms are more real than Timothy because they are more constantly present than him. Heidegger, Derrida and myself all argue that this idea is nothing more than a violently destructive myth, and I claim that it evolved during the long duration of Mesopotamian agriculture, whose logistical structure eventually required industry to maintain itself, hence fossil fuels, global warming and mass extinction.

It is almost there in Turner's paintings of the slave ship and Death riding a pale horse: a light that makes everything transparent, that does not so much illuminate as irradiate. Like God taking a photograph: the non-human sees us, in the white light of its fireball, hotter than the sun. *Like* God: this is not an endorsement of a scholastic *causa sui* inhabiting a beyond, but a reminder that we are dealing with a physical entity. Yet this is a *weird* physical entity, 'weird' meaning 'fateful' and 'strange of appearance' at the same time, a fusion of causality (fate) and the aesthetic (appearance) that much post-Mesopotamian philosophy has struggled to keep apart. To what are we listening when we attune to the hyperobject? Is this uncertainty not precisely *what* we are hearing? Isn't it the case that the affect delivered to us in the rain of fallout, the intense wind following the energy flash, the decades-long radiation sickness, is something uncanny? If it has a name perhaps it is *weirdness*. The fusion of fate and appearance is precisely what disturbs about radiation: it is light, which Western culture habitually thinks as a revealer of what is the case, not a causal agent. Electromagnetic waves beyond violet are weird both because they illuminate things in a non-standard way—think of an X-ray image; and because they have an obvious causal force—again, think of an X-ray penetrating my flesh. X-rays confuse the commonsense difference between light and matter, since they can directly wound and destroy life, even as they illuminate it, brighter than bright. An X-ray photon is a terrific example of a non-human that has agency—it is evidently not alive, yet it is evidently agential. They see you. They see you so intensely that in sufficient quantities they kill you. X-rays and gamma rays give the lie to the artificial division between *perceiving* and *causing* that has plagued philosophy and ideology since at least the Kantian turn. In an age of ecological awareness, the idea that the perceptual dimension is a neutral field is ended, in part by lethal entities that make up that very dimension itself. The time of nuclear materials and global warming is a time of lethal illumination.

Hyperobjects signal 'the end of the world', not because they might destroy it (though they might), but more deeply because they end myths of 'presence', the idea that reality is something that you can see and touch directly, or know directly. For a world to be coherent, there must be a 'hither' and a 'yonder', a 'now' and a 'then'. Nuclear materials are so massively distributed in time and space that they end the idea that there is a definite 'over yonder' and a 'hither' that remain constantly present so that we can point to them. This idea depends upon a stable (human) vantage point.

Plutonium-239 decays for 24,000 years. That timescale is roughly comparable with the paintings on the walls of the Chauvet cave, the oldest human art we know of. Ethical and political decisions based on self-interest just fail at these scales. In 24,000 years, the following will be true: (1) No one will be meaningfully related to me in particular; (2) The slightest thing I do now will have grave consequences.[5] At this scale there is no me, no human even, worth talking about—yet what I do 'now' affects what happens 'then'. Likewise geological time, emerging for humans since the advent of modernity, is an abyss whose reality becomes increasingly uncanny, not less, the more scientific instruments are able to probe it. Knowledge ceases to be demystification, if it ever was.

Now evaporates into a sickening relative motion of traffic between past and future. Perhaps it is better to say that now evaporates into nowness: something is still happening, but it is impossible in advance to draw a thin, rigid boundary around it. The past simply is appearance. The thin layer of carbon, and the thin layer of radioactive materials, are the appearance of the past in the Arctic ice, in deep lakes, in Earth's crust. My face is a map of everything that happened to it. This coffee cup is a record of the traumas undergone by a lump of clay as it was moulded and fired and glazed. Form is appearance: form is the past. The form of an object is not present, but is rather an archaeological record.

Likewise, *myself* just is a record of what has happened to 'me'. As Freud argues, ego just is the text of "abandoned object cathexes".[6] Why can Freud say this? Because objects of all kinds are already that: objects are records of trauma. At this ontological level, there is not so much difference between me and a gamma ray, or between me and Earth's crust. Earth is geotrauma, a palimpsest of necessarily violent events.[7]

What of the future? The past is how things appear. *How things are* is the future. The future is not to be found outside of things. This kind of future is what Derrida calls the *arrivant*, the never-present to-come of a thing. No access mode, or combination of modes, will exhaust a thing. Thinking about it, throwing it in the dustbin, shooting it around a particle accelerator, interviewing it, ignoring it—nothing totally works. An infinitely exploded view of an object, under all possible lighting conditions and for all sentient beings, is not that object. Merleau-Ponty's argument that a thing is just a fantasy.[8] When I turn over the cup, the cup now has another underside, and this should alert me to a more general openness in which the very side I'm looking at isn't totally available either. Hyperobjects simply make this fact highly visible and poignant.

There is no present. There are only past and future—or rather, a plenum of entities emitting different pasts and futures, that coincide like trains that move relative to one another; and the *rift* between past

5 Parfit, Derek, *Reasons and Persons*, Oxford: Oxford University Press, 1984, pp 355–357, 371–377.

6 Freud, Sigmund, *The Ego and the Id*, Joan Riviere trans, James Strachey ed, New York: Norton, 1989, p 24.

7 Land, Nick, *Fanged Noumena: Collected Writings 1987–2007*, Falmouth: Urbanomic, 2011, pp 335, 448. See also Negarestani, Reza, *Cyclonopedia: Complicity with Anonymous Materials*, Melbourne: re.press, 2008.

8 Harman, Graham, *Guerrilla Metaphysics: Phenomenology and the Carpentry of Things*, Chicago: Open Court, 2005, pp 52–53.

and future, appearance and essence. The meaning of a poem is its future: it will have been read five minutes from now, next week, and more than this, its meaning is futurality, or as Percy Shelley puts it, "the gigantic shadows that futurity casts upon the present".[9] The past of the poem, its letters, its paper, its ink, its authors, its readers, its readings, is the appearance of the poem, the poem's form. This gives us a way to think about hyperobjects: a hyperobject is a message in a bottle from the future. Nuclear radiation is an augury, a writing in flesh or in the sky, but an augury that lacks a stable or consistent system of meaning to underwrite it. We have no idea what it will all have meant—yet.

Nuclear radiation burns through our concepts of time and space.

Ecological awareness is without the present. The calls for a restoration of a balance that never existed on Earth—Earth being the name for a text of geotrauma—are desperate attempts to put the genie back in the bottle. The perverse triumphalism that rubbernecks some future sadistic victory of Gaia over her malfunctioning components—the viral human—is a futile attempt to master the irreducible uncanny futurality of things: all things—a styrofoam cup that lasts for 500 years, a dog dosed with strontium-90 encased in a block of concrete for 40 years, the shadow of a human impressed on a Hiroshima wall.[10] In an amazing paradox, nuclear radiation, despite all its physical violence, teaches us how to think less violently than what too often passes for environmentalist thought.

A more genuine acknowledgement of what is happening—how radiation forces us to glimpse the rift between essence and appearance, the vanishing of the present and of presence—is the work of Butoh, the Japanese 'dance of darkness' that was invented in the wake of Hiroshima.[11] In Butoh, the human body no longer floats as if weightless in abstract space, but is pressed down from all sides by a horrible gravity, the spacetime emitted by a gigantic object, preventing the human from achieving escape velocity. It is as if gigantic waves are distorting the human face into sickening masks of itself, and Butoh faces are already heavily made up to appear mask-like. The body is powdered with ash as if from the fallout of an atomic bomb.[12] The dancing body and its facial expression is a reaction shot, the shadow of a hyperobject impressed on human flesh.

What is happening to reality in the Anthropocene is that it is becoming more vivid and unreal. Without a world, without Nature, non-humans crowd into human space, leering like the faces of Butoh dancers. One of the disturbing consequences is that the very sense of unreality is an index of reality itself. We can't directly or fully know what's happening, on all kinds of levels. The difference between a face and a mask collapses. Habitual meaningfulness coordinates dissolve: "What constitutes pretense is that, in the end, you don't know whether it's pretense or not."[13] This irreducible unreality is a *symptom of reality* as such, the uncanny intersection of geotrauma and human history. Covered in ash the human dances, caught in a horrible and mysterious physicality without a beyond, without an outside, without presence.

9 Shelley, Percy, "A Defence of Poetry", *Shelley's Poetry and Prose*, Donald H Reiman and Neil Fraistat ed, New York and London: WW Norton, 2002, pp 509–535.

10 Book, Steven A, William L Spangler and Laura A Swartz, "Effects of Lifetime Ingestion of 90Sr in Beagle Dogs", *Radiation Research*, vol 90, 1982, pp 244–251.

11 Kurihara, Nanako, "The Most Remote Thing in the Universe: Critical Analysis of Hijikata Tatsumi's Butoh Dance", PhD dissertation, New York University, 1996.

12 Fraleigh, Sondra, *Butoh: Metamorphic Dance and Global Alchemy*, Urbana: University of Illinois Press, 2010, p 61.

There might be many ways of sustaining the kind of response that Butoh opens up to nuclear radiation as a hyperobject. Maybe we should not store plutonium deep underground with militarised warnings, or in knives and forks without any warning whatsoever (this was actually suggested in the late 1990s). Perhaps we should get hold of small pieces of plutonium, store them in a way that we can monitor them, and encase them in a substance that will not leak radiation, above ground, so you can maintain the structure, and so that you can take responsibility for it. You, the human, made the plutonium, or you the human can understand what it is—therefore you are responsible. Let's put these structures in the middle of every town square on Earth. Nuclear materials will be 'there' but 'not there' at the same time, obvious to all yet distributed across time and space as ever. It's just that we will have found an appropriate care mode for such hyperobjects, a care mode that is also distributed across time and space.

One day there might be pilgrimages to them and circumambulations. A whole spirituality of care might arise around them. Horror and depression might give way to sadness and joy. We bristle plutoniumly. Or we feel suicidal plutoniumly. Or we cry plutoniumly. Or we even dance plutoniumly.

13 Lacan, Jacques, *Le seminaire, Livre III: Les psychoses*, Paris: Editions de Seuil, 1981, p 48.

Explosions Bleues

037

MONSIEUR LE PRESIDENT DE LA
CONFERENCE INTERNATIONALE DE LA
DETECTION DES EXPLOSIONS ATOMIQUES

MONSIEUR LE PRESIDENT,
MESSIEURS LES DELEGUES,

JE ME FAIS UN DEVOIR EN TOUTE HUMILITE, MAIS AUSSI EN TOUTE CONSCIENCE D'ARTISTE, DE FAIRE UNE PROPOSITION AU COMITE DIRECTEUR DE VOTRE CONFERENCE SUR LES EXPLOSIONS ATOMIQUES ET THERMO-NUCLEAIRES. CETTE PROPOSITION EST SIMPLE : PEINDRE EN BLEU LES BOMBES A et H, DE FACON A CE QUE LEURS EVENTUELLES EXPLOSIONS NE SOIENT PAS CONNUES DE CEUX-LA, SEULS QUI ONT TOUT INTERET A EN DISSIMULER L'EXISTENCE OU (CE QUI REVIENT AU MEME) A LA REVELER A DES FINS PUREMENT POLITIQUES, MAIS A TOUS CEUX QUI ONT LE PLUS HAUT INTERET A ETRE MIS AU COURANT LES PREMIERS DE CE GENRE DE PERTURBATION : JE VEUX DIRE L'ENSEMBLE DE MES CONTEMPORAINS. IL SUFFIRA DE M'INDIQUER L'EMPLACEMENT ET LE NOMBRE DES BOMBES A et H POUR QUE, MOYENNANT UNE REMUNERATION A DEBATTRE MAIS QUI DEVRA, EN TOUT ETAT DE CAUSE, COUVRIR :

A) – LE PRIX DES COLORANTS;
B) – MON APPORT ARTISTIQUE PROPRE (JE ME CHARGE DE LA COLORATION – EN BLEU – DE TOUTES LES FUTURES EXPLOSIONS NUCLEAIRES.

IL EST BIEN EVIDENT QUE NOUS EXCLUERONS LE BLEU DE COBALT COMME IGNOMINIEUSEMENT RADIOACTIF ET QUE NOUS N'EMPLOIERONS QUE LE BLEU KLEIN QUI M'A VALU LA CELEBRITE QUE VOUS SAVEZ. BIEN QUE TRES PRIS PAR MON ACTUEL TRAVAIL ET NOTAMMENT PAR LA SPECIALISATION DE L'AMBIANCE DU GRAND OPERA DE GELSEN-KIRCHEN, LE COTE HUMANITAIRE DE MA PROPOSITION ME SEMBLE DEVOIR PRIMER TOUTE AUTRE CONSIDERATION. NE CROYEZ PAS CEPENDANT QUE JE SUIS DE CEUX QUI FONT PASSER L'ART APRES LA MATIERE. BIEN AU CONTRAIRE, LA DESINTEGRATION DE CELLE-CI NOUS PERMETTRA-T-ELLE LES PLUS EXTRAORDINAIRES REALISATIONS MONOCHROMES QUE L'HUMANITE, ET J'OSE LE DIRE LE COSMOS – AURONT

/.....

83

038

CONNU.

A CE DOUBLE EFFET, JE RESTE, MESSIEURS, VOTRE TRES DEVOUE.

X.

COPIE A :
a) – Sa SAINTETE LE DALAÏ LAMA
b) – Sa SAINTETE LE PAPE PIE XII
c) – M. LE PRESIDENT DE LA LIGUE DES DROITS DE L'HOMME
d) – M. LE DIRECTEUR DU COMITE INTERNATIONAL DE LA PAIX
e) – M. LE SECRETAIRE GENERAL DE L'O.N.U.
f) – M. LE SECRETAIRE GENERAL DE L'U.N.E.S.C.O.
g) – M. LE PRESIDENT DE LA FEDERATION INTERNATIONALE DE JUDO
h) – M. LE REDACTEUR EN CHEF DU CHRISTIANSEN MONITOR
i) – M. BERTRAND RUSSEL
j) – M. LE DOCTEUR ALBERT SCHEIWTZER

P.S. – IL EST BIEN EVIDENT QUE NON SEULEMENT L'EXPLOSION, MAIS LES " FALL OUTS " SERONT INALTERABLEMENT TEINTS EN BLEU PAR MON PROCEDE.

I.K.B.

83

President of the International Conference for the Detection of Nuclear Explosions

Honorable President, Distinguished Delegates,

I take upon myself in complete humility, but also in full conscience of an artist, to present a proposition to the board of directors of your Conference with regard to atomic and thermonuclear explosions. This proposition is quite simple: to paint A- and H-bombs blue in such a manner that their eventual explosions should not be recognized by only those who have vested interests in concealing their existence or (which amounts to the same thing) revealing it for purely political purposes but by all who have the greatest interest in being the first to be informed of this type of disturbance, which I deem to say is all of my contemporaries. All I need is the position and the number of A-bombs and H-bombs and a remuneration, to be discussed, that ought, in any case, to cover:

—The price of colorants.

—My own artistic contribution (I will be responsible for the colouring—in blue—of all future nuclear explosions).

It is quite clear that we shall exclude cobalt blue as being notoriously radioactive and that we shall use only Klein Blue, which has earned me the celebrity of which you are undoubtedly aware.

Although I am fully occupied with my current work, notable with creating the ambiance of the great Gelsenkirchen Opera House, the humanitarian aspect of my proposal seems to me to have priority over any other considerations. Do not think, however, that I am among those who place art after matter. Quite to the contrary, its disintegration allows for the most spectacular monochrome realizations that humanity, and I dare say, the cosmos itself will have known.

In this double effect, I remain, distinguished sirs, your very devoted,

K.

Cc: His Holiness the Dalai Lama; His Holiness the Pope Pius XII; President of the League of the Rights of Man; Director of the International Committee of Peace; Secretary General of the United Nations; Secretary General of UNESCO; President of the International Federal of Judo; Editor-in-Chief of the Christian Science Monitor; Bertrand Russell; Dr. Albert Schweitzer.

PS It is clear that not only the explosions but also the "fallouts" ought to be inalterably tinted in blue by my IKB procedure.

Translation by Klaus Ottmann in: Klein, Yves and Ottmann, Klaus, 1928–1962, *Overcoming the problematics of art: the writings of Yves Klein*, New York: Spring Publications, pp 27–28.

In response to the nuclear accident at Fukushima Daiichi and the problem of detecting varying levels of radiation hazard, Toshiba invented the portable gamma camera to render visible radioactive isotopes. Nuclear contaminates, whose decay-rates are devastatingly extended in time and whose stealth-like molecular dispersal spreads globally offers a paradigmatic case of what Rob Nixon has called "slow violence". These gradual and distributed processes of environmental damage lack the perceptual intensity of conflict or refuse the dramatic immediacy favoured by media. Unlike other anthropogenic accidents, evidence for nuclear events secrets itself in matter as a dangerous latency that only emerges under certain conditions or using certain technical procedures.

Inside the Reactor Building, Unit 1, Fukushima Daiichi Nuclear Power Station: large equipment service entrance to the south side airlock. Toshiba Gamma Camera, 22 May 2011, courtesy TEPCO.