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Photographed by the Earth: War and media in light of nuclear events

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Abstract

This article charts a media historical relation between radiation and celluloid film, ranging from the downwind 1956 production of *The Conqueror* to early scientific imaging practices, war photography, war documentaries, military industrial film, and contemporary artists working on radiation aesthetics. Posing the collection as a diagnostic media ecology, this article argues that the valuable evidence provided by the environmental metadata stored in celluloid film is the product of ecological warfare and violence. By turning to the material sciences for a better understanding of how nuclear weapons affect media on large spatial and temporal scales we gain a parallax view to how photographic practices – defined as the aesthetic exchange of light and energy – occur autonomously within our ecology, although some of these forces are mobilised in deadly and imperceptible ways. By demonstrating that non-human agencies released by Cold War energy policies have contaminated military industrial and commercial film archives alike, this article asserts that nuclear testing and warfare have contributed to a global condition of test-subjectivity that can be evidenced by diagnostic media ecology.

Keywords: nuclear testing, toxicity, environmental media, media ecology, material politics

1 Double exposure, radiation, and imperceptible violence

Fig. 1: John Wayne and sons with Geiger counter on the set of The Conqueror (1956).

In a rare photo taken on set of the 1956 film *The Conqueror* (Dick Powell), we see the late John Wayne posing with his two sons while they contemplate a dusty metal box.[1] The location shoot for the film occurred just outside St. George, Utah, and a little less than 200 kilometers downwind from the Nevada National Security site where the United States government detonated 126 atmospheric nuclear tests between 1951 and 1963, along with another 825 explosions below the surface of the Earth.[2] The device that the men are leaning on is a Geiger counter. Wayne reportedly brought the machine to the set as a joke prop at the suggestion of the film's publicist so everyone could brush off the then casual scares of atmospheric radiation poisoning. As Jane London wrote in an alarming 1980 retrospective on the disaster, the toxic clouds of radioactive dust were *not laughing matter*:

> [The Geiger counter] went berserk. Wayne, who had tried it out in California, thought it must have been broken. The dust storms were so severe in the area that Dick Powell often wore a surgical mask during filming. Besides breathing the dust, 700 meals a day were prepared for the cast and crew from local and contaminated food. Even today milk produced in the area shows traces of radioactivity. When all the outdoor scenes had been shot, 60 tons of the dust were carted back to the RKO studios in Culver City to recreate desert scenes convincingly.[3]

London's article reminds us that media infrastructures and industries shape more than the popular imagination of the physical environment – they also interact with and are affected by those ecologies local to production, whether toxic or benign. In the case of *The Conqueror*, the contaminated earth remained as dispersed refuse in the industrial neighborhoods surrounding the RKO lots for years to come – a landscape souvenir left by the military-entertainment complex.

In what is now Hollywood legend, 91 of the 220 people working on the film had contracted cancer by 1980, and 46 died. These statistics occur at a rate three times the national average.[4] Like many who fell ill as a suspected consequence of the policies staged by the Department of Energy during the Cold War era, causality can only be intimated by these statistics – claims of environmental poisoning are bolstered by the spike in cancer and childhood leukemia throughout the populated areas that were deliberately targeted for fallout distribution so to avoid Los Angeles and Las Vegas.[5] The imperceptible forces of the Earth are notoriously difficult to catalogue empirically.[6] While numerous cultural geographers[7] have determined that continental nuclear testing amounted to a covert war against the American populace and environment – an extended episode of 'continuing ecocide and internal colonialism'[8] – the media documentation of this tragedy is as abstract as the invisible threat itself. The hidden power of this mode of state-sanctioned violence[9] lies in the hazy and uncertain environmental relations found between radiation and health.

As Rob Nixon has recently demonstrated, modern violence occurs at the very limits of perception.[10] When analysing the effects of radiation on our media systems it is the political capacities of human perception[11] that pose the greatest challenges to visible evidence. How do the unseen forces of the Earth work on our media? How can we cartographically map environmental toxicity by tracing violence across great magnitudes of space, time, and form? Is it possible to assemble media ecologies that index a 'violence that lingers and kills in the present day and far beyond –

as if we could still die from military choices made by the Greeks in the Peloponnesian Wars'?[12]

To address the imperceptibility of radiation and its *unsightly violence* we require a critical methodology that is interdisciplinary and transversal in approach. Félix Guattari's proposition of an ethico-aesthetic category for the expansive criticism of media ecology – wherein 'nature cannot be separated from culture; in order to comprehend the interactions between ecosystems, the mecanosphere and the social and individual Universes of reference, we must learn to think "transversally"'[13] – engenders the analytical techniques employed by this analysis. By drawing from media theory, cinema studies, anthropology, history, ecocriticism, science studies, and energy humanities, and threading these approaches together through different kinds of visible evidence, this argument follows a contemporary vein of media ecological scholarship that seeks to clarify the obscured material politics hidden in the complex reticulation of nature, society, and subjectivity. Dominic Pettman[14] and Matthew Fuller[15] have advocated for transversal approaches to media ecology in chorus with Jussi Parikka's inquiries regarding neglected non-human politics that surface from the 'entanglement of technological epistemologies and practices, aesthetic modes of knowledge, non-human ontologies, and awareness of political economy and exhaustive global capitalist production and consumption'.[16] This interdisciplinary approach helps illuminate violence operating on the edge of human perception while directing inquiries toward structural issues surrounding the anthropocentric reliance on human sensation in environmental representation; it also explores what the limits of senses mean for ecological politics.

To return to the photograph of Wayne and his children, we can see this image as a cultural symptom of a greater ecological problem – or as the unsedimented fallout that surfaces unexpectedly from a much larger and forgotten media archive. In Parikka's recent advocacy for the use of material sciences in forming a 'green media studies',[17] he points to Jennifer Gabrys' lucid observation that the ontological underpinnings of archival media objects have expanded links to those environments present to their creation: 'instead of demonstrating historical advances, these [archival media] objects provide evidence of the dust that sediments as a record of these material and technological imaginings'.[18] If we look at the image of Wayne and his family from this perspective the photograph narrates a publicity joke on a film set, but it also captures a discursive and historical index to those popular attitudes and imaginative ecologies that supported the widespread ecocide enacted by the Pentagon. What's more, we can

push this analysis one step further by turning to the material sciences to reveal how toxic environments impact aesthetics.

In the case of the unique relationship found between radiation and celluloid it is possible to trace how ecological energy processes and those imperceptible forms of violence released by negligent state polices not only present themselves within the contours of anthropocentric photographic representation but also, as I will later contend, contain a form of political potential. The photograph of Wayne and sons is then a double exposure, flashed by both innocuous and toxic forms of light. Photographic representation is challenged by hidden energetic ecologies, as the image is pregnant with imperceptible and violent markings that exceed the celluloid documentation of the visible spectrum. If we turn our attention toward the unseen and environmental qualities of photography the driving question becomes this: how do we read photography after nuclear disaster?

2 Diagnostic media ecology and the general barometry of light

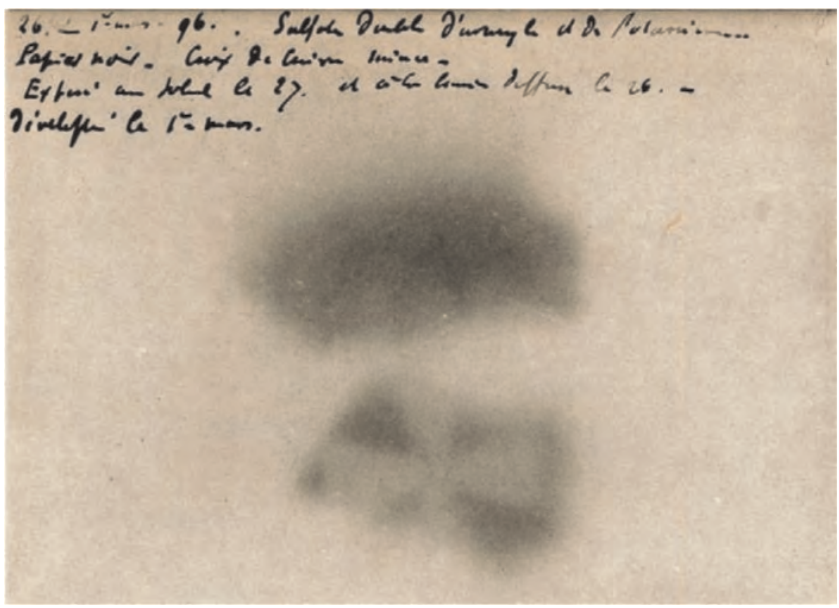

Fig. 2: Image of a Cross produced by Radioactivity (*Henri Becquerel, February 1896*).

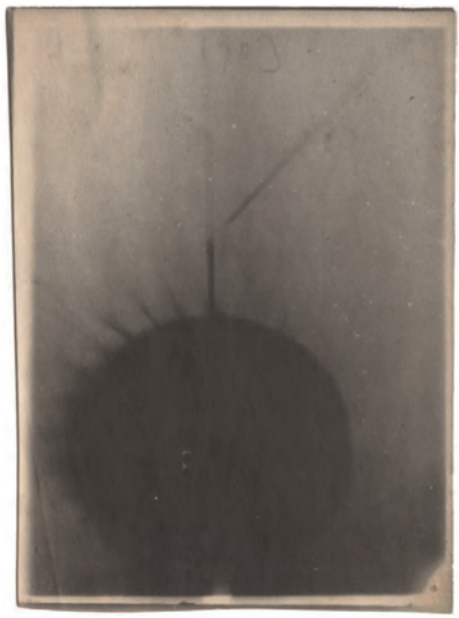

Fig. 3: Isolation of Gamma Radiation in Radium (*Henri Becquerel, 1903*).

In 1896, just one year after William Rontgen discovered the X-ray, a French physicist named Henri Becquerel made an equally important discovery in the history of scientific imaging.[19] While trying to understand why the minerals used in the creation of X-rays displayed luminescent properties, Becquerel attempted exposing fluorescent uranium salts to Lumière Étiquette Bleue glass photographic plates covered in black paper.[20]

The results of this experiment were startling: an exposure had formed in the absence of visible light – as though the earthly matter itself was reaching out and participating in photographic processes with a determined non-human agency. Following this discovery a long series of scientific experiments carried out by Becquerel, William Crookes, and several other Parisian physicists centered on the aesthetic effects of imperceptible rays that relied on photographic practices as an empirical method. Kelley Wilder notes that Becquerel's findings worked beyond linear media representation: 'photographs could be used both as evidence of the physical characteristics of the radiation and as illustration of it'.[21] Photography, then, became an early variety of Geiger counter in terms of scientific usefulness, exceeding economies of representation by repurposing aesthetics into a functional diagnostic tool for *the general barometry of light*. Celluloid and Geiger counters share a sensitivity to the material ecologies of energy that make up our world, as do human beings who

are violently exposed: 'radiation suffuses the human body, the earth, the atmosphere, and the cosmos… light is profoundly transformative of our bodily ecologies; the irradiation of tissue continues after the body's death'.[22]

While the X-ray made a profound intervention across the cinematic arts, be it through James Sibley Watson's stunning cinefluorography or through the cultural impacts noted by Lisa Cartwright[23] and Akira Lippit,[24] Becquerel's Earthly photographs and their important aesthetic legacy have received little attention in media studies. These ghostly imprints are reminders that celluloid film is sensitive to environments operating beyond the human senses and that toxicity can surface in film as an aesthetic. With this radical indexicality we can trace violence from the individual artifact of a stained celluloid photograph as an evidentiary symptom of radioactive toxicity to the global processes of energy operating on a much larger scale and politics, as Elizabeth DeLoughrey writes: 'the violence of radiation ecologies' can be determined by 'the ecological relationship to place made possible by light [a]s simultaneously local (in its perception) and planetary (in the universal movement of light)'.[25] DeLoughrey's observation suggests an aesthetic criticism that puts pressure on eco-critical concentrations of environmental representation by instead turning our focus toward how the widespread material effects of environmental weaponry have political traction in the superstructure of the world beyond human sensation.[26] The political potential of a toxic or dirty media that is recovered and reexamined for its interaction with energetic forces beyond human sensation is found in both its evidentiary presentation of violence and as an operative force challenging popular conceptions about how environments work within the anthropocentric frame.

3 The weaponisation of light and materiality of energy

In Akira Lippit's vivid book describing the emergence of avisuality in postwar visual culture he provides a reading of the permanent shadows burnt into the architecture of Hiroshima and Nagasaki that tilts into an environmental media consideration:

> [i]f the atomic blasts and blackened skies can be thought of as massive cameras, then the victims of this *dark atomic room* can be seen as photographic effects. Seared organic and nonorganic matter left dark stains, opaque artifacts

> of once vital bodies, on the pavements and other surfaces of this grotesque theater. The 'shadows,' as they were called, are actually photograms, images formed by the direct exposure of objects on photographic surfaces. Photographic sculptures.[27]

Lippit's account of nuclear weaponry as a large-scale media form relies on considering light as an energetic materiality – an observation that echoes those original expressions made by Becquerel when the surprising emission of energy from inert matter burned an imprint on a photographic plate. Light has forcefulness, and the radioactive scatterings released by atomic detonations are harmful varieties of energy that share a similar physical structure to the more familiar and benign visible light.

Fig. 4-5: Yoshito Matsushige's photos of Hiroshima on 6 August 1945.

Yoshito Matsushige's photographs of the atomic bombing in Hiroshima on 6 August 1945 are the only remaining celluloid records taken on the ground the day of the event. The images not only survived the horrid conditions surrounding the aftermath of the attack but also endured the heavy censorship that immediately followed capitulation.[28] The photos appear damaged, stained, and timeworn in areas. One features a remnant 'shadow' left by someone sitting on a step during the flash; another depicts victims searching through rubble, and still others picture people suffering as they try to understand the burns on their skin. Each photo is unprecedented in its presentation of ecological violence married with fragmented formal techniques: out of focus and poorly framed, these images also describe the despair and failing body of the photographer.

Matsushige's photos are stained with small light leaks and white dots that form dripping constellations across the documents. Barbara Marcoń writes that these spots are 'visible mechanical damage to the negatives hidden during the Occupation, which were often kept in far from adequate conditions, such as being buried underground… damage to the image caused by improper storage is a material sign of the US Occupation policy'.[29] Marcoń's assertion that the photograph's aesthetics have, in part,

been generated by their incubation in the political ecology of censorship is insightful, but I would like to suggest that the marks on these photographs might also bear the inscription of the radiation flooding Hiroshima that day. This pattern of aesthetic damage has a striking similarity to other atomic media events in the 20th century.

4 A media history of celluloid and radiation

Fig. 6-7: The radiation-damaged photography of Igor Kostin.

On 26 April 1986 a photographer for the Novosti Press Agency was dropped by helicopter on the roof of Nuclear Reactor 3 at Chernobyl about 14 hours after the explosion.[30] The five images captured by Igor Kostin depict those labourers assigned to plug the toxic hole that was rapidly releasing invisible waste. Covered from head to foot in heavy lead, these men were dropped off on the roof of the reactor building to heroically stop the leak. The white streaks at the bottom of the exposures align with the intermittent space of 35 mm sprocket holes and are the direct imprint of intense radiation. As Kostin struggled with shaking hands to document the clean-up the developing ecological crisis was already penetrating some of the very first images produced at Chernobyl.[31]

On the same day filmmaker Vladimir Shevchenko was authorised to film the efforts of the so-called 'liquidators' from a circling helicopter. After developing the 35 mm footage Shevchenko experienced a similar contamination to Kostin's images, as Susan Schuppli explains:

> [u]pon projection, small flares of light momentarily ignite the surface of the film, sparking and crackling; they conjure a pyrotechnics of syncopated spectrality. It is an act of radiological recording, whereby the radical imprint of the disaster was inscribed directly into the emulsion of the film as decaying particles moved through the exterior casing of the movie camera. It was not a representation of catastrophe but an actual toxic event in which a lethal dose of radiation was ingrained within the molecules of each and every silver halide particle.[32]

The footage is observable today in Shevchenko's 1986 documentary *Chernobyl: Chronicle of Difficult Weeks*. These celluloid-based media forms, when considered together, form a diagnostic media ecology that provides more political value than simply indexing a radiological climate; these images also demonstrate that archival studies of analog media disclose varieties of photography that are not fully of human intent. The participation of energy processes alongside anthropocentric media documentation reveal photography as a medium that is thinly stretched into environments in motion well beyond the limits of the human visual field.

Some of the liquidators who survived doses of radiation six to eight times the lethal threshold are interviewed in a 2006 documentary titled *The Battle of Chernobyl*.[33] Konstantin Fedetov describes how 'after a day of work, our hands would ache and we could not make a fist… your eyes hurt, and there was a metal taste in your mouth… even today, twenty years later, I can still taste the lead in my mouth', while Kostin notes how 'the first time I went up on the roof, I was struck by the mystical feeling

there'. These bodily sensations are the symptoms of the invisible violence of radiation poisoning working through human biology. Following Lippit's assertion – that the shadows of victims in Hiroshima and Nagasaki were the result of a deadly photographic flash in the weaponisation of light – we can follow that logic and determine that the somatic conditions experienced by the liquidators working in the wreckage of Chernobyl are in fact symptoms of a harrowing Cold War logic: the military treated human biology as a kind of film.

5 The film of the skin: State-sanctioned ecocide and U.S. nuclear testing

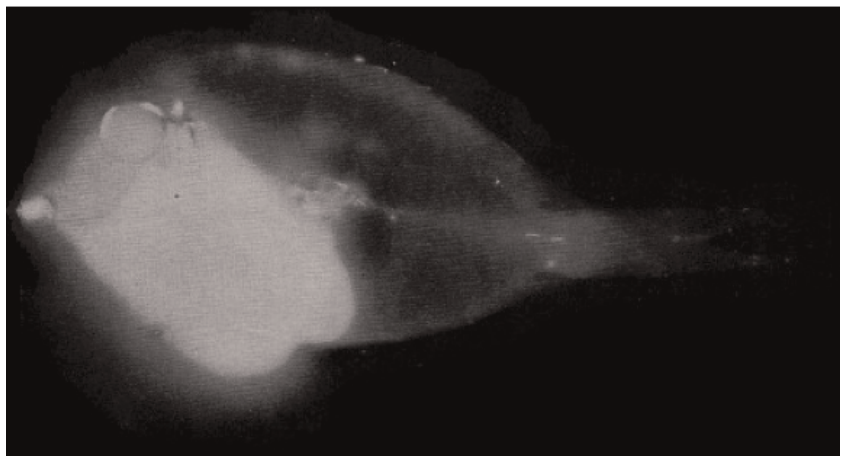

Fig. 8: 'Radio-Autograph' from a contaminated puffy sturgeon fish.

Anthropologist Joseph Masco refers to the 'radio-autographs' used by military researchers during the atomic testing era as a 'new sign of our modernity'.[34] These images were developed by retrieving fish from the areas surrounding the Pacific Proving Grounds after a nuclear detonation, cutting the animals in half, and placing the bisected creatures internal-organs down on a photographic plate.[35] The concentration of the radioactive contamination in the body eventually exposes a ghostly outline of the fish anatomy. The toxic infection documented by the radio-autographs also flows throughout connected food chains and ecosystems, which leads to Masco's inevitable conclusion regarding the Bikini Atoll tests that: 'almost all seagoing fish have been radioactive'.[36] Accordingly, our question might be: have all media been radioactive?

The United States government has released over 70 industrial films documenting the testing era in Nevada and the Bikini Atoll, now available on a Department of Energy website.[37] These films range from 10 minutes to an hour and were produced by the Air Force's Lookout Mountain studios – 'a fully self-contained 100,000 square foot studio overlooking the famous Sunset Strip' that employed 'both military and civilian personnel recruited from nearby motion picture studios such as Metro-Goldwyn Mayer, Warner Brothers Studio, and RKO Pictures'.[38] This web-accessible archive is a small portion of the 6,500 films produced by Lookout Mountain; the publically-released footage has suspiciously passed state censorship processes. Misgivings aside, some of this military industrial cinema betrays signs of the upsetting logic that ran throughout the Pentagon's Cold War policy, particularly in the films that depict animal testing.

Fig. 9-12: Stills from Operation Redwing-Military Effects animal testing.

In *Operation Redwing-Military Effects* we watch as soldiers assemble animals for testing during the Redwing missions that took place on the Pacific Proving Ground in the Marshall Islands between 4 May and 21 July 1956. The voice-of-God narrator speaks over the preparations:

> [t]he biomedical effects program consisted of one project with the objective of obtaining information on the requirements for protection against cornea retinal burns. Rabbits and monkeys were exposed to the thermal pulse of several Redwing detonations. Timing and shutter mechanisms for fractionating the light-pulse time-wise and shutters and filters as possible protective devices for the eye were tested at all stations.[39]

The military use of camera shutters and analog imaging technology immediately signals a dangerous aspect of the state-sanctioned logic informing the testing era: the Department of Energy understood that nuclear devices and media technology were fundamentally similar machines, both participating in the same violent ecology of energy. This is living biology tragically exposed as though film material.

Joseph Masco describes these animals as 'instrument-bod[ies]' that are 'portrayed in the film with the same efficiency as those demonstrated on various kinds of machinery'.[40] The conclusion that follows from the policies present in the test footage shores up the already startling recognition that animals had become demonstrable media-forms in the eyes of the Pentagon, as such rationality enacts what we could term a *test subjectivity*[41] for all those living downwind from the blasts. Masco writes that the tests are

> [a]n important illustration of a larger production and deployment of radioactive natures since 1945. In a variety of ways, soldiers and citizens were also part of this experimental regime, exponentially expanding the frame of the

> nuclear experiment from the confines of the Nevada Test Site to the global biosphere: … 'all organs and tissues of the body have received some radiation exposure'.[42]

Each atomic detonation and accident sends arcs of energetic information across great magnitudes of space, just as it decays in the equally grand temporal magnitude of half-life. Radiation poisoning is no longer a question answered through confirmation but instead a general condition measured by degree. Transversal approaches to media ecology become an essential diagnostic tool for assembling those media forms that interact with the unseen forces moving within our shared ecology. While this is useful in evidencing imperceptible violence these diagnostics hold political potential for media practitioners interested in critically investigating the technologies that helped build the anthropocentric worldview that supports contemporary environmental negligence. Reading Guattari, Pettman reminds us of our ethical responsibility to create

> 'dissident vectors' as well as 'experiments in the suspension of meaning' to detoxify the collective sphere. [Ecology must] become a concern for all those who comprehend the stakes of protecting 'the environment': whether natural, cultural, social, or personal… the human seems to be the privileged (potential) revolutionary subject.[43]

6 The return to Becquerel: Contemporary media response to nuclear events

Mike Davis has compiled a series of morose stories, including: a 1953 incident where one family had 4,390 farm animals destroyed by atomic beta rays; the bloom of childhood leukemia in Utah; the death of 6,000 sheep during a failed nerve gas experiment; and the unborn fetuses in the town of St. George that more closely resemble jellyfish than humans. Davis' work exposed the extent to which nuclear, chemical, and ordinance weapon tests turned the four corners area of the American southwest into a veritable wasteland, or the 'National Sacrifice Zone',[44] while also cataloguing a number of ecologically-minded artistic productions that directly responded to the damaged landscape throughout the 1980s and 1990s. He points to photographer Richard Misrach, alongside the still active Atomic Photographer's guild,[45] as heroes of the responsive eco-media movement.

In some of his most iconic photos Misrach, in collaboration with Susan Sontag, captured a series of pits in the American southwest where local farmers were encouraged to dump any animals that mysteriously died in the region. In *Violent Legacies: Three Cantos*, Sontag and Misrach recount a 1953 story about the Bulloch brothers in Sand Springs Valley whose sheep gave birth to mutated ewes before dying en masse. Other livestock soon died from atomic beta rays – 4,390 in total.[46] This narrative sets the stage for Misrach's celebrated 1987-1989 photo series 'The Pit', which relentlessly depicts anonymous dead animal pits scattered across the southwest.[47]

Fig. 13: 'Lingering Radiation', autoradiograph impression from a nuclear-bombed tree stump. elin o'Hara slavick, After Hiroshima (2013).

While Misrach might epitomise the ecocritical activist gesture of imaging, representing, and distributing visual information about the long-term environmental effects originating in ecocidal Cold War policies, other media activists have taken a different approach. elin o'Hara slavick provides a less linear response by foregrounding the plasticity of humanity's relationship to the unseen processes of the Earth throughout her 2009 series *After Hiroshima*.[48] This project adopts a media ecological perspective in its historical examination of human/environmental relations and finds inspiration in Becquerel's original discovery regarding atomic energy and photography. In one example, 'Lingering Radiation', a contact print of an X-ray

has been exposed to a tree stump bombed by atomic weaponry. The image outlines plant biology still contaminated and emitting energy 70 years after atomic exposure.[49] slavick's work looks back in time to a historical moment when humankind's relation to the environment radically shifted. She then exports this watershed epistemological event into a contemporary and politically-charged climate for the purpose of demonstrating that the material environment did not always look as it does today, and that the future (and how we sense the world as media forms) governs and inflects the history of human perception.

This rhetorical movement of looking into the past for relational techniques that crystallise a moment of human/environmental relations, and casting that same uncertainty forward and into current politics, works to confirm for viewers how the anthropocentric political relations through which we arrange the Earth are fundamentally open to change and have sensory terms and clauses negotiated by the media. A transversal ecological approach to media archives can, in effect, *make new sense* of the world by reanimating a perceived Earth that is not homologous with the environment visible today. The challenge lies in whether this micropolitics of sensation can expand along transversal lines in a manner that fully embraces non-human agencies. As Fuller remarks, we need aesthetics that

> make us imagine a nature in which nature itself must be imagined, sensed and thought through. At a time when human practices are rendering the earth definitively *unheimlich* for an increasing number of species, abandoning the human as the sole user or producer of art is one perverse step towards doing so.[50]

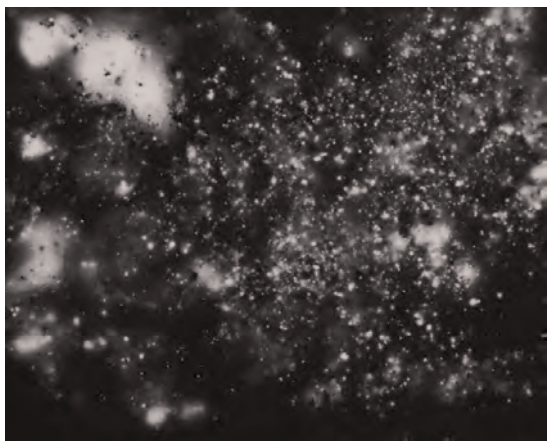

Fig. 14: 'Trace #7 Nihonmatsu Castle (*Nihonmatsu, Fukushima*)*, 2012. From 'Trace: Cameraless Records of Radioactive Contamination', Shimpei Takeda, 2013.*

The Japanese artist Shimpei Takeda has created a similar project using Becquerel's techniques to document site-specific ecologies after the Fukushima disaster. Using soil samples collected from various national historic locations, including castles and temples, Takeda has created a photographic cartography of fallout since 2011, while suggesting that radioactivity is as much a part of Japanese cultural history as the landmarks he studies.[51] By highlighting how even the most cherished historical spaces are co-composed by a history that is always and in the first place environmental, Takeda provokes mind-numbing questions about temporality and radioactive toxicity. The castle where Takeda created this print was erected 600 years ago, but the site's enduring legacy was formed only recently by the nearby Fukushima reactors and will outlast the Murmachi architecture by thousands of years.

7 Energy humanities and analog media after nuclear detonation

Fully mapping nuclear disasters by scanning media archives for traces of aesthetic contamination is a massive project, yet simply evidencing, verifying, and re-representing crisis is not a significant contribution to how we theorise and act on large-scale ecological issues. For anthropologist Dominic Boyer and cultural theorist Imre Szeman, better solutions start with interdisciplinary research that draws from the sciences to form what they term an 'Energy humanities', as 'today's energy and environmental dilemmas are fundamentally problems of ethics, habits, values, institutions, belief, and power – all traditional areas of expertise of the humanities and humanistic social sciences'.[52] Boyer and Szeman's manifesto contends that the future is not entirely fatal. The solution to our problem is actually much simpler than a technological messiah, but seemingly insurmountable just the same: we have hit an 'impasse afflicting humanity – [a] gap between knowledge and action, insight and involvement'.[53] This popular cognitive impasse is a polite way of describing a systemic environmental illiteracy that does not adequately account for the interlinked ecologies of materiality, energy, and the ethical questions circling how our media systems impact cultural perception of the world.

Adrian Ivakhiv echoes the energy humanities manifesto while reading Nadia Bozak's landmark study of cinema's impact on ecology and resource infrastructure.[54] Ivakhiv reminds us that moving images are, already, energy humanities:

> [c]inema… is a thoroughly ecological process. It has always depended on a powerful combination of at least two forms of solar energy: the capture of reflected solar light itself, and the indirect products of that energy that have been stored and compounded over millennia in the form of fossil fuels and their photochemical derivatives. Cinema is a form of captured, organized, and released light-heat-energy-movement.[55]

Ivakhiv's argument supports the suggestion I am making here, that celluloid media – when conceived as an interactive process in the ecology of energy – occurs 'naturally' or autonomously within the environment and operates beyond anthropocentric intent. This poses a theoretical problem by disrupting arguments that maintain media as pictures of the world that is only visible or political for the human. Instead, cinema and photography occur autonomously without humans, as well, and these ecological and non-human material politics can impact human culture and politics in unforeseen ways. The unpredictability of the Earth's autonomous aesthetic practices hold open a promise for a future that is imagined differently from the present environmental conditions we sense today.

The intellectual gamble, then, might be to ask how a contaminated media can be a useful media? How do these war-stained aesthetics – partially generated by decisively non-human processes – help us to better understand how we relate to the environment and, hopefully, aid us in finding cultural alternatives for a less precarious future? An energy humanities is devoted to imagining novel and different futures that rely less on the representation, reification, and documentation of the environment as a series of fragile or condemned material objects that exist for humans and human use alone. Instead, transversal approaches to ecological politics emphasise how factors like nuclear warfare and energy distribution have become entangled with ecological forces, human aesthetics, and cultural perception. Exploring these occluded connections could lead to political conditions that are preferable to the seemingly unending series of environmental crises we face today. The shape, vision, perception, and actualisation of the future raised by Boyer and Szeman depends on imaginative creative projects like that of slavick and Takeda, whose artwork reorients human relationality through an aesthetic engagement with energy ecologies operating beyond the human. This investigation of Earthly photography in light of nuclear events has yielded new insights into the role of energetic non-human agency in media ecologies and clarified how some visual media engage in violent sensory histories, also that some practitioners have learned how to imagine the contemporary world differently

using recycled perceptual-environmental techniques. Transversal research and artistic practices comprise a radical politics promising untapped future sets of relations that, we hope, realise improved environmental conditions for humans and otherwise.

As a parting example, we can see how transversality is politically productive in fields closely related to the media ecological study of energy. A process developed by a group of scientists led by Kevin Uno enables an empirical methodological test for radioactive content emitted during the testing era as it is present in ivory today. This process, which is fundamentally similar to the radioautographs made by slavick and Takeda, allowed Uno to determine whether the bone had been harvested before or after the 1989 trade ban, effectively confirming that specific pieces of ivory had been poached.[56] By rethinking atomic testing alongside the film-like qualities of the body, as suggested by mid-century military practices, a political intervention occurs in the social and a senseless economy of slaughter is brought nearer to a close. Employing similar techniques, a second set of researchers made a discovery regarding how we can identify the veracity of long lost paintings via their relation to the period of global atomic testing.[57] If the aura can be restored, albeit through the Earth's autonomous photography, what is the radical political potential of an aesthetic practice that takes non-human ecologies of energy seriously? Here, environmental media is a meteorological process for a future material politics – or perhaps an empirical barometery of light.

Notes

1. See Medved & Medved 1984, pp. 47-52.
2. See Solnit 2009, pp. 28-246 for a comprehensive history, see also Scarpino 2009, p. 66.
3. London 1980.
4. See Jackovich 1980 and Zoellner 2009, p. 94.
5. An Atomic Energy Commission memo discovered by Carole Gallagher cites downwind Mormon populations as a 'low-use segment of the population'. See Gallagher 1993, p. xxiii.
6. Joseph Masco notes that the National Cancer Institute approximates that between ten and 70,000 Americans will develop thyroid cancer as a result of continental Nuclear testing. See Masco 2006, pp. 26-27.
7. This is not an exhaustive list, but I am enormously indebted to the invaluable research of the following: Davis 1999, Gallagher 1993, Kuletz 1998 and 2001, Masco 2006, Solnit 2014, and Walker 2000.
8. Davis 1999, p. 73. See also Kuletz 1998, and 2001, pp. 237-260.
9. Violence is a central term deployed throughout this article. I intend its use primarily in the basic sense of physical damage to bodies and environments. This traditional under-

standing folds together state-sanctioned actions of impunity alongside Rob Nixon's account of 'slow violence' as: 'a violence of delayed destruction that is dispersed across time and space, an attritional violence that is not typically viewed as violence at all' (Nixon 2011, p. 2). This gesture is designed to highlight how the damage caused by radioactivity exists in a temporal condition removed from anthropocentric immediacy, as this violence flows through materiality, biology, and ecosystems in a manner occluded to human vision. Violence, here, is damage across time and space as it touches down through ecological destruction, state policy, warfare, and the cultural perception of threat. See also James Elkins on violence, politics, and aesthetics in slavick 2013, pp. 11-12.

10. Nixon 2011, pp. 200-232.
11. In media ecology, as Matthew Fuller asserts, the 'capacities of perception are immediately and explicitly politicized' (Fuller 2005, p. 90).
12. Mielke 2005, p. 29.
13. Guattari 2000, p. 29.
14. Pettman writes: '[t]he fragility of the world's ecosystem reminds us of the fragility of the financial system, as well as that of society itself, as a contract between sublimating selves' (Pettman 2011, p. 174).
15. Fuller writes: 'media are rightly perceived as being profoundly political or ethico-aesthetic at all scales … Guattari's repeated linkage and cross-fertilization of the three modes, "mental," "natural," and "social" of ecology within "ecosophy" provides insight into the way that any of these or other modes of an ecology always demand carrying over into another mode, another universe of reference, and always another' (Fuller 2005, p. 5).
16. Parikka 2013b, p. 118.
17. Parikka 2013a, p. 76.
18. Gabrys 2011, p. 104.
19. See Wilder 2009. Becquerel's photos available at: https://jahschem.wikispaces.com/history+of+radiation; http://galleryhip.com/henri-becquerel-experiment.html.
20. See Wilder 2009, pp. 58-65, and slavick 2009, pp. 307-328.
21. Wilder 2009, p. 64.
22. DeLoughrey 2009, pp. 479, 486.
23. See Cartwright 1995, pp. 107-142.
24. See Lippit 1999, pp. 65-83, and 2005, pp. 13-60.
25. DeLoughrey 2009, pp. 469, 470.
26. DeLoughrey draws a distinction between the ecocritical focus on the vulnerability of the environment and the non-human turn involved in taking seriously those energetic political economies at work beyond anthropocentricism. The radical index to the superstructure of radiation ecologies is 'what illuminates matter but is not necessarily constituted by it … Radiation suggests a universal and global ecology that implicates the human and the nonhuman' (ibid., pp. 469, 471).
27. Lippit 2005, p. 94. See also Virilio 1989, p. 85 and Mavor 2012, pp.139-156.
28. See Utsumi 2012, p. 178 and Marcoń 2011, pp. 787-797.
29. Marcoń 2011, p. 792.
30. See Swarbrick 2006.
31. See Saffron 1996.
32. Schuppli 2011, p. 127.
33. The film is available online at: http://www.youtube.com/watch?v=18o_X696dYw.
34. Masco 2006, p. 305.

35. http://upload.wikimedia.org/wikipedia/commons/4/48/Crossroads_Radioactive_Puffy_Surgeon_Fish.jpg, Joint Task Force One, Operation Crossroads: the Official Pictorial Record, 1946, p. 216.
36. Ibid., p. 305. Masco is citing an Operation Crossroads researcher named David Bradley while referring to the marine life found in the Pacific Proving Ground area. Later, he writes: 'the experimental projects that produced and now maintain the bomb have collectively turned the entire biosphere into an experimental zone – one in which we all live' (Ibid., p. 315).
37. The Department of Energy collection: http://www.nv.doe.gov/library/films/testfilms.aspx, on Critical Commons: http://www.criticalcommons.org/author/kham, on YouTube: https://www.youtube.com/playlist?list=PLEFFE6316B694B346, with annotated summaries: http://www.rocassoc.org/open/items/10/nuclearTest.htm.
38. These quotes come from a Department of Energy fact sheet: http://www.nv.doe.gov/library/factsheets/DOENV_1142.pdf. See also O'Gorman & Hamilton 2012, pp. 189-208 and 2011, pp. 41-66.
39. Clip begins at 18:47 at: http://www.youtube.com/watch?v=IRSkvFijDrM&t=18m47s
40. Masco 2006, pp. 309-310.
41. I am grateful to James Tobias for suggesting this term. I understand a condition of 'test subjectivity' in close proximity to Adriana Petryna's conception of a 'biological citizenship', where 'only through concrete understandings of particular worlds of knowledge, reason, and suffering, and the way they are mediated and shaped by local histories and political economies, can we possibly come to terms with the intricate human dimensions that protect or undermine health. Seen this way, health is a construction as well as a contested way of being and evolving in the world' (Petryna 2002, p. 33).
42. Masco 2006, p. 311.
43. Pettman 2011, p. 190.
44. Davis 1999, pp. 58-60.
45. Their work is available at: http://atomicphotographers.com/.
46. See Misrach & Sontag 1992, pp. 39-59.
47. See Davis's wonderful commentary (Davis 1999, pp. 51-57).
48. More of her work available at: http://www.elinoharaslavick.com/autoradiographs.html.
49. See slavick 2009, p. 309.
50. Fuller 2010, p. 20. See also Parikka's reading of Fuller (Parikka 2013b, p. 117).
51. See Takeda 2013, pp. 206-220, also at: http://www.geologicnow.com/.
52. Boyer & Szeman 2014, also at: http://www.universityaffairs.ca/the-rise-of-energy-humanities.aspx.
53. Ibid.
54. See Bozak 2012.
55. Ivakhiv 2013, p. 338.
56. See Uno 2013.
57. See Caforio 2014.

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