The Four-Minute Warning Drawing Machine: revealing the assemblages of nuclear deterrence

Michael Mulvihill

Doctor of Philosophy

School of Arts and Culture

1st November 2019

ABSTRACT

This research sets out to use art practice as a critical method to make the social and cultural production of nuclear weapon systems visible in everyday life experience. The research draws upon a critical framework based on new materialist philosophies that see reality as composed of interacting “machinic” assemblages of affects and more-than-human relationships (DeLanda 2015). These philosophies position active processes, such as artmaking, as tacit ways of making visible “the concrete yet complex materiality of bodies immersed in social relationships of power” (Braidotti 2015), which are otherwise invisible to fixed representational ontology.

The artworks that have emerged establish entwined relationships between nuclear weapon manufacture and artmaking by making commonalities between workshop configuration, administrative processes and transportation. Insight has also been drawn from immersive work within the Cold War archives at RAF Fylingdales as the station’s – and the RAF’s – first artist in residence. Unprecedented access was given to the site, which reveals the ballistic missile early warning station’s interconnectivity beyond its barbed wire perimeter.

These relationships have been conceptualised as the four-minute warning drawing assemblage comprising interactive social parts that include drawing practices and instruments of deterrence, constantly producing new techno–social worlds and novel arrangements of life beyond normative perception. In doing so, the research makes a contribution to new and urgent debates about nuclear weapons and the emerging risk of nuclear war by providing different and innovative ways of thinking about society and our relationships to the bomb.

Dedicated with lots of love to my Mam, Rotha (1948 – 2013)

Acknowledgements

Eternal love and thanks to Chloë Barker for your love, patience and support. Lots of love to my Dad - Mick Mulvihill, my brother - Paul, Ruben, and Elvis. As-well-as Lesley and Paul Barker with Doug, Nero, Brucie, Philippe Philope, Libby and Dave, Tomothy, Buggins, Poppers, and G.P.W.

Thanks for the incredible support of my supervisors Professor Rachel Woodward, Professor Philip Steinberg and Professor Richard Clay. Without their support and guidance, this work would not have been possible. Special thanks to Flt Lieutenant Richard Weeks at RAF Fylingdales who made the Artist Residency and this work happen. Kevin Booth and the curatorial and collections teams at English Heritage. Along with Sarah Booth and the dedicated team at Whitby Literature and Philosophical Society. Also Doctor Gair Dunlop and Doctor Al

Additional thanks to: Mike Bartlett; Doctor Luke Bennett (Sheffield Hallam University); Professor Stephen Graham (Newcastle University); Dan Vernon, Alison Millar, Paul Howard and Erica Starling Productions. Last but by no means least everyone within the Northern Bridge Doctoral Training Partnership and across the Faculty of Humanities Arts and Social Sciences at Newcastle University.

Contents

List of Images

1962

Figure 2.12 Robert Rauschenberg and Yvonne Rainer with Bell Laboratories engineers working on *9 Evenings: Theatre and Engineering* (1966) [Redacted for copyright]

Figure 2.13 (Right) Bell Laboratories' Stanley R Mickelsen's Safeguard Missile and Radar Complex, North Dakota [Redacted for copyright]

Figure 2.14 Military analyst Herman Kahn [Redacted for copyright]

Figure 2.15 Artist James Lee Byars [Redacted for copyright]

Figure 2.16 Julius Shulman *The Wohlstetter Family* (1955) [Redacted for copyright]

Figure 2.17 Leonard McCombe *RAND Corporation analysts meet in the Wohlstetter home* (1959) [Redacted for copyright]

Figure 2.18 Conceptual drawing of a Minuteman III missile silo[Redacted for copyright]

Figure 2.19 Unveiling of the *Chicago Picasso* (1967) [Redacted for copyright]

Figure 2.20 Analysts Roberta and Albert Wohlstetter [Redacted for copyright]

Figure 2.21 Art historian Meyer Schapiro [Redacted for copyright]

Figure 2.22 BMEWS training manual L1000-2

Figure 3.1 Joey the Mechanical Boy's drawings of trams at various stages of his treatment [Redacted for copyright]

Figure 3.2 Still from Strategic Defense Initiative (Star Wars) concept video c1983 [Redacted for copyright]

Figure 3.3 (Left) Fanfold drawing paper from Washington Computer Centre early 1980s

Figure 3.4 (Right) Michael Mulvihill *A drawing of space warfare* (1982 aged 9)

Figure 3.5 RAF Fylingdales block and data flow diagram

Figure 6.13 (Right) Flt Lt Richard Weeks at the unused weapon serving hatch in the former SSPAR armoury

Figure 6.14 (Left) SSPAR foyer with the ceremonial spade used to break the ground for the building

Figure 6.15 (Right) SSPAR foyer seating area and blast door entrance to the operations bunker

Figure 6.16 SSPAR radar with (left to right): Professor Richard Clay, Ellie Clifford of Whistledown Productions and Flt Lt Richard Weeks

Figure 6.17 Computer representation of 21st Space Wing global radar coverage, which is similar to displays in the Space Operations Room [Redacted for copyright]

Figure 6.18 (Left) Space Operations Briefing Room with Flt Lt Richard Weeks and Professor Rachel Woodward inspecting various items relating to RAF Fylingdales space monitoring and early warning activities

Figure 6.19 (Right) Briefing room screen with various awards and articles related to RAF Fylingdales space and early warning mission

Figure 7.1 For Trump Love Putin? Still from an animation of Russian nuclear warheads descending on Mar-a-Lago, Florida [Redacted for copyright]

List of Abbreviations

ABM	Anti-ballistic missile
AFB	Air Force base
AIR	Artist in residence
AHRC	Arts and Humanities Research Council
APR	Annual progression review
BwO	Body without organs
BMEWS	Ballistic missile early warning station
CAD	Computer-aided design
CDR	Centre for Design Research (Stanford University)
CNC	Computer numerical control
COMSPACEAF	Command of Space and Air Force
DTO	Data take-off
DJCAD	Duncan of Jordanstone College of Art and Design
ECCM	Electronic counter countermeasure
ECM	Electronic countermeasure
FMWDM	Four-minute warning drawing machine
GBI	Ground-based interceptor
GLCM	Ground-launch cruise missile
IBM	International Business Machines
ICBM	Intercontinental ballistic missile

ICL	International Computers Limited
INF	Intermediate-range nuclear forces
IRBM	Intermediate-range ballistic missile
MAD	Mutually assured destruction
MIP	Missile impact predictor
MIPOP	Missile Impact Predictor Operations Program
MIRV	Multiple independently targeted re-entry vehicle
MOD	Ministry of Defence
MWSRG	Military War and Security Research Group
NATO	North Atlantic Treaty Organisation
NMD	National Missile Defense
NORAD	North American Aerospace Defence Command
NUMAC	Northumbrian Universities Multiple Access Computer
NRO	National Reconnaissance Organisation
PAVE PAWS	Precision Acquisition Vehicle Entry Phased Array Warning System
PLA	Polylactic acid
PSI	Pounds per square inch
RAF	Royal Air Force
RCA	Radio Corporation of America
RF	Radio frequency
ROC	Royal Observer Corps
RV	Re-entry vehicle

SAC	Strategic Air Command
SAC	School of Arts and Culture
SDI	Strategic Defence Initiative
SFTNSA	Standby for the new stone age
SHAPE	Supreme Headquarters of Allied Powers in Europe
SHQ	Station headquarters
SIP	Satellite information processor
SSB	Single sideband
SSBN	United States Navy hull classification for ballistic missile submarine (SS – submersible ship, B – ballistic missile, N – nuclear powered)
STL	Stereo lithography
SSPAR	Solid state phased array radar
SW	USAF 21st Space Wing
USAF	United States Air Force
USSTRATCOM	United States Strategic Command
W	Warhead

Chapter 1: The Four-Minute Warning

1.1 Last night, the plan for future war, was all I saw on Channel Four[1]

Once, when I was a boy, I ran home as fast as I could from school to see if I could make it back within the four-minute nuclear air attack warning. Four minutes was the given flight time of nuclear-armed intermediate-range ballistic missiles (IRBM) to travel from their launch sites in Central Soviet Russia and Eastern Europe to their targets in the United Kingdom. It was 1983 and tension had been building between the United States and the Soviet Union over deployments of an array of new nuclear weapons systems in Europe. The mood of the country was grimly resigned to a future nuclear war being a real possibility, and the television discussion of this probability was encapsulated by the song lyrics “the plan for future war, was all I saw on Channel Four” from *Shoplifters of the World Unite* (1987) by The Smiths.

At this time my mum had become vocal about supporting the women at the Greenham Common Peace Camp. The camp had become a focus of action against the deployment of ground-launch cruise missiles (GLCMs) to the USAF 501st Tactical Missile Wing stationed at RAF Greenham Common. My mum’s support for the Women’s Peace Camp at Greenham had provoked dispute with my auntie, but it also heightened the sense of precarity. Even on brilliant summer days during family holidays, the notion of ontological importance was often invoked, with the observation that the bucolic landscapes of Oxfordshire or the Lake District where we stayed could be gone in a searing white flash.[2] However, this sense of an imminent end was also a common cultural phenomenon, one that was emblemised by the four-minute warning, and the

[1] Johnny Marr, Morrissey, *Shoplifters of the World Unite* (London: Rough Trade 1987).

[2] This statement is attributed to a family holiday in Oxfordshire, where we stayed on a caravan park at the end of the runway at RAF Brize Norton in 1982.

question of what would you do with your last 240 seconds was often a topic for television comedy such as the BBC's *Not the Nine O'Clock News* (1979–1982), popular music such as Ultravox's *Dancing with tears in my eyes* (1984), or as conversation in the school playground and classroom.

My school at the time was called Hadrian Junior School and was opposite the Arbeia Roman Fort excavation in South Shields. One time, while I sat in lessons with my class mates, the four-minute air attack warning siren droned into life and rapidly raised to a high-pitched wail. Everyone froze: the end of the world had begun. A moment later, the siren powered down and everyone, including our teacher, laughed and talked excitedly with relief that we were not in a nuclear war. This event set the scene for my experiment to see if it was possible to make it home if the air attack siren was the actual four-minute warning.

My home was near the school and it normally did not take my friends and I very long to walk the distance and so we all ate our lunch at home. I wondered if I could run the distance in an emergency. One day, after the school bell sounded for lunch, I launched myself into a sprint home, running as fast as I could. I imagined that the missiles were on their way and I needed to be with my parents and brother before they struck. I remember my face felt hot and flushed, my chest was wheezing, my throat felt raw and the inside of my mouth tasted of iron. When I reached the house, I thought I'd been so quick, I gasped for air and my legs were shaking. I looked at my Fred Flintstone watch, which had a rock that marked out the seconds, and saw it had taken me six minutes to get home. This memory has now taken on particular significance as I am the first artist to have a residency at RAF Fylingdales ballistic missile early warning radar station (BMEWS), which is the very place where the four-minute warning would have been raised.

1.2 RAF Fylingdales

RAF Fylingdales, situated on Snod Hill in the North York Moors National Park, is one of three BMEWS. The others are at AFB Thule, Greenland and AFB Clear, Alaska, situated around the North Pole to watch for intercontinental ballistic missiles (ICBMs) and intermediate-range ballistic missiles (IRBMs) being launched against the United States, the United Kingdom and NATO allies. As a secondary mission the station also keeps watch and helps maintain a catalogue of all 49,000 human-made items in orbit around the Earth, ranging from space junk the size of a cricket ball, to the International Space Station. RAF Fylingdales is a key element for the maintenance of the US and UK nuclear deterrent by providing early warning of a nuclear attack in order to provide time to launch a counter attack. The station has performed these roles since becoming operational on 17th September 1963 and since the ground was broken for construction of RAF Fylingdales in 1960, an archive of all activities and materialities has been accumulated. I was invited to RAF Fylingdales to take a look at the archive and collections a few months into researching this PhD, in February 2016, with the idea of suggesting ways they could turn it into a display for visitors.

The invitation had come as a result of an artistic intervention at English Heritage Group 20 York Royal Observer Corps (ROC) HQ (or the York Cold War Bunker) called *Standby for the New Stone Age* (2015). I had been invited by curator Kevin Booth to install artworks among the Cold War artefacts of the bunker. The artworks had been made during a Leverhulme Artist in Residence with the Military War and Security Research Group at Newcastle University. The artworks were part of an ongoing practice that sought to make sense of the memory of my run from school, by making the interconnected relationships of places and people that comprised the nuclear deterrent visible. This practice-led doctoral research continues this enquiry and is formulated around three questions:

How and by what mechanism do nuclear weapons systems interact and produce socially and culturally?

Why should creative arts practice be used to do this?

What new knowledge does creative practice produce about nuclear weapons?

During the preview evening of *Standby for the New Stone Age*, I begun talking about my work and memories of the four-minute warning to Dr Faye Priory (a conservator at the York Museum Trust). Faye said that she also had a story for me because she was in discussion with RAF Fylingdales about a Cold War exhibition they were putting together at the radar station using the artefacts from their archives. Faye explained that RAF Fylingdales was enquiring about a loan of a mannequin to dress in a nuclear biological and chemical (NBC) warfare suit but York Museum could not oblige because RAF Fylingdales could not provide enough assurance that the mannequin would not damage the NBC suit. Faye thought that RAF Fylingdales would be interested in meeting me and offered to make an introduction to Flt Lt Richard Weeks, media relation officer at RAF Fylingdales and nascent curator of the station archive and collection.

I spent three hours with Flt Lt Richard Weeks looking over the materials in RAF Fylingdales' archive and collection. The collection took up three rooms and included a section of one of the original golf ball radomes, which Flt Lt Weeks took delight in pointing out was made of cardboard. After we had looked at the machinery, control consoles, photographs and documents, Flt Lt Weeks asked what would I like to do with all off it. I suggested an artist residency in the RAF Fylingdales archive, which would be explored and sifted by the process of making artwork about its content. Richard really liked the proposal and said that if I could explain my intentions on one side of A4, then he would send it up to RAF Air Command at High Wycombe to get approved. The

archive has never been seen in public. Although stabilised, with items sorted into rational piles, it is not catalogued and much of its content is still unknown. Nevertheless, each item in the archive was part of an assemblage that operated as a crucial part of the nuclear deterrent for almost 30 years of the Cold War. Therefore, this research is the first time that many of the items will be made known to a wider public, or subjected to critical enquiry, and it is the first time that RAF Fylingdales itself has been the subject of a concentrated period of analysis. Despite RAF Fylingdales' iconic presence on the North York Moors, there has been little in the way of substantive history of the site written in the 55 years of ballistic missile early warning operations.

1.3 RAF Fylingdales: A history of histories

The most complete written history of RAF Fylingdales is BCF Wilson's *Royal Air Force Fylingdales: A History* (1983) published by the RAF to commemorate 30 years of continuous operations. Wilson presents an anecdotal account of the author's career at RAF Fylingdales and an overview of the history of Radio Corporation of America Great Britain (RCA GB), which built and maintained the site. A more critical account of RAF Fylingdales' origins is given in a paper by Graham Spinardi entitled *Golfballs on the Moor: Building the Fylingdales Ballistic Early Warning Radar* (2007. Spinardi's work was the result of his archival research at the National Archives and investigates the political decisions made by the government of Harold MacMillan. Spinardi's account included diplomatic discussion about the final positioning of RAF Fylingdales near Whitby, instead of the Shetland Islands where the US preferred. Spinardi explains that by locating the BMEW station on the North York Moors, it provided just enough political leverage to justify the £43 million operating cost of RAF Fylingdales over its lifetime, which made it one of the most expensive structures on the planet.[3] The cost would be footed by UK tax payers, even though many criticised the four-minute warning that the RAF Fylingdales would give as not being enough time to boil a kettle, let alone raise a

[3] Conversation with Flt Lt Richard Weeks, 28 June 2016, RAF Fylingdales .

meaningful public alarm. Nevertheless, it was thought to be enough warning to get the UK's nuclear bomber forces airborne and, therefore, to maintain the credibility of the UK nuclear deterrent when threatened by ICBMs.

An account of the materialities at RAF Fylingdales and its operations are provided by Wayne C Cocroft and Roger Thomas in *Cold War: Building for Nuclear Confrontation 1946–1989* published by English Heritage in 2003. This is a substantive survey of Cold War archaeology that was coming to English Heritage's attention following the end of the Cold War in the mid-1990s and early 21st century. The work draws on fieldwork and a photographic survey that was conducted at RAF Fylingdales in 1998, before the demolition of the golf ball radomes. The findings of this survey are also reported in Historic England's *Historic Building Report: RAF Fylingdales, Snod Hill, Lockton, North Yorkshire*, which draws upon interviews with staff and BCF Wilson's *RAF Fylingdales: A history* for historic context. Another detailed account of RAF Fylingdales is given in a restricted report published by the Defence Science and Technology Laboratory at Porton Down called *RAF Fylingdales: an historic perspective* (2002). This document draws upon the same National Record Office sources as Spinardi, along with material that came to hand from the RAF Fylingdales archive and conversations with senior staff. It traces RAF Fylingdales' origins back to World War II and the desire to build a defence radar against the V2 threat. However, the document explains that this was not deemed urgent until the possible threat from thermonuclear weapons launched from ICBMs was demonstrated by the launch of Sputnik in October 1957.

RAF Fylingdales occasionally makes an appearance in academic research materials that are investigating related topics. Two examples are Rachel Woodward's survey of Ministry of Defence estates in *Military Geographies* (2004) and David Wood's *Territoriality and Identity at RAF Menwith Hill* (2008), in which he stresses that RAF Fylingdales is often confused with the intelligence and signals centre outside of Harrogate, on account of the geodesic radome structures that were common to both sites. For obvious reasons, RAF Fylingdales is referenced in Stan Openshaw, Philip

Steadman and Owen Greene's *Doomsday: Britain after Nuclear Attack* (1983) because of the station's role in the maintenance of the nuclear deterrence through its early warning function, as mentioned above. This made RAF Fylingdales a likely primary target in the opening gambit of an all-out nuclear strike by the Soviet Union upon the US, UK and NATO allies. Such an event is alluded to in Nicolas Meyer's television movie *The Day After* (1983), when soldiers guarding a Minuteman III ICBM silo are told that early warning radars in California (PAVE PAW AFB Beale) and Yorkshire, England had been wiped out.

Other cultural appearances for RAF Fylingdales include being the subject of the Jethro Tull song *Fylingdale Flyer* from the band's album *A* from 1980 (see Figure 1.1). The song title was later taken by RAF Fylingdales for a run of newsletters that were produced between 2003 until 2009, when the station began the @RAFFylingdales Twitter handle. While there are abundant stories about RAF Fylingdales in the media and press, spanning the entire period of the station's existence, many have focused on controversy, including: the effects of the radar upon homing pigeons' ability to navigate; radiation hazards from radar operations; RAF Fylingdales making the North York Moors a target for thermonuclear attack; and even that the base is a site for stored UFOs. There are also many press articles that look at the station's history, covering RAF Fylingdales' role in operating the International Space Station and, more recently, local charitable events such as the station's contribution to RAF100 with a charity run, or the recent summer gala event where Darth Vader, a squad of Stormtroopers, and a couple of Jawas made an appearance (see Figure 1.2).

Figure 1.1 (Left) Jethro Tull *Fylingdale Flyer* (1980)

Figure 1.2 (Right) RAF Fylingdales' summer gala day (2018)

RAF Fylingdales has also made a few, if rare, appearances on television, the most recent being Channel 5's *Coast to Coast* (2017), presented by Tony Robinson, which featured RAF Fylingdales in an episode about Robin Hood's Bay. The station also featured in an episode of BBC's *Inside Out* (2013) to mark the 50th Anniversary of operations at RAF Fylingdales. One of the first appearances of RAF Fylingdales was at the beginning of BBC Horizon's *The World of Buckminster Fuller* (1964), in which the influential architect and inventor of the geodesic dome introduces the documentary about his work in front of the three golf ball radomes at RAF Fylingdales. The latest national media appearance of RAF Fylingdales was on a documentary, *Two Minutes to Midnight*, directed by Ellie Clifford for Whistledown Productions and co-written and presented by Richard Clay for BBC Radio Four. In this programme, I am introduced as the first artist in residence at RAF Fylingdales and I speak to Richard Clay alongside Flt Lt Richard Weeks about some of the findings that have emerged from this practice-based research. The programme presented the artist residency as a distinct contribution – among the work of other academics and activists – in arms control and nuclear non-proliferation. These include: Dr Rachel Bronson, President and CEO of the *Bulletin of the Atomic Scientists*, who manage The Doomsday Clock; Eric Schlosser, author of *Command and Control* (2013); David Blunkett PC, former leader of Sheffield Council who designated the city a nuclear-free zone during the 1980s; Dr Nick Ritchie of York

University, who led the research project *Nuclear-Armed Britain*, funded by the Joseph Rowntree Charitable Trust; and Beatrice Fihn, executive director of the International Campaign to Abolish Nuclear Weapons.

1.4 1980s Cold War

The intention of this creative analysis is not to produce a historical representation of RAF Fylingdales. Rather, the research questions are addressed by seeking to investigate the social and cultural interconnectivity produced by RAF Fylingdales and by also exploring my own smaller scale and local experience of the Cold War in the 1980s. Arms control and non-proliferation experts Dr Jeffrey Lewis and Aaron Stein stated in their *Arms Control Wonk* podcast, 30th October 2018, that there has been growing academic and historic interest in this period due to the US National Security Adviser for the Trump administration's announcement of a planned withdrawal from the INF treaty signed in 1987. In this programme, entitled *Pulling out of the INF*, Lewis also highlights his own personel experience. Lewis recounts that it was the fear of nuclear war he experienced as a young adult in the 1980s that also influenced his career as an expert in arms control. Therefore, this PhD's research can be viewed as timely in that it sits within a growing tendency among experts to make the role of nuclear weapons in geopolitics and social orders visible. It uses a first person, or situated and creative, position, in order to explore the interrelationships between small-scale personal experience with the large-scale materialities of mass destruction.

The appropriateness of this approach to conceptualising nuclear weapons and war as social phenomena has precedent in the aforementioned television movie *The Day After* (1983), but also in the children's book by Raymond Briggs, *When the Wind Blows* (1982), which narrates a fictional account of Joe and Hilda Bloggs, a retired couple struggling for life in the aftermath of nuclear war. Another example is Peter Watkins' film *The War Game* (1963) made for showing on, but subsequently banned by, the BBC

until 1984. Watkin's film adopts a *vox populi* style of television journalism to present an account of the days leading to nuclear war, which escalates from geopolitical tension in Indochina. This is followed by an account of nuclear attacks on Surrey and Kent, and finally the survivors' testimonies as authorities grapple to maintain social cohesion after the war. Yet probably the most deeply disturbing account is the BBC docudrama *Threads* (1984) that follows two families living in Sheffield. It begins three weeks before the war and follows through to 15 years after the attack, where society has been driven back in time by the nuclear war to a brutal medieval existence (see Figure 1.3). The datasets for the effects of the weapons used against Sheffield were derived from geographer Stan Openshaw's computer models made at Newcastle University and published in *Doomsday: Britain after Nuclear Attack* (1983) mentioned above.

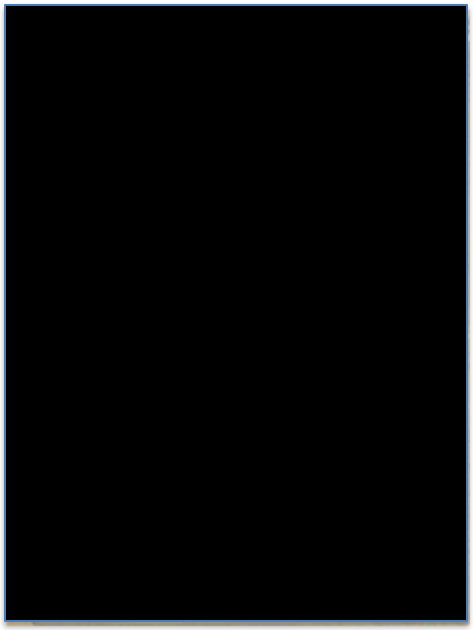

Figure 1.3 *Threads* (1984) BBC *Radio Times* cover 22–29 September 1984

1.5 Indistinct geographies of nuclear war

A contemporary account of the effects of a limited and completely accidental nuclear war between North Korea and the United States is given by Dr Jeffrey Lewis' *The 2020 Commission Report on the North Korean Nuclear Attacks Against The United States* (2018). This is a fictional account that draws upon Lewis' expertise of the North Korean nuclear weapon and missile programme and international strategies for the use of nuclear weapons. In the novel, Lewis describes how a misjudged tweet from President Donald Trump that goads Kim Jong Un is misunderstood and transforms into a geopolitical crisis resulting in a nuclear war between North Korea, Japan, South Korea and the United States (see Figure 1.4). Lewis shows that the consequences of military and political mistakes are horribly amplified by nuclear weapons and, in this case, results in the death of millions of people and the destruction of Seoul, Busan, Tokyo, Yokohama, Manhattan, Arlington County, Honolulu and Mar-a-Lago.

Geographer Dr Becky Alexis-Martin explains that nuclear war is geographically distinct from all other kinds of warfare because the space in which it will be fought (or, its productions) is immersive and dramatically compresses spatial temporalities. For example, Alexis-Martin explains that the speed and range of the ICBM, coupled with the destructive capacity of their thermonuclear warheads, shrinks time and space and dissolves the normal confines of territories and bordered terrain, while the technologies and industries that design, innovate and manufacture nuclear weapon systems globally mobilise social, technical and economic networks. Alexis-Martin explains that the effect of the nuclear war assemblage is to produce new kinds of social phenomenon where the normal distinction between war and peace, the warzone and the domestic, the

actual and the virtual, and even everywhere and nowhere are collapsed by the material affects of the weapon systems.[4]

Figure 1.4 News of a North Korean missile test on its way to the President of the United States.

Captured on Instagram at Mar-a-Lago 13th February 2017.

As we shall see, the ontological churn caused by the invention of the ICBM and thermonuclear weapons forms the central investigative drive of this thesis but it also aligns with the main concerns of critical military geographies, which human geographer Rachel Woodward describes as looking:

[4] I have discussed the idea of nuclear deterrent assemblages including concept of the Four Minute Warning Drawing with Doctor Becky Alexis Martins who makes reference to this PhD research in the cited paper, see Becky Alexis-Martin, 'Geographies of nuclear warfare: future spaces, zones and technologies' in Rachel Woodward (ed), *A Research Agenda for Military Geography*. (London: Edward Elgar [in press]) [n.p.]

> at how the continual preparation which states make in order to be able to wage war and engage in military operations shape wider economic, social, environmental and cultural geographies.[5]

Some of the themes and concerns of *Military Geographies* that intersect with this research include Matthew Rech and Tanya Woodyer's work on ludic geopolitics. Woodyer, in *Ludic Geopolitics: children's play, war toys and re-enchantment with the British military* (2017) shows that children's understanding of geopolitics are both inscribed and articulated through play with war toys and action figures. Rech, in a paper entitled *Ephemera(l) Geopolitics: The Material Cultures of British Military Recruitment* (2015) points out that we should think about our domestic life as making and remaking the geopolitical. They both show how children are affected by large-scale geopolitical actors and actions but also how new formations of geopolitics are effected through embodied, tacit and ludic activities such as imaginative play. The influence of nuclear and geopolitics of outer space upon worlding practices of childhood are explored by Fraser MacDonald in *Geopolitics and 'The Vision Thing': Regarding Britain and America's First Nuclear Missile* (2008). The paper is an account of a "space daft" school boy's journey across Scotland to experience a test launch of the US and UK corporal missile. MacDonald concludes that understanding geopolitical production should seek to include more-than-representational modes that operate in the affectivities of the senses.

Embodied geopolitics and the more-than-human relationships, or assemblages, which are produced by operations of combat aircraft are considered by Alison Williams in *Enabling persistent presence? Performing the embodied geopolitics of the Unmanned Aerial Vehicle assemblage* (2011). By considering the operations of Reaper Drones as a world-spanning cyborg assemblage composed of drone aircraft connected to a human pilot via global virtual networks, Williams demonstrates that new kinds of geopolitics and

[5] Rachel Woodward, *Military Geographies* (New Jersey: Wiley-Blackwell, 2004), p.4.

military operational parameters are being constantly produced by embodied variations in the assemblage, which inevitably exceed the intended design, or specifications, of a military campaign. Elsewhere in *Disrupting air power: Performativity and the unsettling of geopolitical frames through artworks* (2014)*,* Williams explores how creative variations also have the potential to completely reinscribe the expressive capacities and meaning of material objects such as combat aircraft. Through a discussion about the unexpectedness of the encounter with works of art by artist Fiona Banner – *Tornado* (2010) *All the World's Fighter Planes* (2004) and *Harrier and Jaguar* (2010) – installed in the Duveen Galleries in Tate Britain, Williams concludes that rather than merely raising questions that disrupt the understanding of military aircraft, but by instead incorporating the aircraft within the artmaking process, our embodied experience of geopolitics is tacitly transformed.

1.6 **Artmaking and embodied nuclear geopolitics**

Curator Ele Carpenter's *Nuclear Culture* project, supported by Arts Catalyst, has provided an extensive survey that seeks to apprehend meaningful representation of "The Nuclear". The project has sought to develop a critical field of nuclear and art engagement – sometimes by commissioning projects in the exceptional spaces of the nuclear, such as Trevor Paglen's *Trinity Cube* (2015), installed within the exclusion area of the Fukushima Daiichi Power Plant. Through experimental and creative approaches, the *Nuclear Culture* project attempted to grasp at tangible meanings to represent notions that exceed human experience, yet are materially associated with the nuclear, such as disaster, environment, radiation and deep time storage – required to last beyond any corporal human existence. Carpenter's concerns are distinct from this PhD research topic in that they look at the long-term legacies of the nuclear industry, rather than the existential transformation produced by nuclear weapons' dangerous

capacities;[6] there are, nevertheless, deeply entangled relationships between the nuclear power industry, nuclear weapons manufacture and the legacy of materiality of nuclear warfighting. These meshed themes run through Stefan Gec's *Fragment/Vengeance* (2001), a scaled representation of HMS Vengeance, a Vanguard-class Trident submarine, constructed to mark one hundred years of submarine building in Barrow-in-Furness, a town that is almost entirely reliant on the nuclear industries of West Cumbria. Similarly, Louise K Wilson's *A Record of Fear* (2005) was commissioned by the National Trust, and uses the voices of a choir singing love madrigals to cause a tacit pause in how the abandoned spaces of the AWE laboratories on Orford Ness are encountered. The laboratories were used to test the endurance of non-nuclear components of the WE177b thermonuclear bomb. Artist Matthew Flintham describes Louise K Wilson's intervention as generous and conciliatory, which opens new possibilities and renewal beyond the death-dealing machinery that was tested at the site.[7]

Perhaps the dramatic force of *A Record of Fear* (2005) derives from preconceived notions of nuclear spaces that heightened the drama of the ruined laboratories. However, the encounter with a space of, or what was a space of, nuclear war, is not always so obvious. Nuclear non-proliferation expert Aaron Stein commented that the Iranian nuclear weapons programme was less like a vast industrial complex, but more of a bureaucracy composed of spreadsheets and emails that linked activities and processes related to bomb making. In a public discussion called *Nuclear Art and Archives* held at Dundee Centre for Contemporary Art, artist Gair Dunlop tells the audience that in his experience, nuclear spaces are often prosaic or dull administrative

[6] I discussed the distinction with Ele Carpenter shortly before beginning the Leverhulme Trust Residency at Newcastle University. We both thought there were marked distinctions in that Ele's concerns were focused upon deep time and nuclear waste storage, while it occurred to us that my concerns were to do with the social, military and geopolitical effects produced by a class of weapon systems. The conversation took place at Tate Britain, October 2014.

[7] Matthew Flintham, 'The Military–Pastoral Complex: Contemporary Representations of Militarism in the Landscape: Art & Environment', Spring 2012 in *Tate Papers*, no.17 <https://www.tate.org.uk/research/publications/tate-papers/17/military-pastoral-complex-contemporary-representations-of-militarism-in-the-landscape> [accessed 9 February 2019].

spaces, yet they often contain the most extraordinary objects (Figure 1.5). In Dunlop's essay *Relics of acceleration: a field guide* (2013) he explains that:

> Artists, if they can use wit and critical awareness in the face of seduction by the ruinous charms of such sites [like abandoned nuclear bunkers] can deploy a wide range of techniques to probe and transmit atmospheres, residues and consequences. Among the many advantages of their position is an ability to sidestep the common-sensical and enter into questioning dialogue with the rational approaches of other specialists.[8]

These techniques of probing and transmitting atmosphere, residues and consequences almost entirely map over Fraser MacDonald and Alison Williams' notion of how tacit, embodied and more-than-representational encounters produce new and different ways in which geopolitics are experienced. This connects the large-scale narratives of superpower geopolitics and military technologies with small and intimate embodied experiences, which, as is explained by both Gair Dunlop and Alison Williams, can be accessed through creative art practice.

8 Gair Dunlop, 'Relics of Acceleration' in John Armitage and Ryan Bishop (eds), *Virilio and Visual Culture* (Edinburgh: Edinburgh University Press, 2013), pp.207–226 (p.208).

Figure 1.5 Gair Dunlop *Atom Town* (2011)

Courtesy of the artist

1.7 The war machine

Notions of indistinct geographies that are produced by the technologies of nuclear deterrence, embodied and creative engagements with the geopolitical, and social assemblages composed of organic and technical elements, are all constitutive parts of Gilles Deleuze and Félix Guattari's concept of the war machine. They introduce the concept in *A Thousand Plateaus* (1980). However, they explain that the war machine is not warlike, rather it is descriptive of a process that distorts, dissolves or changes state, like structures of organisation. For Deleuze and Guattari, the war machine is an embodied creative process that collapses rational or common-sense boundaries and distinctions, producing new and different possibilities. These possibilities are produced through perpetually changing assemblages that, as Manuel DeLanda explains, are at work coding and decoding the social milieu. Assemblages are at work everywhere and it is through this conceptual framing that I engage with RAF Fylingdales to understand the multiple ways in which the nuclear deterrent manifests and co-produces – socially, culturally and artistically.

In chapter 2, I describe RAF Fylingdales' operation through Deleuze and Guattari's concept of the war machine and Manuel DeLanda's assemblage theory. I use these notions to map out the ontological effects of the launch of Sputnik 1, which led to the establishment of RAF Fylingdales. I show how assemblages and the war machine operate through processes of deterritorialisation and are perpetually remaking the social in new, unexpected ways – ways that evade fixed definition and representation. Through materialities of the RAF Fylingdales archive, I show connective trajectories that even link art historian Meyer Schapiro's notions of figure and ground to RAF Fylingdales' core operational procedures of noise-to-signal, used by RAF Fylingdales IBM 7090 mainframe computers to distinguish threatening nuclear warheads.

The transgressive processes of the war machine are explored further in chapter 3 as I first give an account of how taxonomic arrangements of knowledge both stabilise and instrumentalise power structures that render other possibilities invisible. This is explored by examining the drawings of Joey, an autistic child patient of psychiatrist Bruno Bettelheim, who eschewed Joey's lived experiences of a techno–social environment that he actualised in his drawings as a symptom of psychiatric pathology. Nevertheless, I explain that the forces and flow that Joey made visible in his drawings are at work, constantly adjusting and building social assemblages through creative and transformative processes of becoming. Chapter 3 pivots around the retelling of a childhood story of making a drawing in response to news broadcasts about the mounting nuclear tension between the United States and Soviet Union. This story is also developed through materialities discovered in the RAF Fylingdales archive, which draw patterns of intersectionality between the materialities of ballistic missile early warning at RAF Fylingdales, into my family's living room and onto the fanfold computer paper that I made drawings upon – the same type of paper used by the IBM 7090 computers at RAF Fylingdales.

Chapter 4 explores social interconnectivities between the battlefield and art workshop through three epistemological encounters. The first is an encounter with the nuclear weapon assemblages, and the artful skills of the weapon designers. The inconceivable consequences of their work are imagined in nuclear combat on the north-east coast of England. The second encounter explores the use of art practice and processes of artmaking in combat on battlefields throughout history. The third epistemological encounter is a situated account of meeting an old friend from Duncan of Jordanstone College of Art, [redacted], whose art training became incorporated into his Royal Marine battlefield practice and his work protecting the United Kingdom Nuclear Deterrent at HMNB Clyde.

Chapter 5 is a detailed account of the studio practice of this PhD that takes the form of a constructed interview. The interview gives an account of the process and decisions

involved in producing my artworks for the exhibition *Jenny, Reggie, Tony and Cleo*, which took place in the Long Gallery at Newcastle University. The artworks shown in the exhibition were a result of tacit encounters with the deterrent, either embodied by [redacted], or through being embedded in the archive at RAF Fylingdales. Chapter 6 is a thick description of working with Flt Lt Richard Weeks at RAF Fylingdales. This chapter describes the events leading towards making an artistic intervention in the SSPAR radar building at RAF Fylingdales. In doing so, the chapter provides a fuller account of how the art residency came about and the experiences of working with the materialities of nuclear deterrence. Finally, the epilogue examines the implications of using creative and assemblage thinking to look at the heritage of nuclear deterrence, while situating this research in contemporary events such as the United States' withdrawal from the INF treaty, and the manufacture of a new nuclear warhead.

CHAPTER 2: The War Machine

2.1 The ballistic missile early warning station (BMEWS)

RAF Fylingdales is a BMEWS situated within the North York Moors National Park along the A169 road between Whitby and Pickering. On a clear day, the truncated pyramid shape of the solid state phased array radar (SSPAR) can be seen up to 30 km away on the A171 approach to the seaside town of Whitby. RAF Fylingdales is one of three BMEWS radar situated around the North Pole and is designated as Site III; the other sites are AFB Thule (Site I) in Greenland and AFB Clear (Site II) in Alaska.[9] Together, their primary mission is to watch out for signs and to provide warning of strategic nuclear missiles being launched over the North Pole and out of the Atlantic against the United States, United Kingdom and NATO Joint Forces; therefore, they create a deterring effect by giving the Western Allies time to respond with a nuclear counterattack.[10]

RAF Fylingdales enables this role because the SSPAR provides a full 360-degree view of the heavens from each of the three 25-metre radar faces of the truncated pyramid.[11] Each face supports 2,560 transmit and receive antennas, and together they produce an invisible plate of energy that can be electronically steered and extended horizontally in every direction for 5,000 km, allowing the SSPAR to track 800 separate objects, larger than a cricket ball, at the same time. The SSPAR replaced the former AN/FPS-49 tracker radars that consisted of three mechanical dishes: two dishes scanned the

[9] RAF Fylingdales: Archive [photography room] pp 1-44 'RAF Form 540: RAF Fylingdales operations record book, September 2003'.

[10] Ibid.

[11] The SSPAR is unique in that it provides 360-degree view of the sky, giving it the capability to see submarine-launched ballistic missiles launched from the Atlantic Ocean. Flt Lt Richard Weeks in conversation with Michael Mulvihill 2016–2017.

horizon in an eastward direction, looking for a missile threat from the Soviet Union, while the third radar would have been used to track the threatening object. The radars were enclosed in fibreglass and cardboard geodesic radomes made by Goodyear Aerospace under consultation from Buckminster Fuller's company, Geodesics. The RAF Fylingdales site, along with the other two BMEWS radar facilities, was built and operated by Radio Corporation of America. Since construction of Site III began in 1960, the radomes became a prominent feature of the landscape of the North York Moors and are a cultural icon, referred to as the golf balls. In the early 1990s, they were joined, and later replaced, by the SSPAR pyramid built by Raytheon (see Figure 2.1).[12] However, the mission and operations of RAF Fylingdales have remained consistent since becoming operational on 17th September 1963.

In this chapter, I investigate RAF Fylingdales using Gilles Deleuze and Félix Guattari's concept of the war machine and assemblage theory. By describing the operational function of RAF Fylingdales, which is nested into the global span of the USAF 21st Space Wing, I aim to show that RAF Fylingdales should be regarded as an assemblage, which operates beyond its ascribed military function, and interacts with its social and cultural environment through creative variation and metamorphic transformations. Deleuze and Guattari argue that these transformations and variations should be regarded as the war machine, which exceed accepted epistemological delineation. By conceiving RAF Fylingdales as an assemblage that is interacting socially across space and time, I show how the arts and creative practices have been a part of RAF Fylingdales' operational parameters since conception, including the materiality of mutually assured destruction.

[12] The Tracker site was demolished in 2006. From conversation with Flt Lt Richard Weeks during visit to RAF Fylingdales February 2016–August 2018.

Figure 2.1 Steve Rowell *Vigilamus (We are Watching)* 2009, showing one side of the SSPAR radar building

2.2 The first of four minutes

RAF Fylingdales operates at the highest level of readiness, 365.25 days a year, 24 hours a day, to provide a minimum of four-minutes' warning for Western Ally nuclear retaliatory forces.[13] On detection of an unidentifiable object, the crew, based in the space operations centre within the SSPAR, have 60 seconds to definitively declare the data being received from the radar and computers as being valid and known, or anomalous and a possible threat.[14] If a threat is confirmed, the data is transferred to a higher command level that is split between RAF Air Command and USAF Air Force Space Command. RAF Fylingdales is one of many sensors that work in conjunction with each other operated by USAF 21st Space Wing (SW) headquartered at Peterson AFB, Colorado. The 21st SW boast that they are the most geographically dispersed wing in the USAF[15] and their sensory assets include ground-based radar, telescopes and a constellation of infrared satellites.[16] These are managed through USAF 21st Operation

[13]Conversation at RAF Fylingdales, August 2017, RAF Fylingdales.

[14] RAF Fylingdales: Archive, 'RAF Form 540, September 2003'.

[15] Peterson Air Force Base, *21st Space Wing,* 2017 <http://www.peterson.af.mil/About/Fact-Sheets/Display/Article/326192/21st-space-wing/> [accessed 11 February 2019].

[16] Each sensor is managed by the 21st Operations Group that includes: SSPAR at RAF Fylingdale, AFB Thule and AFB Clear, PAVE PAW ground-based radar at AFB Beale, California and AFS Cape Cod,

Group, which is staffed by 4,300 government officers and contractors in 22 locations across eight countries. The wing's representation at RAF Fylingdales is by a single liaison officer who coordinates the partnership missile warning and secondary space surveillance mission.

RAF Fylingdales is under the command of a Wing Commander, who reports to RAF Air Officer Commanding Group 2 and USAF Commander Air Force Space (COMSPACEAF). The station reports on missile launches and other events to UK Space Operations Centre (SPOC) located at RAF Air Command, RAF High Wycombe, and US Missile Warning Centre located at Cheyenne Mountain Air Station, Colorado. Here, operations are coordinated with the North American Aerospace Defense Command, more commonly known as NORAD, and United States Strategic Command (USSTRATCOM, the post-Cold War successor to Strategic Air Command or SAC) based at AFB Offutt, Nebraska, which is responsible for operation and deployment of the US land, sea and air strategic nuclear weapons. Ultimate responsibility for final decisions to launch nuclear weapons rests with the President of the United States of America. In the United Kingdom, orders to launch nuclear retaliation are directed from the Prime Minister to Northwood, the UK military command headquarters, where firing orders are sent from Royal Navy Command Operation to the fleet of Vanguard Trident submarines. Once RAF Fylingdales has confirmed a possible threat to the US, UK and NATO, the station's role is over, and all the space operations crew has to do is wait out the last three minutes before the nuclear weapons descend from space onto their targets.

Massachusetts for warning against SLBMs and perimeter acquisition radar attack characterization system (PARCS) based at Cavalier AFB, North Dakota. Other sensors are Morón Air Base, Spain, space surveillance unit on the island of Diego Garcia. Maui, ground-based electro-optical deep space surveillance system, White Sands Missile Range. Defense Support Program infrared satellite. The 21st SW also channels Defense Support Program satellite information to forward users.

2.3 All orbital objects look like nuclear weapons

The task of missile warning is made perilous because – to the SSPAR radar – all objects in orbit around, and falling towards, Earth, look and behave like nuclear warheads. So, in order to minimise the risk of accidental nuclear war, RAF Fylingdales, in partnership with 21st SW, track and keep close account of all missile tests and space rocket launches. They also track the 1,700 operational satellites, including the International Space Station, and 49,000 pieces of debris left over from space launches and other operations. This allows RAF Fylingdales and 21st SW to distinguish the background "noise" of orbital objects from a foreground "signal" of a possible threat. The increasing amount of debris in Earth orbit presents a very serious danger and RAF Fylingdales' secondary, space tracking and collision warning, mission has become the station's main activity, as Earthbound life-supporting infrastructure and the organisation of experience (through portable electronics) have become more reliant on space-based systems.[17]

The dual roles of providing warning of potential nuclear attack and surveillance of satellites and other human-made objects in Earth orbit are deeply entangled with the launch of Sputnik 1. Sputnik was propelled into orbit fixed on top of a Soviet R-7 Semyorka rocket, the world's first intercontinental ballistic missile, from Baikonur Cosmodrome site 1 on 3rd October 1957. The satellite orbited the Earth 1,440 times before de-orbiting and burning up in the Earth's atmosphere three months later. However, along with the world's first satellite, the four-tonne, thirty-metre-long final stage of the R7 ICBM joined Sputnik in orbit to become the world's first piece of space junk.[18] In the next section, I want to explain how RAF Fylingdales' operations and

[17] Stephen Graham, 'Satellite: Enigmatic Presence', chap 1 in *Vertical: The City from Satellite to Bunker* (London: Verso, 2016), p.25.

[18] Katarina Damjanov, 'Of Defunct Satellites and Other Space Debris: Media Waste in the Orbital Commons, *Science, Technology and Human Values,* 42(1) (2016), pp.166–185.

mission should be viewed in relation to the geopolitical crisis caused by the launch of Sputnik 1 and the conception of mutually assured destruction.

2.4 The Sputnik Crisis

The launch of Sputnik 1 brought ominous implications. The mixed jubilation at the news of humankind leaving the bounds of the Earth was captured by Hannah Arendt, who wrote:

> The event second in importance to no other, not even splitting the atom, would have been greeted with unmitigated joy if it had not been for the uncomfortable military and political implications attending it.[19]

Three years prior to the launch of Sputnik, on 1st March 1954, the United States succeeded in exploding its first weaponised thermonuclear bomb during Operation Castle Bravo. The weapon exploded with a power of 15 megatons, 1,000 times more powerful than the atomic bomb used against Hiroshima during World War II. The weapon employed a device called the Teller–Ulam invention, which used a bomb similar to the device dropped on Nagasaki to initiate a fusion reaction in a uranium flask containing hydrogen fuel. This innovation meant that nuclear weapons became far cheaper to produce due to the abundance of hydrogen fuel. This also meant that there was virtually no limit to the amount of bombs that could be manufactured, nor limits upon the weapon's power. Most worryingly, the Teller–Ulam invention made it theoretically possible to make a nuclear weapon small enough to be launched into space.

---

[19] Hannah Arendt, 'Vita Activa and The Human Condition', chap 1 in *The Human Condition,* (Chicago: Chicago University Press, 1998), p.7.

The Americans feared that the Russians were working towards this end when the Soviet Union tested a megaton nuclear device a few months before the Castle Bravo explosion. Despite the Soviet explosion being relatively small and being produced using an adapted Nagasaki bomb design, analysis of the fall-out cloud from the Soviet test showed that they were using solid hydrogen fuel to boost the weapon's explosive yield. To the United States, this indicated that the Soviet Union was working towards making a miniaturised nuclear bomb for a space weapon. On 22nd November 1955, the Soviet Union exploded their first megaton-range hydrogen bomb at Semipalatinsk in Kazakhstan. This time, the design of the device utilised a mechanism similar to the Teller–Ulam invention. Although still one tenth the power of Castle Bravo, the device detonated at a yield of 1.6 megatons – 100 times more powerful than the Hiroshima atomic bomb. Then, in August 1957, the Russians flew the first long-range flight of the R7 ICBM, which delivered a dummy warhead into the Pacific Ocean 6,000 km away from the rocket's launch site at Baikonur Cosmodrome (see Figure 2.2). The following October, the R7 delivered the first human-made satellite into orbit (see Figure 2.3)

Figure 2.2 (Left) Soviet launch systems from R7 ICBM to Soyuz Space Launcher

Figure 2.3 (Right) Sputnik, launched October 3 1957 by an R7 ICBM

2.5 Mutually Assured Destruction

The launch of Sputnik 1 dealt a double blow to the United States. Firstly, the Soviet Union had exceeded the US technically in being the first to place a satellite into orbit. But they had also demonstrated that it was possible to lift a payload of similar weight to a thermonuclear bomb into orbit. The Americans thought it was only a matter of time before the Russians would use the R7 to put a thermonuclear bomb into orbit, which could be dropped anywhere on Earth with little warning and no defence. Supporters of Senator John F Kennedy's bid for presidency derided the Eisenhower administration for allowing simultaneous gaps to open in both the Arms Race and Space Race.[20] In response, and only three months after the launch of Sputnik 1 on 8th January 1958, Congress in the United States signed into existence new space-based weapon systems and civil space organisations. These included the Atlas, Titan and Minuteman ICBM programmes, instituting National Aeronautic Space Administration (NASA) and approving the construction of the BMEWS early warning radar.[21] One month later, RCA was awarded the contract for BMEWS[22] and two years later, the Ministry of Public Buildings and Works established a presence on the future site of RAF Fylingdales.[23]

The programmes, approved by Eisenhower, created the apparatus of what became known as mutually assured destruction (MAD). However, the doctrine, in name and form, was a technology of the new Kennedy administration that came to office in January 1961. MAD was actually known as assured destruction, which was supposed to deter a Soviet nuclear attack from space by ensuring early warning of an attack in order

---

[20] Fred Kaplan, 'The Report of Maximum Danger', chap 9 in *Wizards of Armageddon,* (New York: Simon and Schuster, 1983), pp.144–154.

[21] Roger JC Thomas, *Historic Building Report: RAF Fylingdales, Snod Hill, Lockton, North Yorkshire,* (Swindon: National Monuments Record Centre, Crown Copyright, 1998), p.2.

[22] [RESTRICTED] Alan Collinson, *RAF Fylingdales: an historical perspective* (Porton Down: Defence Science and Technology Laboratory, Crown Copyright, 2002).

[23] Roger JC Thomas, *Historic Building Report.*

to give time for a response, and the theoretical survivability of enough of the United States' ICBM forces to assure the in-kind destruction of the Soviet Union. But, through a satirical op-ed in the New York Times, assured destruction acquired the infamous moniker mutually assured destruction, which was shortened to MAD. This acronym has since come to embody the absurdly precarious position the space and nuclear assemblages had placed upon the very existence of the world. The result of the MAD machinery meant that there was little in human affairs that was not subjected to mutually assured destruction's teleological effect, which sought to ward off the literal end of history by proliferating the actual means of doing so.

In the next section, I look at the philosophical effect of MAD upon Gilles Deleuze and Félix Guattari and their formulation of the concept of the war machine and its relationship to assemblage theory.

2.6 The war machine

Laura Guillaume and Brad Evan point out that Gilles Deleuze and Félix Guattari formulated their concept of the war machine during the nuclear arms build up of the 1960s.[24] Deleuze and Guattari had been influenced by Michel Foucault's thought that war could (and was) utilised as a political mechanism for exerting power and repression[25] and that the ability of the state to utilise warlike repression had been greatly facilitated by the "pseudo-peace" resulting from technologies such as MAD.[26] Foucault had formulated his hypothesis through an inversion of 19th century military

[24] Brad Evans and Laura Guillaume, 'Deleuze and War: Introduction', *Theory & Event* 13, no. 3 (2010) <https://muse.jhu.edu/> [accessed 12 February 2019].

[25] J Reid, 'Deleuze's War Machine: Nomadism against the State', *Millennium*, 32(1), (2003), pp.57–85.

[26] Ibid.

strategist Carl von Clausewitz's famous statement that war is politics by other means.[27] But Deleuze and Guattari diverged from Foucault's reading of Clausewitz to think of the war as a process that exceeds politics and is external to the state. Instead their viewpoint stemmed from a reading of Clausewitz's "Fascinating Trinity of War", where Clausewitz states that war is:

> a fascinating trinity—composed of primordial violence, hatred and enmity, which are to be regarded as a blind natural force; the play of chance and probability, within which the creative spirit is free to roam.[28]

Through exploring Clausewitz's fascinating trinity, Deleuze and Guattari conceived of their war machine as being composed of forces, visceral affects and arbitrary interrelationships. And, just like the actual effect of war on state and sovereign structures, Deleuze and Guattari's war machine destabilises stratification of power and systems of order. According to Deleuze and Guattari, through the war machine's operational process, indeterminate zones of disorder are created out of which new ways of living and organisation of life are made possible. Deleuze and Guattari, therefore, thought of the war machine in revolutionary terms, and compared the actions of this device of affects and intensities to activities of resistance fighters, the creativity of poets and the working process of artists. Unlike Foucault's conception of war, the action of the Deleuze–Guattari war machine is external to states and politics, and operates through creative variations that unsettle sovereign structures of reason and epistemological order.[29] Nevertheless, Manuel DeLanda warns that the concept of the war machine can be easily misunderstood because of Deleuze and Guattari's emphasis on creativity and extensive process of becoming. DeLanda explains:

---

[27] Ibid.

[28] Carl von Clausewitz, *On War,* ed. Michael Howard, Peter Paret and Bernard Brodie (New Jersey: Princeton University Press, 1989), p.84.

[29] See chapter 3.

> This [...] praise should not be taken to imply that they view any particular military assemblage [...] as a model for better social order, and certainly not to imply approval or commendation of war itself. Rather, the term “war machine” refers to a special regime in the operation of any *organisational assemblage,* a regime in which the organisation exhibits its capacity to operate by making use of continuous variation. [Deleuze and Guattari] write, for example of [...] fields of knowledge production that actualise the war machine.[30]

The war machine should not then be understood in terms of binary value judgements of good or bad. Rather, it should be analysed by the assemblages and relationships through which the war machine operates. In their treatise *Nomadology: The War Machine*, Deleuze and Guattari explain that because war is a process that runs against or is external to the state:

> the State, has no war machine of its own; it can only appropriate one in the form of military institutions.[31]

As a result of state appropriation of the war machine by way of the military, war itself becomes the object rather than a process of change, and in these terms, MAD is the clearest actualisation of state use of war machines turned towards the process of producing war for war’s sake. For the rest of this chapter, I will describe Manuel DeLanda’s explanation of assemblage theory, which constitutes the mechanics of the Deleuze–Guattari war machine. I then use this explanation to make explicit the hidden

---

[30] Manuel DeLanda, ‘Assemblage and the Weapons of War’, chap 3 in *Assemblage Theory* (Edinburgh: Edinburgh University Press, 2016), p.84.

[31] Gilles Deleuze and Félix Guattari, ‘Axiom 1. The war machine is exterior to the State apparatus’, chap 1 in *Nomadology: The War Machine*. Trans. Brian Massumi (Seattle: Wormwood Distribution, 2010), p.7.

operations of war machines and their creative extension within the design, technologies and operations of Cold War assemblages such as RAF Fylingdales and mid-20th century artistic production.

2.7 Warrior–Animal–Weapon

Rather than analyse how the war machine interacts with the state through space weapon assemblages like the ICBM thermonuclear warhead, Deleuze and Guattari shift to a time when weapon systems required less sophisticated state structures for their existence and were operated by nomadic armies.[32]

> What the nomads invented was the man–animal–weapon, man–horse–bow assemblage. Through this assemblage of speed, the ages of metal are marked by innovation. The socketed bronze battle-axe of the Hyksos and the iron sword of Hittites have been compared to miniature atomic bombs.[33]

Through explaining these mechanisms, Manuel DeLanda constructs a theory of assemblage which he explains are complex social arrangement of objects: bodies – both human and animal, expressions, qualities and spatial territories that come together temporarily in space and time. In doing so, assemblages innovate new functionality that leads to the production of new social realities.[34] Innovations such as the metal stirrup enabled the warrior to have a sure platform on a galloping horse that increased the

---

[32] Gilles Deleuze and Félix Guattari, 'Problem I: Is there a *war* of warding off the formation of a State apparatus (or its equivalents in a group)?', chap 2 in *Nomadology,* p.14.

[33] Gilles Deleuze and Félix Guattari, '1227: Treatise on Nomadology-The War Machine', chap 12 in *A Thousand Plateaus* Trans. Brian Massumi (London: Bloomsbury, 2016), p.471.

[34] G Livesey, 'Assemblage' in *Deleuze Dictionary* ed. Adrian Parr (Edinburgh: Edinburgh University Press, 2010), p.18.

power and performance of weaponry such as a bow and arrow, bronze battle-axes or iron swords.[35] The warrior on horseback enhanced the performance of these ancient weapons to such a degree that they become different in nature than when they are not operating together. As a result, they produced a new age of ancient warfare in exactly the same way as the assembling of miniaturised nuclear weapons upon ICBMs produced the age of MAD.

The stirrup, the bronze-axe, and the floating plutonium pit (that made miniature nuclear warheads possible) are all the productions of other assemblages emerging from innovations such as metallurgy and forging. How these innovations are tied to creative practice and process will be further explored in chapter 4.[36] But for now, assemblages can be conceived as being constituted by social and technical interactions that become materially actualised in new things, activities or states of affairs. DeLanda stresses that because assemblages are ontologically tied to relationships with other material things and events happening across time and space, they are not posed of transcendent or abstract qualities whereby their meaning and laws of use reside in homogeneous wholes that are reproducible into constituent parts.[37] Rather, assemblages are always heterogeneous formations that cannot be reduced to the properties of their parts.[38] An assemblage can only be decomposed into independently operating components that have their own independent properties and are in themselves assemblages.[39] As a consequence, social reality is in a constant process of renewal and production by

---

[35] Manuel DeLanda, 'Assemblage and the Weapons of War', chap 3 in *Assemblage Theory,* p.68.

[36] See chapter 4.

[37] Manuel DeLanda, '*Assemblage Theory, Society and Deleuze',* 2011 <https://www.youtube.com/watch?v=J-I5e7ixw78> [accessed 11 February 2019].

[38] Unlike a thing that is thought of as homogenous, where the properties of each part are fused with the abilities of the whole object. DeLanda explains that an assemblage is irreducible to the composition of its parts, but that it is decomposable because it is made of parts that can exist independently of the assembled whole, and that these can be plugged into different assemblages to make something new. Ibid.

[39] Ibid.

assemblages within assemblages that descend in scale from the intergalactic to the subatomic.

2.8 Expressive and Material components

DeLanda explains that each assemblage is distinguished from others through its expressive and material properties that can also be thought of as components. The expressive components codify the assemblage through meaningful content such as colour and texture, facial expression, body posture or the shape of landscapes and skyline.[40] Therefore, material components of assemblages can be understood as the spatial boundaries where the expressive components are contained.[41] Material and expressive components co-constitute each other as qualities such as colours, textures, shine, tastes, or smells and corporeal materialities such as atoms, metals, concrete, blood, flesh and bone. This means that the definition of the assemblage's spatial borders are dependent upon the expressive codification of the assemblage's material identity at any one time.

2.9 Territorialisation and codification

The spatial boundaries of the assemblage are also determined by how tightly its borders are territorialised. DeLanda explains that territorialisation and codification determine how readily different assemblages assemble with each other. Deeply codified and extremely territorialised assemblages, such as security zones and armies, produce deeply homogenised wholes that seldom interact externally with other assemblages. Assemblages that are deterritorialised by having more open spatial borders and fluidity

[40] Ibid.

[41] Ibid.

in the process of expressive codification connect with other assemblages to make new or different arrangements and possibilities. We can therefore think of the operation of a Deleuze and Guattari war machine as a process that deterritorialises hardened borders and, as a result, destabilises coded identities to make new entities and arrangements. The effects, affects and variation of territorialisation and codification functions of an assemblage can be both perceived and experienced when transiting through RAF Fylingdales' security perimeter into the base itself. which is described in the next few sections.

2.10a War machines of Fylingdales Moor

Upon taking the slip road off the A169 onto the approach road towards RAF Fylingdales, the SSPAR radar looms in the near distance – coding and militarising the moor upon which sheep graze.[42] A little way on, you will be stopped at a guardhouse by two Ministry of Defence (MOD) police officers. Their identity and purpose, of protecting the territory in which the SSPAR operates, is unquestionable because of the uniforms and one officer is armed with an automatic rifle. The other police officer is dressed in a high-vis jacket and approaches the car to establish that your details correspond with their records, or codified list, to allow you to pass through the perimeter. The details check out, and the police officers send you forward to the police station within the security zone between the razor-wire hard perimeter and RAF Fylingdales.

At the security perimeter, there is a small group of sheep waiting for the electric gate to the secure area to open. This area is heavily policed by electronic surveillance and is patrolled by a police 4x4 (in case an unwelcome assemblage should get too close to the radar station boundary). Because you and your vehicle are expected, the electric gate slides aside but allows the small cluster of waiting sheep to wander in ahead of your vehicle. The sheep make for a grass verge opposite the one-storey police station and

[42] J Beck, 'Concrete Ambivalence: Inside the Bunker Complex', *Cultural Politics,* (2011) 7(1), pp.79–102.

graze under a blue radio frequency radiation warning sign. You park your car, check you have valid photographic identification and make for the police station to check-in and collect the permits that allow you onto the actual site of RAF Fylingdales.

However, leaving the police station there is a kerfuffle.

An MOD police officer in a high-vis jacket is attempting to shepherd the sheep back out through the electric gate, but they evade both his capture and coded administrative security processes. Instead of the SSPAR, or armed police being the embodiments of war machines, Deleuze and Guattari might observe that it is the sheep on the moor which are the actual war machines because they temporarily force creative variation in the perimeter of RAF Fylingdales. This causes the MOD police to become shepherds – a variation upon their state-assigned identities. How and why these phenomenon occur will become more apparent over the next sections. Firstly with a critical review of Delanda's assemblage theory against Deleuze and Guattari's ideas. Secondly by an overview of the use of assemblage theory in geopolitical analysis. Finally I will take a closer look at one of Delanda's standout innovation to Deleuze and Guattari's social ontology, the assemblage with knobs on.

2.10b The Delanda Assemblage

According to theorist Andrew Ball, Delanda's Assemblage Theory is a significant expansion on Deleuze and Guattari concept, which results in a comprehensive social ontology of assemblage.[43] Delanda had criticised Deleuze and Guattari's original concept of assemblage for having little definition. Arguing that the concept of assemblage needed to be deduced from various places in Deleuze and Guattari's philosophical oeuvre, in particular *Anti-Oedipus: Capitalism and Schizophrenia* and *A*

[43] Andrew Ball, 'Manuel Delanda, Assemblage theory (Edinburgh University 2016)', *Parrhesia* (2018) 29, pp 241-247

Thousand Plateaus. Delanda further criticised Deleuze and Guattari concept because the philosophers refer to assemblages by a variety of names such as multiplicity, arrangement, strata, or war machine. Delanda points out that the relationship between these ideas are left for readers to deduce or interpret. While Deleuze and Guattari imply in the introduction of *ATP* that it is in reading that the reader co-produces the book's content.[44] Delanda thinks this has made Deleuze and Guattari's concept of assemblage virtual impossible to use as a viable social ontology outside of specialised fields of post-structural philosophy.[45]

However, Ball thinks that Delanda's assemblage theory is less a distinctive body of thought and is more a work of secondary scholarship that builds upon Deleuze and Guattari's original notion. Nevertheless Ball identifies a number of distinct and innovative characteristics of Delanda's concept that have recently been taken up in the social sciences and are worth spelling out. Firstly, Delanda's assemblages are compose of *relations of externality*. As explained earlier by the Warrior-Animal-Weapon Assemblage, assemblages cannot be reduced to the sum of their parts. Each part of the assemblage is independent and is capable of detaching from one assemblage and joining with another. This marks out Delanda's assemblages from other relational theories such as Bruno Latour's Actor Network Theory. Instead Latour's assemblages are composed from *relations of interiority.* Where, instead of the parts retaining independence, the identity of components of the ANT assemblage are defined by the network they constitute.[46] Secondly, while assemblages are composed of independent parts their identity and social function are contingent on immanent interaction that create properties, which are perpetually emergent. For example the devastating properties of the Warrior-Horse-Weapon assemblage transforms as the horse moves towards a fast gallop, which is dependent upon interaction between warrior and animal.[47] Or the action of the sheep transforming the MOD police into temporary shepherds on the perimeter of RAF Fylingdales. This means the nature of assemblages are not determined by fixed essences or transcendent meaning, rather they are defined

[44] Gilles Deleuze and Felix Guattari, *A Thousand Plateaus,* p 2
[45] Manuel Delanda, '*Assemblage Theory, Society and Deleuze*' [accessed 11 February 2019]
[46] Andrew Ball, 'Manuel Delanda, Assemblage theory (Edinburgh University 2016)'
[47] Manuel Delanda, 'Assemblage Theory, Society and Deleuze' [accessed 11 February 2019]

by their social interactions at any one time. Thirdly, and following from the previous point, in Delanda's assemblage theory there are no distinction in levels of existence, or taxonomic hierarchies of transcendence such as genus, species and organism. Each component of an assemblage is itself an assemblage "all the way down".[48] Therefore the environment of an assemblage is also composed of more interacting assemblages that fill the entire universe from sub-atomic scales to immense intergalactic structures. Graham Harman, who developed the realist philosophy Object Orientated Ontology (OOO), argues that Delanda's ontology, composed of assemblage within assemblages, makes it impossible to define or interpret objects as consistent entities.[49] An argument that Delanda dismisses as irrelevant because the emergent nature of the assemblage's properties disavows the existence of objects with fixed meaning, consistency or continuity.[50] Fourthly, but on this point in agreement with Harman's OOO, the universe of interacting and emerging assemblages exist independently of human mind and consciousness, and possess autonomous non-human agency. Delanda explains that the independent agency of assemblages had been denied by Deleuze and Guattari because their social ontology of assemblage had been limited by retaining Badiouan defined modes of existence based upon the individual, the group, and the social field.[51] Delanda argues that these 'reified generalities' obscure social operations and emergent interactions of assemblages. Delanda identifies other types of 'reified generalities' (or 'black-box' or monolithic terms) such as state, capitalism or military. Delanda corrects this aspect of Deleuze and Guattari's assemblage theory by providing a more detailed account of different kinds and scales of social agency. This has the effect of breakdown monolithic definitions into complex assemblages that are interacting with other assemblages in a constant production and disintegration of emergent identities. Ball summarises Delanda's assemblages as being:

> Historical, unique, relationally contingent, mind-independent agents that are part

---

[48] Andrew Ball, 'Manuel Delanda, Assemblage theory (Edinburgh University 2016)'
[49] Mark Losoncz, 'Manuel Delanda, Graham Harman: The Rise of Realism' 2017 in *Phenomenological Reviews* <https://reviews.ophen.org/2017/11/22/manuel-delanda-graham-harman-the-rise-of-realism/> [accessed 13 September 2019]

[50] Ibid
[51] As in philosopher Alain Badiou

> of a flat, non-hierarchical plane of existence that is immanent rather than transcendent and material rather than ideal.[52]

The fact that assemblages are also spatial should also be stressed, and it is through a spatial conceptualization of assemblages that Martin Muller explains why assemblage theory has been readily taken up by geographers. Muller points out that assemblage theory was adopted as human geographers began to move away from investigating 'meaning', in the wake of the cultural turn of the late 1980s. Since then there has been renewed concern for materiality, embodiment, matter as well as process and practices that produce the world.[53] Over the next section I will look at the contribution assemblage theory is currently making to geopolitical debate and demonstrates how assemblage is being used to produce both geo-political and geo-historical account of emerging events.

2.10c Geopolitical Assemblages

Muller explains that, for reason elaborated above, assemblage theory provides a distinct utility for analysing the interrelation between power, politics and space.[54] He points out that while Deleuze and Guattari's work on assemblage is not political, in the sense that it provides tools for justification or critique of institutions. The assemblage theory that has emerged from the philosophers' work, does form a political (as well as social) ontology. This in turn provides the means to account for transformative, creative, and deterritorializing processes occurring in the materiality of geopolitical relationships.[55] For Jason Dittmer assemblage theory gives an alternative to the idealised and macro-scaled theories of traditional international relation (IR) studies. Dittmer explains that the problem with the traditional IR viewpoints based upon 'reified generalities' is their tendency to reinforce underlining colonial and imperial discourses, which then lead to

---

[52] Andrew Ball, 'Manuel Delanda, Assemblage theory (Edinburgh University 2016)'
[53] Martin Muller, 'Assemblage and Actor-networks: Rethinking Socio-material Power Politics and Space', *Geography Compass* (2015) 9(1) pp. 27-41
[54] Ibid
[55] Ibid

negative real word consequences for those caught in the middle of a crisis.[56] Dittmer explains that:

> These discourses cannot be countered with mere deconstruction, but require constructive accounts that explain the actual empirical phenomena in question [assemblage] therefore offer[s] a micro-scaled account of power […] which helps us to understand the evolution of the geopolitical assemblage over time.[57]

The micro-scales that Dittmer refers to are sub-national that interact in human and non-human communities, family and friendship networks, communication technologies such as mobile phones that connect communities, and even the materiality of these devices.[58] Along these lines, in the next chapter, I will explain how Deleuze and Guattari drew their influence from psychiatrist Franz Fanon. Fanon, disavowed prevailing Freudian idealisation of the family, instead conceive family of members as individuals who are all actually and bodily entwined within the effects of actual events such as wars, revolutions or state violence.[59] Manuel Delanda is also explicit about assemblage theory ability to produce micro-scale and embodied accounts of material geopolitical and geo-historical events. In a lecture given to students of European Graduate School, Delanda draws upon the various Lebanese Wars to show how processes of territorialisation and cultural coding produced increasingly divided and culturally policed communities in Beirut. He explains that factions formed along religious lines with a coded mind sets that justified extreme violence against one another that inevitably erupted in conflict.[60] Assemblage can also be used to account for geopolitical consequences that emerge from even sub-atomic scales. In chapter 4 I will describe Delanda's account of emergent and multi-scaled creative interaction between molecular

---

[56] Jasom Dittmer, 'Geopolitical Assemblages and Everyday Diplomacy', chap1 in *Diplomatic Materials: Affect, Assemblage and Foreign Policy* (Durham: Duke University Press, 2017) p14
[57] Ibid p15
[58] Steve McQueen, interviewed by Hamza Walker, *The Renaissance Society* [video] , <https://vimeo.com/16536169> September 16 2017 [accessed September 18th 2019]
[59] Chapter 3 p65
[60] Manuel Delanda, 'Assemblage Theory, Society and Deleuze' [accessed 11 February 2019]

changes in metal being forged into a weapon by an artisan, and its' visceral deployment in battle.[61] In doing so Delanda shows that battlefields are not demarcated special areas, or black boxes, but zones of micro-scales social interaction. Similarly Muller observes that assemblage theory has lent itself to enquiring into the proliferation of technologies such as big data and algorithms that regulate not only our everyday online experience. But also how the same technologies are intergrated into global networks of cyber-warfare. For Muller this results in the effect of crumpling the sense of space between everyday lived experience and warfare.[62] The complex spatialities of warfare that assemblage theory illuminates is described by Alison Williams's investigation of cybernetic human and non-human relationships in military drone operations, which I referred to in my introduction. Williams draws upon Donna Harraway cyborg assemblages to analyse how the human operators of predator drones has been subsumed into global spanning technical and robotic military networks.[63] In doing so Williams echoes political philosopher Jane Bennett's reflection that:

> Humans are always in composition with nonhumanity, never outside of a sticky web of connections or an ecology.[64]

Jane Bennett, in *The Agency of Assemblages and the North American Blackout,* uses the 2003 outage of the North American power grid to explore both the 'sticky ecology' of assemblage and the various non-human agents that constituted the event. Bennet explains that:

The electrical power grid is a good example of an assemblage. It is a material cluster of charged parts that are indeed affiliated, remaining in sufficient proximity and

---

[61] Chapter 4 p103
[62] Muller
[63] Allison Williams, 'Enabling persistent presence? Performing the embodied geopolitics of the Unmanned Aerial Vehicle assemblage' *Political Geography* (2011) 30(7) pp. 381-390
[64] Jane Bennett, 'The Agency of Assemblage and the North American Blackout' *Public Culture* (2005) 17(3) pp. 445-65

coordination to function as a (flowing) system. The coherence of this system endures alongside energies and factions that fly out from it and disturb it from within […] the elements of the assemblage, while they include humans and their constructions, also include some very active and powerful nonhumans: electrons, trees, wind, [and] electromagnetic fields.[65]

For Bennett the power of assemblage theory is its ability to produce new and complex inter-relationships that make new discursive possibilities from geo-historic accounts.

However, Jason Dittmer points out that assemblage theory has not been without critics who see it as a mechanism that overcomplicates social processes, or leads to thick description of phenomenon. But philosopher Rosi Braidotti argues that this is precisely the point of new materialist ontologies such as assemblage. To produce, thick, situated and actual accounts that make visible the complex creative interactions between human and non-human actants. These points of view cannot be apprehended by elevated, idealised or reified views of power and politics.[66] As examples Dittmer points to the inability of traditional approaches of IR to anticipate events such as the collapse of the Soviet Union, or the War on Terror.[67]In the next chapter I will explore Deleuze and Guattari's emphasis upon creative process and production as a method to critique ontologies based upon essences or foundational claims. While over the next section I will discuss an idiosyncratic function that Delanda incorporates into his assemblage theory, namely the assemblages with knobs on. The upshot of which is to situate creative transformation and expression as a critical and tacit function of assemblage based analysis.

---

[65] Ibid
[66] Rosi Braidotti interviewed by Rick Dolphinijn and Iris van der Tuin, 'Interview with Rosi Braidotti', in *New Materialism: Interviews and Cartographies,* eds. Rick Dolphijn and Iris van der Tuin (Ann Arbor: Open Humanities Press, 2012) p. 30
[67] Dittmar p.15

2.11 Assemblages with knobs on

One of the most innovative aspects of Delanda's assemblage theory is the parameterisation function he adds to all assemblages. Delanda conceives assemblages as machines with two control knobs that determines extent to which an assemblage's identity is fixed or fluid. The mechanism for turning these dials are the interaction between micro and macro geo-historic events and materialization, which produce more than human creative variations that affect across all social scales. Deleuze and Guattari explain that the war machine exists only through its metamorphic abilities for creative variation.[68] DeLanda explains that these phenomenon are produced by the operations of assemblages, which are in themselves actual spatial manifestations. DeLanda proposes that transformation, or creative variations, of assemblages are operated by the characteristics of territorialisation and codification that can also be applied to any kind of spatial ordering, from ancient weapon arrangements or military organisations, such as RAF Fylingdales and moorland sheep.[69] This leads DeLanda to arrive at a novel addition to assemblage theory with the addition of two controls or "knobs", one labelled territorialisation and the other codification. These controls are not metaphor, nor illustrative, and they are not actual in the sense that they are material manifestations. The dials are instead virtual but, nevertheless, they determine the material creative variation of the assemblage and its metamorphic potential.[70] The addition of the control knobs are tangible mechanism that help emphasise that assemblages are constituted of emerging, geographic and historically locatable events. These events produce transformations in the assemblage leading to new possibilities not conceived by human mind.

Delanda's control dials and the creative variations they produce owe much to the ideas

---

[68] Gilles Deleuze and Félix Guattari, 'Problem I: Is there a *war* of warding off the formation of a State apparatus (or its equivalents in a group)?', chap 2 in *Nomadology: The War Machine*. Trans. Brian Massumi (Seattle: Wormwood Distribution, 2010), p.16.

[69] Manuel DeLanda, A*ssemblage Theory, Society and Deleuze,* 2011.

[70] Ibid.

of Gilbert Simondon who also influenced many aspects of Gilles Deleuze and Felix Guattari's ontology. In the introduction to Anne Sauvagnargues's *Artmachines: Deleuze, Guattari, Simondon*, Gregory Flaxman expresses the importance of Simondon upon Deleuze in particular the development of a more-than-human creativity and aesthetics. Flaxman writes that Simondon

> Extend[ed] concepst of […] art and aesthetics, into the semiotic machines of philosophy and […] science.[71]

Simondon's concern was to give an account of the ways in which machines produced new kinds of hybrid subjectivities through human encounters with technology. For Simondon philosophies such as phenomenology gave impoverished accounts of technology, which argued industrialisation had subtracted from human experience. On the contrary, Simondon thought that technologies offered new possibilities for states of being that added to human experience rather than diminish.[72] For Simondon the human subject was produced through a perpetual process of individuation as bodies and experiences fall in and out of assemblages with technical objects.

Gilbert Simondon ideas drew upon the theory of cybernetics that was emerging from the United States following World War II. Cybernetics also conceived human beings as parts of a complex technical system composed of information feedback. This view was formulated by a group of scientists, engineers and mathematicians working at the Massachusetts Institute of Technology (MIT) during World War II and early Cold War. The principal of the group was Norbert Weiner who was working on targeting solutions for radar guided automated anti-aircraft artillery. Claude Shannon, who was working for Bell Laboratories was also concerned with developing systems that could analyse the motions of an airplane steered by a human pilot. Sociologist Celine Lafontaine explains that Weiner's work produced the first conception of the cyborg assemblage in which a

---

[71] Gregory Flaxman, 'Introduction', in Anne Sauvagnargues, *Artmachines: Deleuze, Guattari, Simondon.* Trans Suzanne Verberber (Edinburgh: Edinburgh University Press), p 5.
[72]John Hart, 'Preface', in Gilbert Simondon, *On the mode of existence of technical objects.* Trans. Ninian Mellamphy (Ontario: University of Western Ontario 1980)

human being (the enemy pilot) is a component of an extended technical network. Weiner conceived this network as being made from different types of 'black boxes' such as aircraft, pilot, radar, and gun with inputs and outputs providing feedback to other 'black boxes'. At the time this was a radical break with a traditional phenomenological point of view that viewed technology as alien to the privileged subject position of human beings.[73] Lafontaine continues to argue that the technical warfighting advances of World War II meant that Weiner's idea was in line with a larger field of military system thinking of the time.

These systems of thought included Operational Research and Claude Shannon's own Information Theory, which also conceived the human soldier as a cyborg component in a web of communication. Shannon's variation of cybernetics became the founding principal of Bell Laboratories Nike Zeus Anti-Ballistic Missile system, which became known as Safeguard and will be discussed later.[74] Other notable influences upon cybernetics were Jay Forrester and John von Neumann. Forrester was a mathematician working for MIT Lincoln Laboratories, who was key to developing the computers operating NORAD's Semi-Automated Ground Environment (SAGE) a forerunner to BMEWS and RAF Fylingdales. While von Neumann had originated the concept of computer Artificial Intelligence; which produced the mathematical solutions for the implosion trigger of the plutonium bomb and selected Nagasaki as one of the targets for the new weapon. He also developed the concepts of systems analysis and games theory, which became the main analytical tools at RAND Corporation, an interdisciplinary think tank established to devise military application for the atomic bomb. RAND Corporation will be also be discussed later in a geo-historical account to explain how systems thinking such as cybernetics became assembled with Mid-Century Modern art practice.

---

[73] This will be explored in the next chapter where cybernetics actually inform psychiatrist Bruno Bettleheim's phenomenological view of the machine and it's dehumanising effects upon his child patient Joey the Mechanical Boy.

[74] Thomas Frike, 'From Shannon to Snowden: the Human Target in Information Theory from the Beginning until Today' *re:publica,* 2014

However, the use of nuclear weapons against Japan during World War II, and their proliferation during the Cold War, weighed upon Weiner forming a deep pessimism where he viewed humanity and its future prospects as:

> Shipwrecked passengers on a doomed planet.[75]

It was during this time that cybernetics broke out from its military application through a series of conferences held between 1946 and 1953. They were funded by the Macy Foundation and became known as the Macy Confereneces. The Macy Conferences were organised by an informal group of scientists from MIT that called themselves the "Teleological society" led by Weiner. Weiner wanted to bring the cybernetic model to the attention of a broader interdisciplinary community composed of physiologists, physicians, psychiatrists, archaeologists, art historians and social scientists. Celine Lafontaine describes nature of discussion in the Macy Conferences:

> Under the revealing theme 'Circular Causal and Feedback Mechanisms in Biology and Social Systems', this series of gatherings constituted the birth of cybernetics. In itself, the choice of the title indicates that the idea of grouping all living organisms, machines and society under one single explicative model was already solidly established. Focused on interdisciplinary, cybernetics represents the course of convergence in post war America […] The huge repercussions of the Macy gatherings were not only due to the prestige of it's participants, such as Norbert Wiener, John von Neumann, [Claude Shannon], Warren McCulloch, Ross Ashby, Roman Jakobson, Gregory Bateson [a psychiatrist that developed the double-bind theory, discussed in the next chapter] and Margaret Meads [who was working at RAND Corporation, discussed later]. Indeed, it was the willingness to build bridges between different areas of knowledge, and the wide range of topics addressed during these gatherings, that made the major

[75] Celin Lafountaine, 'The Cybernetic Matrix of French Theory', *Theory Culture and Society.* (2007) 24(5) pp. 27-46

contribution to [cybernetic's] historical repercussions.[76]

During the spread of cybernetics' influence Simondon invited Weiner as a key note speaker for his own conference 'The Concept of Information in Contemporary Science' which was part of a series of colloquia at Royamount in 1964.[77] However, John Hart, in the introduction to *On the Mode of Existence of Technical Objects,* explains that the outcome of the conference would make visible deep divisions between Weiner's cybernetics and Simondon's own view of human-machine relationships. The consequence of this divide formed the basis of assemblage theory emerging from Simondon's influence upon Deleuze and Guattari. Hart explains that cybernetics reproduced 'rarified generalities' of the natural sciences such as genus and species and inscribed them upon machines. For Simondon the effect was to stabilise mechanisms in opaque 'black boxes', which give little account of processes of transformation nor bodily experience.[78] Simondon thought that cybernetics' open and interdisciplinary claim was actually a form of homogenising imperialism.[79] For this reason cybernetics was blind to actual mechanisms of innovation and technical creativity that occur in moments of tacit rapport and material encounter.[80]

In order to account for these transformations and creative variations, Simondon adopts a strategy that extends aesthetic experience from being soley concerned with appreciation of fine art to the basis of an ontology of interacting things. Anne Sauvagnargues explains that in Simodon's ontology art is no longer an object of contemplation. Instead art is repositioned as a process that makes visible the assembling activities of assemblages. Sauvagnargues states that:

---

[76] Ibid
[77] Hart p. vi
[78] Ibid
[79] Lafontaine also states that cybernetics enable the: establishment of America's intellectual and scientific legitimacy, cybernetics became – alongside the Marshall Plan – one of new global power's standard-bearers. Lafontaine p. 30

[80] Ibid

> Art as technics concerns the way in which materials are captured and assembled into matter of expression. From this perspective, it is the technical assemblage that demands its own aesthetic analysis.[81]

Simondon describes his technical analysis in a posthumously published letter to Jacque Derrida called *On Techno-Aesthetics.* Simondon explains that the technical aesthetic experience is as much located in the action of doing as in contemplation alone:

Contemplation is not techno-aesthetics' primary category. It's in usage, in action, that it becomes […] a tactile means and motor of stimulation. When a nut that is stuck becomes unstuck, one experiences a motoric pleasure, a certain instrumentalized joy, a communication-mediated by the tool-with the thing on which the tool is working. It is like forging: with each bang of the hammer, one experiences the state of the forged metal that stretches and deforms between hammer and anvil […] One could continue like this almost indefinitely moving more or less continuously to the sensation that artistic instruments give to those who play them: the touch of a piano, feeling vibration and tension of the strings of a harp, the snapping of the strings of a hurdy-gurdy […] Art is not only the object of contemplation; for those who practice it, it's a form of action that is a little like practicing sports. Painters feel the stickiness of the paint they are mixing on the palette or spreading on the canvas. Paint can be more or less unctuous, and this tactile, vibratory sensibility comes into play for the active artist, especially when the paintbrush or the knife comes into contact with the canvas that is elastic, and stretched over the frame.[82]

Deleuze and Guattari incorporate Simondon's technical aesthetics into their notion of 'becoming' to describe the creative flow of transformation occurring in assemblages. In the next chapter I will explain how Deleuze and Guattari locate art practice as a way of

---

[81] There are several discrepancies between Deleuze and Simondon's ideas. Anne Sauvagnargues points out that Deleuze and Gauattri seldom explicitly credits Simondon for originating their ideas because Simondon theory retains a human subject as a sole creative agent. For a deeper discussion see: Anne Sauvagnargues, *Artmachines: Deleuze, Guattari, Simondon.* Trans Suzanne Verderber and Eugene W. Holland (Edinburgh: Edinburgh University Press, 2016) p. 75

[82] Gilbert Simondon, Trans. Arne De Boever, 'On Techno-Aesthetics' *Parrhesia* (2012) 14 pp. 1-8

materializing processes of becoming. Thus evoking the above passage shows assemblage theory is driven by creative affects, which cannot be disentangled from actual real word experience and sensation. These experiences and somatic interactions are the actual critique through which analysis is derived. Like Simondon's description of the motoric pleasure derived from the release of a stuck nut, should we then think of the dials on Delanda assemblages as giving tactile feedback? In the next section I will examine an artefact from the RAF Fylingdales archive and collections that was the electronic counter countermeasure console. The console, like cybernetics, owes its origins to MIT Lincoln Laboratories, and is operated by a series of notched and greased dials that controlled RAF Fylingdales's defensive measures against electromagnetic attack by Soviet trawlers. Yet the device shares a history with early electronic music synthesisers. This console will be used as the embodiment of Delanda's "assemblage with knobs on" in order to explore how creative variations and dissonant modes of historic perception become visible by operating the assemblage's dials. In doing so I aim to reveal a micro-scaled geo-history, or rather geo-art-history of RAF Fylingdales emerging from the artistic activities at the Black Mountain College of Art. What will emerge is an account of the formation of the noise to signal doctrine, which is a key component of RAF Fylingdales and USAF early warning capacity. Its origins are owed to a friendship between RAND corporation strategists Roberta and Albert Wohlstetter and the art historian Meyer Schaprio as told by art historian Pamela M Lee.

2.12 The ECCM console

Since the ground was broken for the construction of RAF Fylingdales on Snod Hill, an administrative archive has emerged consisting of photographic documentation of construction, log books of visitors and events, computer readouts, supply catalogues, operation manuals and RAF 540 reporting forms. In time, more physical additions were made, such as engineering training exhibits like a cut away of the klystron multiplier (used for amplifying the signal from the radar). Recent additions included recovered consoles from the AN/FPS-49 Space Operations Room. One of these consoles is the

electronic counter countermeasures system (ECCM), which was installed in 1964 and was visible as a lollipop-like structure on Fylingdales Moor (see Figure 2.5).[83]

The ECCM system was designed to respond to a threat from Soviet trawlers positioned off the coast at Whitby. The fishing vessels were bristling with antenna and electronic countermeasure (ECM) equipment, it was feared, which could be used to electronically blind RAF Fylingdales' radars and interfere with the rearward communication arrays.[84] NORAD ruled out direct military engagement with the trawlers as that risked precipitating a nuclear war with the Soviet Union.[85] Instead, the ECCM equipment engaged the trawlers, attempting to jam the radar in skirmishes composed of electromagnetic atmospheres and fluxes over the moors and North Sea coast of Whitby and Scarborough.

The ECCM console looks like a large metal box painted turquoise, in front of which an operator sits on a leatherette swivel chair. The console has a cathode ray tube monitor protruding out of the assembly and under the screen, there are various knobs labelled bandwidth, frequency, video gain and intensity. On a panel next to the monitor, two large dials sit under two gauges with clusters of smaller knobs for fine-tuning beam signals. There is a third panel that is fitted with Bakelite VU meters and a large volume control dial with a headphone and RCA output sockets (see Figure 2.4). But, when I look at the controls and outputs of the ECCM console, they bear a resemblance to the controls and modular arrangements of a sound synthesiser.

---

[83] [RESTRICTED] Alan Collinson, *RAF Fylingdales: an historical perspective* (Porton Down: Defence Science and Technology Laboratory, Crown Copyright, 2002).

[84] USAF General John K Gerhart, 'Ballistic Missile and Space Weapons Detection Systems' in *North American Air Defense Command and Continental Air Defense Command: Historical Summary* (Colorado: NORAD HQ, 1962), p.35.

[85] Ibid.

Figure 2.4 (Left) RCA ECCM control console in the RAF Fylingdales archive

Figure 2.5 (Right) RCA ECCM tower under construction 1964

Both: RAF Fylingdales Collection and Archive

2.13 Oscillating ontologies

A synthesiser is an electronic musical instrument derived from the technology of electronics and radio frequency. The instrument produces oscillating patterns of sound that modulate and flow through variations as a result of the user turning a set of dials or knobs. Gilles Deleuze experimented with electronic music synthesisers and collaborated with French progressive rock musician Richard Pinhas to produce *Le Voyageur* in 1973.[86] We could imagine that Deleuze thought that by operating the dials and knobs, war machines' affects are produced, which deterritorialised established codes of musical structure in order to make new aural experiences. So, it seemed natural to think of the ECCM console as an actualised control panel of a DeLanda assemblage. Similarly, turning the dials causes not only creative variation in sound but also ontological modulations resulting in metamorphic changes in the perceived ordering of reality, like the way sheep on the moor transformed the operations of the MOD police guarding the perimeter. When looking at and investigating the ECCM

[86] *Richard Pinhas/Gilles Deleuze, 'Le Voyageur',* CERCC, [n.d.] <http://cercc.ens-lyon.fr/spip.php?article300> [accessed 11 February 2019].

console, there actually appears to be an ontological oscillation between the apparatus and the world's first music synthesiser: the RCA Music Synthesiser II, otherwise known as Victor.

The RCA Victor was designed and built at RCA Sarnoff Laboratory in Princeton, New Jersey, a half-hour drive down highway 295 to the RCA Riverton Plant, where RAF Fylingdales' ECCM equipment was manufactured. The Victor was the most advanced electronic musical instrument of its time and was acquired by the Columbia-Princeton Music Centre in 1959. When the instrument was designed and built, the engineers at RCA Sarnoff were also involved in developing radio jamming and electronic counter measures for the United States Department of Defense.[87] By comparing the Victor with the ECCM console it is possible to see the same USAF-specified control components being used on both machines (see Figures 2.6 and 2.7). Could it be possible to turn the dials on the ECCM console to deterritorialise the assemblage and experience the transformation from a device of electronic warfare at RAF Fylingdales into an avant-garde musical instrument? And if we operated the dials, what other creative and ontological transformations would occur?

Figure 2.6 (Left) RCA ECCM oscillator control panel. RAF Fylingdales Collection and Archive

Figure 2.7 (Right) RCA Mark II music synthesiser

[87] Holmes, 'Early Synthesizers and Experiments' in *Analogue Synthesis and Instruments* ([n.pl]: [n.pub.], [n.d.]), pp.141–172.

2.14 Sound and vision

The ECCM machine console now sits on a wooden palate in the RAF Fylingdales archive and visitor centre. During the 1960s, the room was part of the AN/FPS-49 radar RAF Fylingdales' supply depot. Equipment and electronic parts that were needed to maintain the 24-/7 operations at RAF Fylingdales were shipped from suppliers across the United States to North Yorkshire.[88] Then, in 1969, RCA Great Britain, which had been working on behalf of RCA for the construction and maintenance of RAF Fylingdales, was incorporated into the global electronics brand of RCA Limited. The company logo was changed from the thunderbolt to a bold sans-serif font and the management of supply for RAF Fylingdales was shifted from the North York Moors to the new office building, RCA House, which was next door to RCA Limited's premier cinema, the Curzon on Curzon Street, Park Lane, London. These changes were reported in RAF Fylingdales' employee magazine, *Scan* (see Figure 2.8). For the next 20 years, the complex supply chains of semiconductors and mechanical parts for the AN/FPS-49 radars at RAF Fylingdales were managed alongside other ventures of RCA, which included production of semiconductors, tubes for colour televisions, supplying regional TV companies such as Yorkshire Television, services for hotel groups and the release and distribution of records by David Bowie, Iggy Pop, John Denver, ABBA, Diana Ross, Neil Sedaka, Harry Nilsson and Elvis Presley, to name a few (see Figure 2.9).[89] All these changes and metamorphic transformations can be visualised by turning the dials on the ECCM-DeLanda assemblage, shifting between different social realities like tuning an AM radio set. Under one setting, David Bowie is visible, while on another we see streams of semiconductors bound for the ballistic missile early warning station, while the distortion between stable viewing points is the operational flux of the war machine.

---

[88] RAF Fylingdales archive: Pickering 'RCA supply catalogues'.

[89] See chapter 5.

Over the final sections of this chapter, I use this analysis to show how the war machine distorts and collapses mediated epistemological experiences, or common-sense knowledge. By doing so, it is possible to show how the operational materialities of RAF Fylingdales, and mutually assured destruction, emerged from interdisciplinary and avant-garde artistic production of the mid-20th century.

Figure 2.8 (Left) Cover of RCA company magazine *Scan*, summer 1969

RAF Fylingdales Collection and Archive

Figure 2.9 (Right) Single cover for David Bowie's *Heroes* 1976

2.15 Black Mountain College of Art

The most iconic structures of RAF Fylingdales were the three radomes that had enclosed the AN/FPS-49 radar sets, known as the golf balls. Each of the three radomes at RAF Fylingdales comprised 1,646 five- and six-sided panels that were 150 mm thick and made from fibrous cardboard honeycomb bound by fibreglass and polyester resin. The outside of the panels were painted sky blue with Hypalon paint in order to make the

structures less conspicuous against the sky.[90] The panels were manufactured by DuPont for Goodyear Aerospace, under consultation from architect Richard Buckminster Fuller and his company, Geodesic, to produce a self-supporting dome jointed with 60,000 bolts that formed the distinctive golf ball radome shape.

Fuller had constructed the first self-supporting domes during the summer of 1949 at the Black Mountain College of Art in North Carolina where he had been invited to teach by artists Anni and Josef Albers. At the time, the Black Mountain College of Art was an incubator of artistic talent buoyed upon teaching methods transplanted from the Bauhaus by the Albers and architect Walter Gropius, who fled Germany after the art school was closed by the Nazis in 1933. Among the art school's progeny were artists Robert Rauschenberg and Eva Hesse, experimental composer John Cage, choreographers Mercer Cunningham and Yvonne Rainer and beat poet Allen Ginsberg. Over the summer of 1947, Fuller refined his prototype dome that would support itself on a tubular geodesic frame covered in polythene. With help from the staff and students at the Black Mountain College, Buckminster Fuller raised the first dome in which spontaneous performances and recitals were held (see Figure 2.10). In this climate of free creative spirit, Fuller's domes were adopted as the cultural symbol of the utopian counterculture of the 1960s, embodied by the Drop City art commune in Trinidad, Colorado.

Soon after Fuller raised the dome at Black Mountain College of Art, he established Geodesics Inc. in Raleigh, North Carolina, in order to develop the concept of the dome as a dwelling that could be dropped onto sites by helicopter. Fuller saw military potential and among the clients to whom Fuller promoted the concept of dome living were the US Marine Corps, the US Department of Defense and the USAF. For the latter, Fuller thought that the geodesic domes could have a special application of enclosing military

[90] Wayne D Cocroft and Roger JC Thomas, *Cold War: Building for Nuclear Confrontation 1949–1989*, (Swidon: English Heritage 2003).

radar antenna; however, the metal frames of Fuller's domes had not been designed to enclose radar antenna and blocked the radar beam from escaping the radome. In collaboration with the US Department of Defense Lincoln Laboratories at MIT, Fuller and Geodesics Inc. developed a new radome design utilising the self-supporting panels that were used to construct the domes at RAF Fylingdales (see Figure 2.11).[91] Throughout the 1950s, Fuller's domes enclosed military radars, providing air defence cover across NORAD defensive lines in North America and NATO units in Europe, while also providing living spaces for counter-cultural communities.

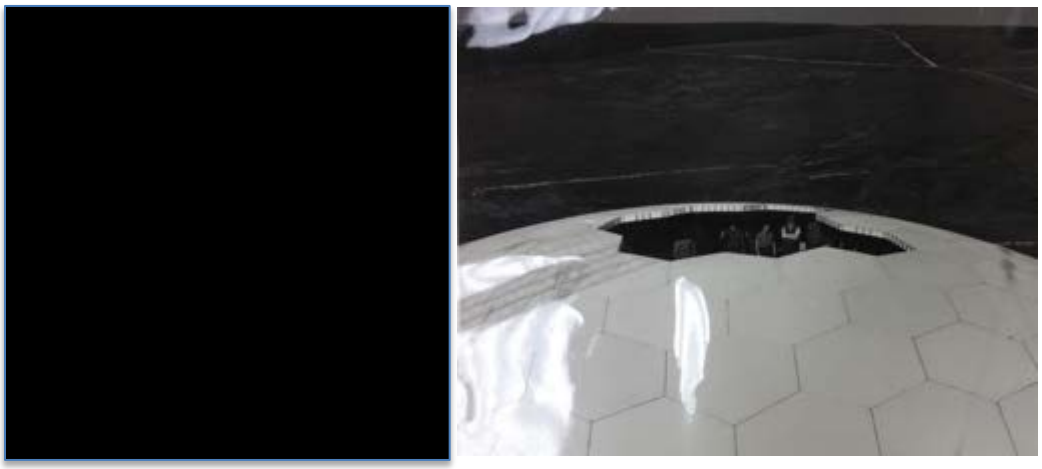

Figure 2.10 (Left) Richard Buckminster Fuller in the first self-supporting geodesic dome at Black Mountain College of Art 1947

Figure 2.11 (Right) Completion of tracker two geodesic radome at RAF Fylingdales 1962

RAF Fylingdales Collection and Archive

2.16 Nike Zeus

The creative practices of other alumni of the Black Mountain College also intersect with the cybernetic Cold War military efforts and the technology of MAD. The organisation *Engineering, Art and Technology* was established by Robert Rauschenberg and Bell

[91] FR Naka and WW Ward, 'Distant-Early-Warning Line Radar: The Quest for Automatic Signal Detection', *Lincoln Laboratories Journal,* 12 no. 2 (200), pp.181–204 (p.200).

Laboratory engineer Billy Klüver. The collaboration produced some of the earliest multimedia and interactive electronic artworks by former Black Mountain College artists and performers such as Cage, Cunningham and Rainer. The collaboration led to *The 9 Evenings: Theatre and Engineering* multimedia art event held at the 69th Regiment Armory, New York between 13th and 23rd October 1966. Bell Laboratories saw the artistic contributions as a way of thinking differently about the manners in which technologies could provide solutions to engineers' most pressing matters of the day. These included the technically challenging Safeguard Anti-Ballistic Missile (ABM) Program, which included the first ever use of phased array radar and the Nike Zeus interceptor missile tipped with a neutron bomb warhead. During the *9 Evenings* event, an innovative system of centralising control of various sensors to trigger speakers or cameras was developed using radio transmitters and FM receptors. The system was known as "theatre electronic environmental modular" and connected participants, mechanisms, people and data together in the artwork,[92] a superimposable schematic for the cybernetic operating environment for an ABM system like Bell Laboratories' Safeguard.[93]

[92] Michelle Kuo, 'Inevitable fusing of specializations: Experiments in Art and Technology' in *Rausenberg* eds Leah Dickerman, Achim Borchardt-Hume (London and New York: Tate Publishing, The Museum of Modern Art, 2016).

[93] The system requirements for 9 Evenings and Safeguard both require detection and response from several field assets. Safeguard assets are described in an article by JW Olsen without reference to EAT. JW Olsen, 'Safeguard data processing system: Architecture of Central Logic and Control', *The Bell System Technical Journal: Safeguard Supplement*, (1975), pp.S41–S61 (p.S41).

Figure 2.12 (Left) Robert Rauschenberg and Yvonne Rainer with Bell Laboratories engineers working on *9 Evenings: Theatre and Engineering* (1966)

Figure 2.13 (Right) Bell Laboratories' Stanley R Mickelsen's Safeguard Missile and Radar Complex, North Dakota

Another crossing point between Bell Laboratories' nuclear cybernetic–military activities and their support of artistic and creative practice is seen in the company's disposal of their 463 West Street research complex in Manhattan. Here Claude Shannon had composed his Information Theory and during World War II, the complex had housed parts of the Manhattan project. But, in the mid-1960s, the company sold the building to abstract expressionist Robert Meier who, in the 1970s, established the Westbeth Artists Community. This came along with many other artist residencies taking place during the 1960s and early 1970s that were supported by defence sector companies such as Lockheed, Hewlett Packard, and RCA as well as by defence and foreign policy think tanks like The Hudson Institute and RAND Corporation.

The Hudson Institute had been established by Herman Kahn, a former RAND Corporation nuclear strategist who was reputed to be one of the architects of MAD (see Figure 2.15). The artist residency programmes were part of Jane Livingstone and Maurice Tuchman's Art and Technology programme for the Los Angeles County

Museum of Art.[94] During this programme, Kahn worked with conceptual artist James Lee Byars on developing and producing the artwork *100 Questions?* (1969) derived from 20 hours of conversation between the strategist and artist (see Figure 2.14). The art and technology programme also included artists such as Jasper Johns, James Turrell, Andy Warhol and Robert Rauschenberg.[95] However, one of the most important nuclear military and artistic practices that impacts upon our story taking place at RAF Fylingdales is told by art historian Pamela M Lee. The story is about how the doctrine of MAD was, in part, the product of war machine capture and creative variation. Born from unlikely friendships between modern artists, architects and historians and the self-styled RAND Corporation nuclear savant, Albert Wohlstetter.

Figure 2.14 (Left) Military analyst Herman Kahn

Figure 2.15 (Right) Artist James Lee Byars

[94] Pamela M Lee, 'Aesthetic Strategist: Albert Wohlstetter, the Cold War, and a Theory of Mid-Century Modernism', *October*, 138 Fall 2011, pp.15–36.

[95] Jane Livingstone and Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971,* (Los Angeles: LACMA, 1971).

2.17 The Aesthetic Strategist[96]

The RAND Corporation was the premier think tank of the Cold War, where its analysts were encouraged to "think the unthinkable". RAND had been established in 1946 by the USAF and the McDonnell Douglas Aircraft Corporation and was situated near the beach at Santa Monica in Los Angeles. The think tank's primary purpose was to devise possible ways of using nuclear weapons' unique destructiveness in combat. The atomic bombing of Hiroshima had, in an instant, overturned all conventional notions of warfare, and presented a singular problem to RAND analysts such as Bernard Brodie regarding what happens when your weapons annihilate and render uninhabitable the territory you are supposed to capture or defend.[97] The analysts at RAND Corporation were interdisciplinary civilians drawn from economists, engineers, physicists, mathematicians, anthropologists and social scientists. The analysts saw themselves as a decisive break from the established military and governmental institution and prided themselves on their supposed new approach to defence and foreign policy. They soon realised that nuclear weapons could never be deployed in actual combat without risking the ending of the world. However, they also thought a nuclear weapon's unique utility lay in its terrifying promise of absolute destruction as a means of deterring any sort of move towards war that used either nuclear or conventional means.

During the RAND Corporation's peak under US President Kennedy and his Secretary of Defense Robert McNamara, war was deemed to be too important to be left to the generals. Defense specialists at RAND saw themselves as protectors of the nation as a result of their use of logic and reason. Many analysts at the RAND Corporation, like Brodie and Herman Kahn, drew from Clausewitz to help formulate theories of deterrence. But Albert Wohlstetter seemed to seek to become an embodiment of

---

[96] Pamela M Lee, *Aesthetic Strategist.*

[97] Fred Kaplan, 'Year Zero', chap 1 in *Wizards of Armageddon,* (New York: Simon and Schuster, 1983), p.9.

Clausewitz's fascinating trinity of war, displaying the sensibilities of both a logician and an aesthete – a modernist soldier of reason in a time of mid-century Armageddon. Fred Kaplan in his book *Wizards of Armageddon* described Albert Wohlstetter as an "otherworldly figure" who had shown little interest in military or strategic matters prior to working for RAND Corporation. In the late 1940s, Albert had tried to establish a housing company in Los Angeles producing prefabricated dwellings that applied the ideas of Bauhaus architects such as Walter Gropius and Paul Weidlinger. Wohlstetter had previously worked with both architects at the National Housing Agency in Washington shortly after World War II, adapting their systems used in aircraft hangar design to make quickly assembled homes.[98] However, at the time, building houses without nails was at odds with Los Angeles housing regulations so Albert's housing company struggled for orders. During this time, Albert's wife Roberta was working in the social science division of RAND Corporation alongside anthropologists such as Margaret Mead, who were analysing social behaviours in the Soviet Union in order to visualise their Cold War opponent.[99] Roberta convinced Albert to meet Charles Hitch, who headed the economics division at RAND who employed Albert as an economics consultant in 1951.[100]

The avant-garde sensibilities of Roberta and Albert were expressed in their modernist home, designed by architect Josef van der Kar, that was situated high in the hills of Laurel Canyon on Woodstock Road. Their neighbours included actor Jane Fonda and musicians Crosby, Stills and Nash.[101] The Wohlstetter House was also photographed by Julian Shulman, depicting Wohlstetter as engaging in a similar Los Angeles mode of

---

[98] Fred Kaplan, 'The Vulnerability Study', chap 9 in *Wizards of Armageddon,* (New York: Simon and Schuster, 1983), pp.94–96.

[99] Melissa Bauma, 'Studying Soviets, not sex: Margaret Meads research at RAND', *Rand Review,* (2018) <https://www.rand.org/blog/rand-review/2018/03/studying-soviets-not-sex-margaret-meads-research-at.html> [accessed 17 November 2018].

[100] Fred Kaplan, 'The Vulnerability Study'.

[101] Timothy Braseth, 'Josef van der Kar: Building Architectural Bridges', *Modernism,* Summer 2011 <http://www.artcrafthomesla.com/Modernism_Magazine_-_Van_der_Kar.pdf> [accessed 6 March 2019].

living as depicted by David Hockney during his stay in Santa Monica (see Figure 2.16). The Wohlstetter's home and lifestyle were also captured by photographer Leonard McCombe for *Life* magazine. The photo-article that appeared in *Life* presents the Wohlstetter house as the setting for a modern, and elite, American family. Their home is portrayed by day as a nurturing environment for their children, but in the evening it becomes a stage for meetings of RAND Corporation analysts who discuss nuclear deterrence while languishing (awkwardly) on bean bags as Albert holds court on an Eames chair (see Figure 2.17).

Figure 2.16 (Left) Julius Shulman *The Wohlstetter Family* (1955)

Figure 2.17 (Right) Leonard McCombe *RAND Corporation analysts meet in the Wohlstetter home* (1959)

2.18 Surprise attack

The first matter that Albert worked on at RAND was assessing the vulnerability of SAC's B-47 and B-36 nuclear bombers, along with their KC-97 refuelling tankers, that were dispersed overseas at bases like RAF Lakenheath. Using data drawn from experts on air defence, aircraft technology and radar, Wohlstetter drew the conclusion that US nuclear bombing forces were hopelessly vulnerable to a surprise attack. The findings were largely ignored by SAC that regarded a "bolt from the blue" nuclear attack as very unlikely. However, after the Soviet Union detonated its hydrogen like bomb in 1953,

which to many in US intelligence indicated the Russians were moving to put a warhead on an ICBM, Albert's thoughts turned to the best way to allow the US nuclear forces to survive and retaliate against a surprise attack and he was supported by Kennedy acolytes such as Robert Sprague, of the electronics multinational Sprague Electric.[102]

The solution that Albert Wohlstetter proposed was to base missiles and aircraft in hardened silos that could withstand being attacked suddenly by nuclear weapons delivered by ICBMs. However, the type of engineering that would be capable of performing this task was unknown to RAND Corporation or anyone else. Albert returned to his Bauhaus colleagues from the National Housing Agency and commissioned structural engineer Paul Weidlinger to produce calculations for conceptual solutions for hardened aircraft hangers and missile silos (see Figure 2.18). Weidlinger had begun his career in 1937 as an apprentice draughtsman to both László Moholy-Nagy and Le Corbusier. His architectural projects included Yale's Beinecke Library, designed by Gordon Bunshaft, the facade of the Saint Francis de Sales church, designed by Marcel Breuer, and the Reader's Digest Building in Tokyo with Antonin Raymond. Weidlinger also collaborated with artists Jean Dubuffet, Isamu Noguchi and Pablo Picasso on large-scale outdoor sculptures such as the *Chicago Picasso* (1967), on the Daley Plaza outside of Mies van der Rohe's Daley Centre in Chicago (see Figure 2.19).

The work that Weidlinger produced for Albert required conceptualising an architecture that could withstand an overpressure of 200 to 2,000 psi that occurred in the 2,000,000 °C fireball of a nuclear explosion. Weidlinger consultancy work led to the design specifications for the Titan II and Minuteman missile silos, and made concrete one of the key concepts of MAD: the survivability of enough nuclear forces in hardened silos to promise a devastating reply.

[102] Sprague Electric was a major supplier of semiconductors to RAF Fylingdales and other BMEWS radar, see RAF Fylingdales archive: Pickering 'Supply'.

Figure 2.18 (Left) Conceptual drawing of a Minuteman III missile silo (c1957)

Figure 2.19 (Right) Unveiling of the *Chicago Picasso* (1967)

2.19 Noise-to-signal

It is one thing to produce a concept of hardening a weapon silo sufficiently to withstand a direct nuclear attack, it is another to know whether the idea could actually perform – which could never be proven outside of an actual nuclear war. Only a few weapons would survive, while many are certain to be wrecked by the Soviet multi-megaton warheads. RCA's ballistic early warning system with the radar stations at Thule, Clear and on Fylingdales Moor, North Yorkshire, provided the United States' nuclear ICBM force with up to 20 minutes notice for launching a counter attack before the enemy missiles descended on their targets. But, because everything in orbit looks like a warhead, a system of accounting needed to be employed in order to distinguish a threatening weapon from space launch debris and satellites in order to avoid a catastrophic false alarm.[103] The system employed is known as noise (the background of orbital space objects) to signal (threatening ICBMs and IRBMs) and was adapted from Roberta and Albert's doctrine of the same name. Art historian Pamela M Lee attributes

[103] Conversation at RAF Fylingdales.

this method to art historian Meyer Schapiro's theory of figure and ground.[104]

Schapiro devised this principle to interrogate a range of flat-wall-based artworks from cave paintings to Italian frescos and modernist abstract paintings.[105] The principal was based upon a semiotic reading to unsettle, what Lee states as "the over-determinations of iconography" or symbolic representation in painting. This was achieved by considering not only the image but the material that made up the paint's support and ground. So, for Schapiro, a painting on a cave wall, or painted into plaster in a church, or oil on canvas, was determined as much by the material and processes that are used to construct the image, but are invisible if attention is focused only on what is represented by the content. Lee explains that Albert Wohlstetter had met Schapiro while he was a postgraduate student of mathematical logics at Columbia University and they both maintained a correspondence for three decades until the beginning of the 1960s. Wohlstetter explains how they met:

> I was finding myself on all sorts of obscure courses […] Like Romanesque Monumental Stone Sculpture and French Illuminated Manuscripts as given by Meyer Schapiro […] Meyer was perhaps the most brilliant lecturer I ever heard.[106]

Wohlstetter and Schapiro's correspondence revolved around discussion about semiotics applied to all kinds of situations. These correspondences have led Lee to draw a comparison between Roberta Wohlstetter's influential book on deterrence theory, *Pearl Harbour: Warning and Decision* (1962). In the book, Roberta's assertions

---

[104] Pamela M Lee, *Aesthetic Strategist.*

[105] Meyer Schapiro, 'On Some Problems in the Semiotics of Visual Art: Field and Vehicle in Image-Signs', *Simiolus: Netherlands Quarterly for the History of Art*, 6, no. 1 (1972), pp.9–19.

[106] Pamela M Lee, *Aesthetic Strategist.*

bear similarity to Schapiro's approach to understanding paintings. For Roberta, the attacks on Pearl Harbour came as a surprise not for want of relevant material but with the human tendency of seeing only those signals with established meaning.[107] Lee goes on to describe how Roberta and Albert Wohlstetter develop this idea at RAND Corporation into noise-to-signal whereby all data is subject to analysis. This would be adopted by the USAF to help B52 crews on a nuclear bombing raid by giving them the ability to distinguish between real radio instructions and a background of decoy broadcast, signal jamming and noise.

Lee stresses that her intention is not to rehabilitate Wohlstetter, nor does Lee wish to impugn Schapiro. But, her argument highlights the exchanges that were occurring between institutions of the military–industrial complex that co-opted methodologies from the arts and humanities to devise the technologies of nuclear deterrence. Albert Wohlstetter publishes his recommendations for hardened missile silos based on Paul Weidlinger's consultancy in a RAND Corporation staff report R-290 'Protecting US power to strike back' dated 1st September 1956. The report precedes the Sputnik Crisis, but nevertheless recommends the need for a system of early warning radar capable of discriminating against the noise of space debris such as meteorites and the threat signal of an incoming Soviet warhead.[108] Albert Wohlstetter also recommends the development of:

> A detection device suitable for giving at least 3 to 5 minute reliable warning of an ICBM attack – one that can be operational by 1960.[109]

---

[107] LB Kirkpatrick, '*Book review of Pearl Harbor: Warning and Decision by Roberta Wohlstetter',* (1993) <https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/vol7no3/html/v07i3a13p_0001.htm> [accessed 17 October 2018].

[108] AJ Wohlstetter, FS Hoffman and HS Rowen, '*Staff Report: Protecting US power to strike back in the 1950s and 1960s'* (Santa Monica: RAND Corporation, 1956), p.72.

[109] Ibid. p.73.

How Albert Wohlstetter's recommendations become RAF Fylingdales is found among a stack of training manuals in the RAF Fylingdales archive. One of these manuals is numbered L1000-2 and has recently been labelled with a yellow post-it note stating "overall description". In the front of the manual is a flow diagram labelled "contractual organisations of BMEWS". At the very top is the US Government and subordinate is the USAF but feeding into this level is the RAND Corporation acting as consultants. Further into the manual it describes how the IBM 7090 computers, known as the missile impact predictor (MIP), and satellite information processor (SIP) use programs that discriminate the signal of an incoming warhead from the background of space debris. Throughout the manual, this process is referred to as noise-to-signal, and in doing so, shows the tendril path of a war machine's metamorphic transformation. In this case, Meyer Schapiro's figure to ground – that was originally devised to interpret the structure of paintings – has been transformed into the operational logic of IBM computers tasked with providing the four-minute warning, which will be described in the following chapter.[110]

Figure 2.20 (Left) Analysts Roberta and Albert Wohlstetter

Figure 2.21 (Right) Art historian Meyer Schapiro

[110] RAF Fylingdales archive: Pickering, 'BMEWS Training Manual: sub-course L1000-2, system analysis handbook'.

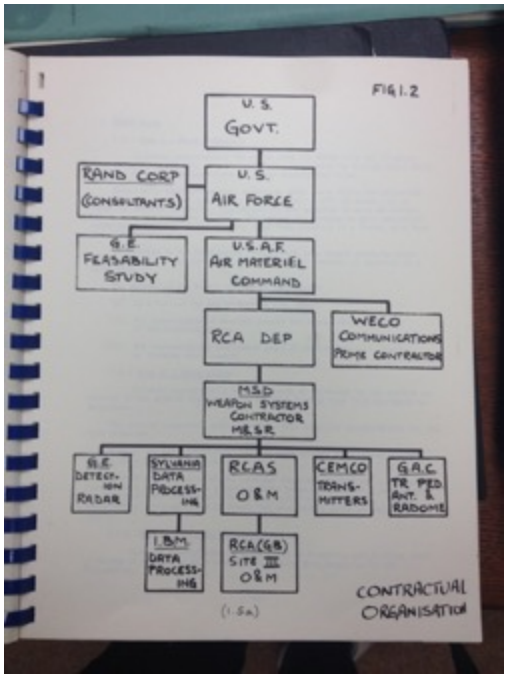

Figure 2.22 BMEWS training manual L1000-2

2.20 Military contemporary art complex

The sociologist Susan Leigh-Star has also highlighted these military and artistic exchanges. In her essay, *Power, technologies and the phenomenology of conventions: on being allergic to onions*, she develops Harold Becker's conception of an artist and art worlds being composed of the tools and routines of many others that are made invisible through coded meaning and inscription produced by art world collective value judgements.[111] Star used this as a model to describe how state structures, such as MAD that encompassed cybernetics, use appropriations to establish new technologies of power through a technical Clausewitzean process of:

> Politics by other means […] whereby technology freezes inscription, knowledge information and alliance inside black boxes, where they become invisible transportable and powerful in hitherto unknown ways as parts of socio–technical

[111] Howard S Becker, *Art Worlds,* (CA: University of California Press, 1982).

networks.[112]

Both the worlds of artist and defence specialist could be viewed as distinct black boxes, but as we have seen, these are not mutually exclusive realms. Star goes on to state that:

> the process of translating the image and concerns of one world into that of another, and then disciplining or maintaining that translation [through representational and meaningful coding] stabilise[s] a powerful network.[113]

By operating the virtual control dials of assemblages, those seemingly distinct worlds show themselves to be actually interchangeable and made of the same materials. With the dials set to certain circumstances, we see Italian frescos as seen by Meyer Schapiro, or the rock star David Bowie, or Buckminster Fuller appearing through the top of his geodesic dome at the Black Mountain School of Art. While under different settings we see that Fuller's domes or Schapiro's theory of figure and ground are also material parts of the machinery of MAD and the core operational parameters of RAF Fylingdales.

It is also possible to see that the same war machine has been appropriated by two seemingly distinct sovereign apparatuses: one of military exceptionality that remakes war for war's sake, and another of artistic institutional exceptionality reproducing art for art's sake; both are in two artificially black boxed domains and, yet, are materially interrelated. Deleuze and Guattari write that:

---

[112] Susan Leigh-Star, 'Power, Technology and the phenomenology of conventions: on being allergic to onions' in *A Sociology of Monsters: Essays on Power Technology and Domination* ed. John Laws (London: Routledge, 1991), p32.

[113] Ibid. p32.

> The state form as a form of inferiority has a tendency to reproduce itself, remaining identical to itself across its variations and easily recognisable within the limits of its poles, always seeking public recognition there is no masked state. But the war machine's form of exteriority is such that it exists only in its own metamorphoses; it exists in an industrial innovation as well as a technological invention, in a commercial circuit as well as in a religious creation, in all flows and currents that only secondarily allow themselves to be appropriated by the state.[114]

Yet, Deleuze and Guattari saw in the creative variations of the war machine and the work of artists a way of destabilising the representation of inscription by state structure, by making the operations of power visible. For Deleuze and Guattari, the processes of making artworks are the same as the creative variations of war machines' operational parameters, which are perpetually coding and decoding, territorialising and deterritorialising. In doing so, the metamorphic processes of war machines create new configurations of assemblages that produce new possibilities and different arrangements of life. In the next chapter, the metamorphic processes of the war machine are discussed in relation to the concept of becoming and the artmaking process, showing how both undermine inscriptive and meaning-making activities of ordering structures by placing emphasis on incorporeal process, action and transformation. I will explain how the actions of assemblages span geopolitical scales to situate individual experience and expression in direct relationship to the concrete and complex geopolitical structures of nuclear deterrence.

[114] Gilles Deleuze and Félix Guattari, 'Problem I: Is there a *war* of warding off the formation of a State apparatus (or its equivalents in a group)?', chap 2 in *Nomadology*..., p.16.

Chapter 3: The Gaze of Oblivion

3.1 The war machine it springs to life, and opens one eager eye[115]

Michel Foucault's introduction to Deleuze and Guattari's book *Anti-Oedipus: Capitalism and Schizophrenia* (1972) is a call to combat, an ululation of Deleuze and Guattari's war machine that is deployed in "a war fought on two fronts: against social exploitation and psychic repression".[116] Foucault describes that among the adversaries that Deleuze and Guattari's war machine was levelled against were those named as the poor technicians of desire, the "psychoanalysts and semiologists of every sign and symptom – who would subjugate the multiplicity of desire to the two-fold law of structure and lack".[117] In doing so, these "technicians of desire" contributed to what Foucault saw as Western thought's consolidation of power through an imperial ordering of knowledge.

For Deleuze, Guattari and Foucault this ordering of knowledge filters, silences and renders invisible social productions and arrangements of reality. On the other hand, Deleuze thought the process of making artwork is a war machine that makes unseen social and epistemological production of deeply coded and powerful assemblages visible. The ways in which artmaking disrupts epistemological orders in order to reveal underlining and intersecting structures of power is considered in this chapter. In doing so, I will show that war machine processes of creative variation and productions of

---

[115] Uwe Fahrenkrog-Petersen, Carlo Karges and Kevin McAlea, '*Ninety Nine Red Balloons'* (Beverly Hills: Epic, 1984).

[116] Michel Foucault, 'Preface' in Gilles Deleuze and Félix Guattari, *Anti-Oedipus*: *Capitalism and Schizophrenia.* Trans. Robert Hurley, Mark Seem and Helen R Lane (Minneapolis: University of Minnesota Press, 2000), p.xi.

[117] Anti-Oedipus names two further adversaries: the ascetics, sad militants, the terrorists of theory, those who would preserve the pure order of politics and political discourse. Bureaucrats of the revolution and the civil servants of truth; and fascism…not only historical fascism but the fascism in everyday behaviour that causes us to desire the very thing that dominates and exploits us. Ibid.

assemblage are materialised by drawing practices, thereby situating the critical impetus of this thesis within the process of making art, which I argue is distinct from functions of representation and meaning making that contribute to obscuring ongoing material processes of social assemblages**.**

The chapter develops over four parts. In the first part I recount the story of Joey the Mechanical Boy, a child patient of psychiatrist Bruno Bettelheim, who was being treated for autism. The story is told by science and technology historian Sungook Hong and shows that, through his drawings, Joey foregrounds the human subject as part-composed of complex socio–technical assemblages, which pre-empt Deleuze and Guattari's *Anti-Oedipus: Schizophrenia and Capitalism.* I will explain how Deleuze and Guattari applied their theory of assemblage to critiques of psychoanalysis and how it contributes to repressive social ordering by binding subjects into perpetually reproduced structures of meaning.

Part two explores how these structures of meaning become unsettled when subjects are viewed as being compositions of inter-relational experiences immersed in processes of creative variation, metamorphic transformations or perpetual becoming. I will explain how philosopher Rosi Braidotti thinks that by paying critical attention to these processes, through activities such as drawing or artmaking, then the complex and material relations in which bodies are immersed become visible. This notion is then explored by a “thick description” of my formative drawing experience as a child living during the extreme Cold War tensions of 1983. I will show that through my research at RAF Fylingdales, these childhood drawings resonate with simulations run by computer systems at the station, which even outputted the results on the same type of fanfold paper that I made drawings upon.

In the third part, Braidotti’s notion of becoming is drawn through art critic and writer Jean Fisher’s ideas about drawing which, for Fisher, is less about inscribing onto a flat

surface than a series of activities and processes that are unbound by space and time. I explore Jean Fisher's argument by looking at a series of artworks called *The End of History*, that I made during a residency in Chicago at the end of the George W Bush era. I explain how I see the drawings as artefacts that emerge not only from the material process of their making, but that also have complex relationships with the environment in which they are made.

In the final section of this chapter, a case is made for the critical importance of artmaking by returning to Deleuze, who explores the drawings of Antonin Artaud in order to develop the notion of a body without organs, a body that disavows structuring by representational knowledge systems, and that is the embodiment of the war machine. The sections lead to a conclusion that my own practice should be seen as the emerging product of a *Four-Minute Warning Drawing Machine*: a heterogeneous social assemblage comprising intersecting childhood experience, historical geopolitics, art materials, computer stationary and nuclear weapons systems. The result is an assemblage that should be understood as a critically deployable device over being an object inscribed for exhibition.

3.2 PART I

3.2.1 Theatre of the unconscious

The focus of Deleuze and Guattari's assault in *Anti-Oedipus* was against the Freudian and Lacanian ordering of an unconscious built upon the familial structure. Deleuze and Guattari criticised mainstream psychoanalytics as doing nothing but trapping the patient in a theatre of the unconscious in a way that merely presented their symptoms as a

metaphysical representation of a prescribed order.[118] An account of this phenomenon is given by historian and philosopher of science Sungook Hong who, writing in *e-flux Architecture*, recounts the story of a child patient of American psychiatrist Bruno Bettelheim, referred to as *Joey the Mechanical Boy*.[119]

Bettelheim was treating Joey for childhood schizophrenia, which is known today as autism. Hong explains that, after withdrawing from verbal communication, Joey began identifying himself as a machine, and could not fall asleep unless he had connected himself to a complex of actual and imagined mechanical artefacts arranged on his bed. Joey also expressed his sense of being composed of technical relationships through drawings. The drawing depicted vehicles, rooms and animals connected by intricate and electrically powered machinery, which Bettelheim interpreted as symptoms of a suppressed humanity.

This was the late 1950s in an America that was benefiting from massive economic expansion but still collectively recovering from World War II and reeling from the power unleashed by their new nuclear weapons against Japanese cities. We saw in chapter 2 how Gilles Deleuze and Félix Guattari conceived the notion of the war machine under the prevailing post-war threat from nuclear weapons. But for philosopher Gunter Anders this climate was causing a kind of social schizophrenia, where machines like the hydrogen bomb, ICBMs, Sputnik 1 and concepts such as MAD produced a deficit between the embodied limits of human imagination and the enormous power and capacities that the machine bestowed. Anders called this phenomenon the Promethean

---

[118] Julian Gill-Peterson, *Childhood blocks Deleuze and Guattari's infant affects,* (2013) <https://juliangillpeterson.wordpress.com/2013/04/29/childhood-blocks-deleuze-and-guattaris-infant-affects/> [accessed August 2017].

[119] Sungook Hong, 'Joey the Mechanical Boy Revisited', *e-flux Architecture* (2018) <https://www.e-flux.com/architecture/superhumanity/179228/joey-the-mechanical-boy-revisited/> [accessed 21 November 2018].

Gap, which was made visible by a seemingly societal suppression of the "human" capacity to empathise. Anders states that:

> We can bomb to shreds hundreds of thousands, but we cannot mourn or regret them.[120]

Bettelheim shared Anders' view that technicity was suppressing what he thought of as a human soul. Sungook Hong explains that, while director of the Orthogenic School for Disturbed Children, Bettelheim developed Gregory Bateson's concept of the double bind into a theory that he thought could be applied to a general public.[121] Bettelheim called his theory "The Refrigerator Mother Theory", which was based upon the assumption that autism was caused by cold and distant parenting. Bettelheim developed the notion in a way that reproduced America of the 1950s, he thought the symbolic role of father as authority was undermined by death, injury or mental health problems caused by World War II. Yet, his theory placed the blame upon what he thought of as the apathetic mother, who brings up her children through mechanical ritual and leaves little space to make emotional bonds.

Bettelheim reported his findings in an article *Joey, the Mechanical Boy* for Scientific American in 1959. Hong explains that:

> According to Bettelheim, Joey's mother did not realise that she was pregnant, and when she gave birth, did not have a strong emotional connection to the child.

---

[120] Gunter Anders, quoted in Michael Hauskeller, *Gunther Anders on Promethean Shame,* Philosophical Reflections (2015) <http://hauskeller.blogspot.com/2013/09/gunther-anders-on-promethean-shame-part.html> [accessed 21 November 2018].

[121] G Bateson, DD Jackson, J Haley & J Weakland, 'Towards a Theory of Schizophrenia' *Behavioral Science,* 1 (1956), pp.251–264.

> Joey's father was a young veteran who was also uninterested in raising children. Joey cried all day, and his parents let him. They fed him at regular intervals. His mother gave him very strict toilet training because it would ultimately save her time. At the age when he started speaking, Joey already showed interest in machines, such as fans, and was adept at disassembling them, but would only talk to himself, not others. "By treating him mechanically," wrote Bettelheim, "his parents made him a machine".[122]

Throughout the 1960s, childhood schizophrenia became more accurately diagnosed as autism and a consensus grew that the syndrome was due to complex physiological effects, including environmental causes that are still not well understood.[123] Hong shows that Bettelheim's diagnosis reinscribed prevailing cultural chauvinism upon Joey and, by extension, his mother. The outcome is that Bettelheim seemed to pay little attention to the actual interactions of the family members. Instead, Joey and his family were treated as a spectacle that represented only Bettelheim's patriarchal and symbolic ordering of the world, which is evident in Bettelheim's analysis of Joey's *Carr Family* drawings.[124]

3.2.2 The Carr Family drawings

Throughout his treatment Joey made drawings on paper in pencil or crayon. The drawings are intricately observed and rendered with an unrefined, but draughtsman-like,

---

[122] Sungook Hong, 'Joey the Mechanical Boy'.

[123] Brett S Abrahams and Daniel H Geschwind, 'Advances in autism genetics: on the threshold of a new neurobiology', *Nature Reviews Genetics*, 9(5) (2008), pp.341–355.

[124] In recent years Bettelheim's theory has been discredited, along with his reputation after it was revealed that Bettelheim possessed a PhD in art history but no qualification to practice psychiatric medicine. Nicola Tucker, '*Turbulent dreams of a damaged saint',* (1995) <https://www.independent.co.uk/arts-entertainment/books/turbulent-dreams-of-a-damaged-saint-1524787.html> [accessed 12 February 2019].

quality of line. The *Carr Family* drawings is composed of three separate drawings made over a period of time. Situated in the centre of the first drawing is a cluster of boxes that appears to comprise a fire engine, or truck or locomotive in a cross-section view. A diagonal boom emerging from the top of the cluster suggests that the vehicle is actually a tram.

The second drawing depicts a semi-reclined figure in another tram, who appears to be operating a device composed of wires. The wheels of the tram sit along the bottom of the page while the current-carrying boom connects directly to the top of the paper through a box of electrical insulators. The final and most complex drawing in the series shows a sloping-fronted tram with diamond shape pantographs connecting the vehicle to the electrical overhead lines. There appears to be a driver who is also depicted in cross section so that their internal organs are apparent. This cross sectioning of the human figure is common in many of Joey's drawings, which often show the passage of food through a human digestive system and into an urban sewer complex.

Hong explains that from Bettelheim's point of view, each iteration of the drawing represented the child's growing self and the diminishing of mechanical influences as the treatment proceeded.[125] Bettelheim's reading of Joey's progress, as depicted in the *Carr Family* drawings, describes a driverless vehicle moving under its own autonomy, representing the machine in full dominion of Joey's psyche. But in the second drawing the passenger appears to Bettelheim as Joey's manifest self. By the third drawing Joey has become what appears to be the driver in full control over the machine, and a fully actualised self.

[125] Sungook Hong 'Joey the Mechanical Boy'.

Figure 3.1 Joey the Mechanical Boy's drawings of trams at various stages of his treatment

However, Hong points out that Bettelheim fails to see that the *Carr Family* drawings are actual depictions of trams and trolleys.[126] Bettelheim ignores the explicit graphical depiction of this data shown by numbers and letters that indicate electrical voltage and current , such as "110 V", which appears in the first drawing, and "AC" and "DC" in the third drawings. He also does not recognise that the drawings explicitly depict the power lines used for operating the tram. Hong explains that this data corresponds to lived experience and that trams can often appear to move without an apparent driver or that there exist types of tram where the driver actually controls the trolley from the back of the vehicle, similar to the position of the "passenger" in Joey's second drawing. Hong concludes that by neglecting to acknowledge observational data, Bettelheim silences, or renders invisible, Joey's claim to possessing actual lived experience. Embodied in this observation is the central critique of psychiatry (as well as all other foundational ontologies) offered by Deleuze and Guattari; that it colonises their patients in an ontological image of the doctor's own making, which, by social extension, is a mechanism through which repression reproduces itself socially.

[126] Sungook Hong, 'Joey the Mechanical Boy'.

3.2.3 The ontology of The Mechanical Boy

Deleuze and Guattari argued that the implications of perceiving children, and childhood, through a psychoanalytical lens meant that anything children do, feel or say was disregarded if it did not symbolically represent an iteration of the family structure as seen by the psychiatrist.[127] And, as we have seen in the case of Joey, the interpretative bureaucracy of psychoanalysis privileged the prevailing Eurocentric, patriarchal and bourgeois arrangement of the family, which excluded other points of views and possibilities.[128] For Bettelheim, the machine represented a menace to, what Foucault might term, the human imperial ordering of reality. Bettelheim writes:

> neither saviour nor destroyer is cast in man's image anymore. The typical modern delusion is of being run by an influencing machine […] Man's delusions in a machine world seem to be tokens of both our hopes and fears of what machines may do for, or to us.[129]

However, Hong explains that Joey's recollection of his treatment and artwork stand in direct contrast to Bettelheim. She explains that:

> Joey said that machines [...] "were a way to show that [I] had intelligence". He was "afraid that people would think that [I] was independent" (if he didn't pretend to be a machine), and he said he "could find many shapes in the shapes the machine parts had". The antagonistic confrontation between humans and

---

[127] Julian Gill-Peterson, *Childhood blocks Deleuze and Guattari's infant affects.*

[128] Gayle Salamon, 'The Place Where Life Hides Away: Merleau-Ponty, Fanon and the Location of Bodily Being' *Difference: A Journal of Feminist Cultural Studies,* 17 no. 2, (2006), pp.97–112.

[129] Sungook Hong, 'Joey the Mechanical Boy'.

> machines that Bettelheim identified as the pathological origin of Joey's condition is evidently absent from Joey's own thinking.[130]

Hong concludes that Joey and his drawings should been viewed in terms of an early pioneer in exploring the discourse of more-than-human existence, preceding socio–technical critiques of power such as in Donna Haraway's Cyborg Manifesto, or Manuel DeLanda's spatialised social assemblages with knobs on, which we looked at in chapter 2. The imagery of Joey's socio–technical drawings and his prevailing view of a reality composed of actual things productively interacting were also vividly reflected by Deleuze and Guattari at the beginning of their *Anti-Oedipus*:

> What a mistake to have ever said the id. Everywhere it is machines — real ones, not figurative ones: machines driving other machines, machines being driven by other machines, with all the necessary couplings and connections […] Hence we are all handymen: each with [their] little machines. For every organ-machine, an energy-machine: all the time, flows and interruptions…Something is produced: the effects of a machine, not mere metaphors.[131]

The implication of a reality composed of interacting parts is that children, their families and even their psychiatrists are active and productive elements in elaborate social assemblages. As we saw in chapter 2, these assemblages spatially and temporally extend – socially, historically and geopolitically. This means that each part of any social assemblage, whether human, mechanical or ovine (as described in the last chapter), has the capacity to productively affect beyond their socially or epistemologically delineated role, function or psychic pathology. As we saw previously with the operation

---

[130] Ibid.

[131] Gilles Deleuze and Félix Guattari, *Anti-Oedipus*: *Capitalism and Schizophrenia,* p.8.

of the war machine, As we saw previously with the operation of the war machine, it is through processes of creative variations that prescribed boundaries can be made meaningless and it becomes possible to deterritorialise, while producing new types of assemblages and social formations. We shall also see in this chapter's next section, these creative processes are, on the one hand, hidden by the reproductive process of meaning making but, on the other hand, they become visible when creative processes are engaged that, as a result, have the ability to show the mechanisms by which bodies are held in structures of power. Therefore, these power structures, whether psychiatric or geopolitical, can show themselves in creative production.

3.3 PART II

3.3.1 Bodies immersed in social relations of power

Taking psychiatrist, philosopher, activist and post-colonial theorist Frantz Fanon as their cue, Deleuze and Guattari explain:

> what a grotesque error to think that the unconscious-as-child is acquainted only with daddy-mommy, and that it doesn't know "in its own way" that its father had a boss who is not a father's father, or moreover that its father himself is a boss who is not a father […] the father and the mother exist only as fragments […] that come into contact with […] agents, meet them face-to-face, square off with them, or settle the differences with them in hand-to-hand combat […] The father, the mother and the self are at grips with, and directly coupled to, the elements of the political and historical situation – the soldier, the cop, the occupier, the collaborator, the radical, the boss.[132]

[132] Gilles Deleuze and Félix Guattari, *Anti-Oedipus,* pp.106–107.

Fanon observed that the affecting forces of history and geopolitics, and those of home and family, operate in close relationship so that all parts are active producers of the world.[133] Knowledge about the world and the role we play within it are never fixed nor certain. Instead, as we saw in Manuel DeLanda's "assemblage theory with knobs on", they emerge from constant processes of deterritorialisation and recoding, which perpetually transform and deform reality.[134] Rather than seeing these transformations as the result of operating virtual dials and knobs, Deleuze thinks of these becomings as drawn lines that have:

> neither beginning nor end, departure or arrival, origin nor destination.[135]

This notion is developed by the new materialist philosopher Rosi Braidotti, who explains that there can never be binary positions, such as beginning and end states, nor fixed points of view such as being or self. Instead, like DeLanda, she sees that there are only variations in the parameter settings of social assemblages. As explained, these social assemblages are adjusted through action, events and occurrences that change space. This leads Braidotti to argue that becomings are non-representational, embodied actualisations of matter, which are constantly being formed into new configurations through various doings. These multiple processes of doing form intricate patterns that ripple, overlap, resonate and fold across space and time. These patterns extend from the smallest components that compose the bodies, such as atoms, through large mechanisms of world government, to galactic-scale interactions. All are composed of

---

[133] Clare Colebrook, 'Why Deleuze?' in *Gilles Deleuze,* (London and New York: Routledge, 2002).

[134] See previous chapter.

[135] Gilles Deleuze and Félix Guattari, 'Becoming-Insense, Becoming Animal, Becoming Imperceptible', in *A Thousand Plateaus,* p.342.

oscillating and intersecting lines of becoming.[136] Braidotti explains in an interview with Rick Dolphijn and Iris van der Tuin that within these patterns drawn from complex overlapping lines of becomings it is possible to see:

> The concrete yet complex materiality of bodies immersed in social relations of power.[137]

In terms of this thesis several methodological questions arise. How can we use analysis of metamorphic transformation and creative becoming to make visible the complex interconnectivities and mechanisms that compose large-scale social assemblages such as the Cold War? And how can we determine not only the impact of nuclear deterrence upon individuals but also examine the worlding consequences of micro-scale encounters with nuclear weapon affects? To do this, I will describe how my formative drawing practice is immersed in the experience of threat caused by deteriorating international relationships between the superpowers leading to the War Crisis of 1983. This will illuminate new research, emerging from the RAF Fylingdales archive, which shows how the drawings I made as a result of seeing images of nuclear war on the family television have material affinity with the IBM 7090 MIP, operating in the heart of RAF Fylingdales.

---

[136] Rosi Braidotti interviewed by Rick Dolphijn and Iris van der Tuin, 'Interview with Rosi Braidotti', in *New Materialism: Interviews and Cartographies,* eds. Rick Dolphijn and Iris van der Tuin (Ann Arbor: Open Humanities Press, 2012), p.28.

[137] Ibid.

3.3.2 Cold War 1983: Turning everything up to 11

Almost 30 years after Joey made his drawings, the Cold War was still delineating patterns drawn on geopolitical scales into which all social relationships of individual bodies were entwined. As mentioned previously, these world affairs led to Deleuze and Guattari's concept of the war machine. Meanwhile, for myself, and like Joey, I composed drawings of the world as it was represented through the family television. The drawings would be made most evenings after school in green biro on fanfold computer paper, depicting the nuclear weaponry that seemingly menaced all life on Earth. The machineries of nuclear warfare were conveyed through the early evening news via the family's ITT television. At the time, I had little awareness that the drawings were producing patterns and trajectories that would intersect with technologies of nuclear war at RAF Fylingdales sometime in the future.

If there was going to be a future.

At this time in 1983, both the codification and territorialisation dials of a nuclear war assemblage were being turned up to 11 by the global superpowers.[138] From the beginning of the 1980s, there was a sharp rise in tension between the United States, along with the NATO Alliance, and the Soviet Union with the forces of the Warsaw Pact. This had been triggered in part by the Soviet Union's deployment of their SS-20 intermediate-range ballistic missile (IRBM) in the missile fields east of the Ural Mountains. Each missile was assembled on a mobile launcher, making them difficult to locate, and had the capacity to deliver three 150 kiloton nuclear warheads onto strategic targets in Western Europe, including the United Kingdom, as far away as the south-

[138] *This is Spinal Tap* [film] dir. Rob Rainer (USA: Embassy Pictures, 1984).

western edge of the Iberian Peninsula and the west coast of Ireland to an accuracy of 750 metres.[139]

By October 1983, the Soviet Union had deployed 360 launchers carrying a total of 1,080 warheads.[140] In 1979 NATO took steps to meet this threat by ratifying a policy to deploy 572 new missiles in Western Europe consisting of: Pershing II IRBMs to be based in West Germany; Gryphon ground-launch cruise missiles (GLCMs) deployed to RAF Molesworth and RAF Greenham Common in the UK, Wüschheim AB, West Germany, Florennes AB, Belgium, Woensdrecht AB, Netherlands and Comiso AB, in Italy.[141] Following several years of failed diplomatic attempts to negotiate a settlement to the standoff, the NATO deployment of both Pershing II IRBMs and Gryphon cruise missiles took place during 1983. The Soviet Union, which had feared that the new missiles gave the US and NATO the capacity to destroy Moscow in a decapitating first strike, adjusted their nuclear posture to launch on warning and meet any attack with an all-out nuclear strike against the United States, United Kingdom and the NATO Alliance.[142]

Prevailing Soviet paranoia of a US–NATO nuclear first strike was not helped by the new policy position of the United States under President Ronald Reagan's administration. This was part of President Reagan rising to the challenge of his election campaign to "Let's Make America Great Again". A new generation of nuclear weapons was developed, such as the MX Peacekeeper ICBM that carried up to 12 350 kiloton nuclear warheads, the deployment of the Trident II submarine-launched ballistic missile (SLBM) to replace Poseidon (US) and Polaris (UK), the revival of the B-1 bomber programme, and the introduction of a policy proposal to develop new space weapons to counter the

---

[139] Stan Openshaw, Philip Steadman and Owen Greene, 'Soviet Weapons and their Targets', in *Doomsday,* p.52.

[140] NATO Online Library, '*Special Meeting of Foreign and Defence Ministers Brussels',* 12 December 1979.

[141] Ibid.

[142] Stan Openshaw, Philip Steadman and Owen Greene, 'Soviet Weapons and their Targets', pp.55–65.

Soviet ICBM threat,[143] which became popularly known as Star Wars (see Figure 3.2).[144] These new agreements also included the phasing out of the tracker radars at RAF Fylingdales, to be replaced with the SSPAR which could meet the threat from the new Soviet Typhoon ballistic missile submarines operating in the Atlantic Ocean and Norwegian Sea. As well as the proposed new space-based defensive weapons, the Reagan administration drew upon many other tropes from the *Star Wars* films (1977, 1980, 1983), positing the Soviet Union as an "Evil Empire" and depicting nuclear warfare as both winnable and a technological extension of the age-old struggle between good and evil.

Then, in September 1983, Korean Airline Flight 007 from New York to Seoul was shot down by a Soviet air-to-air missile killing all 269 passengers and crew. The Soviets accused America of using the plane as a cover for a spying operation to gather intelligence on sensitive air defence sites on the Sakhalin islands. The USA accused the USSR of an act of "inhumane brutality". The danger of a conflict triggered by a military accident or diplomatic miscalculation was now extremely high, with a likelihood that it would result in all-out global nuclear warfare.[145]

---

[143] Randall Forsberg, 'War and Peace in the Nuclear Age; Visions of War and Peace', Interview 3 March 1988, WGBH Media Library & Archives, <http://openvault.wgbh.org/catalog/V_F4ABF4A779CE4613BDBF7A73CC019CAC> [accessed November 2018].

[144] *Star Wars: Return of the Jedi* [film] dir. Richard Marquand (USA: Twentieth Century Fox, 1983).

[145] At this time, 60,000 nuclear weapons existed in the world – mainly split between the USA and Soviet Union – assigning the equivalent yield of one Hiroshima bomb for every person living on the planet. Because of their unique destructive capability and the Soviet emphasis on all-out nuclear warfare, any open combat between the superpowers risked quick escalation, which would deterritorialise the exceptional social space of a battlefield to one that was inclusive of all space on and around the entire world. Many intersections composing the social ontology of the time appeared to be flowing along particular lines of becoming and assembling what appeared to be a catastrophic nuclear war machine that would result in the end of the world.

Figure 3.2 Still from Strategic Defense Initiative (Star Wars) concept video c1983

3.3.3 Tea-time nuclear war sensoria

As previously pointed out by Frantz Fanon, geopolitics happens at all social scales and intimacies. So meanwhile, on a smaller social scale in the living room of our family home, 500 metres from a Soviet IRBM target point between the ferry landings of North and South Shields,[146] I was making drawings of the emerging risk of nuclear war, which was broadcast into our home from the ITT colour television. The television's workings were boxed in a wooden case that had a small control panel to the bottom right of the screen for selecting one of four channel options. The panel also had controls for volume, picture colour, contrast and a power on and off button. The TV screen was the front end of a long cathode ray tube enclosed by a panel of valves and capacitors. These were seldom hidden because the television set often needed to be repaired due to overheating and burnout of the components. Entirely unknown to most people was that the new computers used for missile detection at RAF Fylingdales were being

[146] The warhead's mission objectives are to: block access to the Tyne, destroy Tyne Dock facilities, destroy shipbuilding berths in North and South Shields and to destroy Dunlop rubber manufacturer in North Shields. The warhead would have the explosive yield of 2,500 kiloton and be carried by an R-12 rocket that would be deployed in the later stages of a nuclear exchange. The weapon is capable of flattening industrial concrete structures for a radius from point of impact of around 3 km. See chapter 4.

installed by the same company that made the family television, which, as we shall see later, are hampered by similar faults.[147]

Our television sat upon a purpose-built sandstone plinth that was part of a larger ranch-style fireplace which had been built around a flicker flame (log-effect electric fire). In front of the fireplace was a pine chest that had been bought second hand, stripped of paint, sanded and the natural wood had been varnished. Most evenings after school I would lean on the pine chest coffee table in the centre of the living room and make drawings in green biro on fanfold computer paper. In the drawings, I transcribed images from the early evening news. The news items followed a repeating pattern consisting of newsreader, missile, missiles, Reagan, Thatcher, protest, Parliament, mushroom cloud, newsreader. This repeating rhythm of images became part of the immersive tea-time nuclear war sensoria, from which I would make drawings that synthesised the TV images of Polaris and Trident missiles blasting out of the ocean, into underground complexes hidden in mountains or on the Moon, with spacecraft and astronauts engaged in futuristic nuclear space warfare (see Figures 3.3 and 3.4).

Down both side of the ream of computer paper were sprocket holes and at regular intervals there were perforations that created a natural fold together.[148] As I drew, the paper would lift from the ream. When I had finished a drawing, I would tear it away from the ream along the perforation as if it were an actual readout from a computer. Indeed, on one side of the paper there was actual computer code and data printed in black ink; however, this side was no use for drawing and was only used if I had run out of blank pages. I also had a large stockpile of punch cards that were long, narrow pieces of yellow card with a pink edge along the topside (Figure 3.6). I never used these to draw on because they were full of holes, so they were used as a backup paper stock.

---

[147] The National Archives, *AIR28/2473,* '540 Form April 1–30th MIP Upgrade'.

[148] Rachel Woodward and Chloe Barker also recount how this fanfold computer stationary was brought home from the workplace at the Bank of England, or West Hougham Transmitter to use as drawing paper.

Although, my younger brother would cut them up to make wearable items such as a computer wristwatch using staples, sticky tape or by weaving wool yarn through the punch holes.[149]

The fanfold paper and punch cards were given to us by our auntie who worked at the Department for Health and Social Security Computer Centre in Washington, Tyne and Wear.[150] The centre serviced many government departments and is still today a large data server for the Department of Work and Pensions and the MOD.[151] The punch cards and fanfold paper formed the material means of inputting and outputting information into and from the International Computer Limited (ICL) 2980 mainframe computers that were used at the DHSS Computer Centre. ICL was a British computer hardware, software and service company established in 1968 and dealing mainly in public sector contracts with the Post Office, Department for Health and Social Security and the MOD.[152] However, instead of building their mainframe computers anew, ICL would base the architecture of their computers on existing systems.[153] The 2980 was entirely based on the IBM 7090 mainframe computer that had been designed specifically in 1958 in response to the Sputnik Crisis, described in chapter 2, for operational use on NASA's Mercury Space Project and on USAF BMEWS projects, including RAF Fylingdales.[154]

---

[149] Paul also constructed a large computer out of a corrugated cardboard box, which he stood inside and fed the punch cards out of a slot to the refrain of chockablock, chockablock, chockablock.

[150] Emily Meritt, 'The Washington Development Corporation: Remembering Washington New Town', *Chronical Live,* (2015) <https://www.chroniclelive.co.uk/news/history/gallery/washington-development-corporation-remembering-washington-9088329> [accessed 21 November 2018].

[151] 'Durham House', *Wikimapia,* <http://wikimapia.org/1874279/Durham-House [accessed 21 November 2018].

[152] Centre for computing history, *International Computers Limited* <http://www.computinghistory.org.uk/det/8271/International-Computers-Ltd/> [accessed February 2019].

[153] The company was established by the Wilson Government in the "White Heat of Technology" to compete with IBM. Ibid.

[154] See chapter 2.

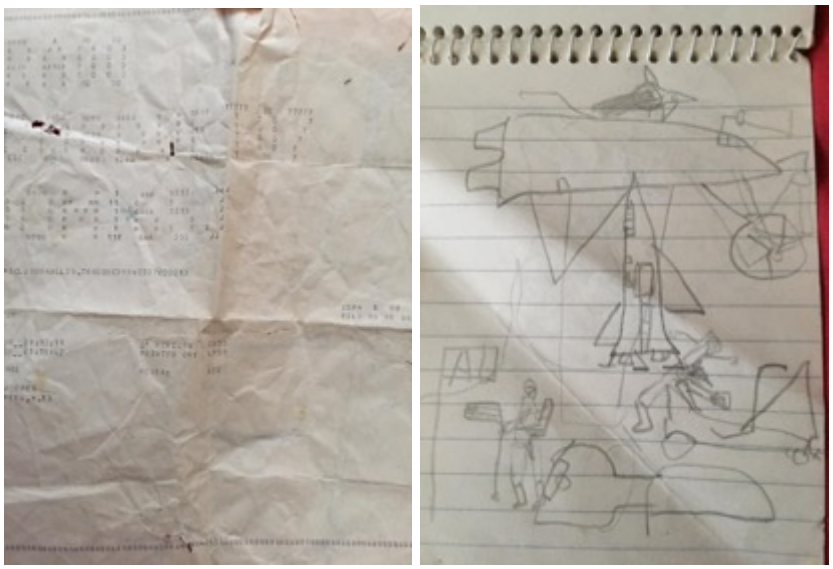

Figure 3.3 (Left) Fanfold drawing paper from Washington Computer Centre early 1980s

Figure 3.4 (Right) Michael Mulvihill *A drawing of space warfare* (1982 aged 9)

3.3.4 Fanfold Armageddon

Turning the virtual dial on the nuclear war assemblage to shift our social scale to a medium and large setting brings RAF Fylingdales into view; 86 kilometres away were the two duplexed IBM 7090s (seven-oh-nineties) known as the MIP form the centre of ballistic missile surveillance and warning.[155] The computers had been designed to provide impact data on inbound ballistic missiles; but, because of the increase in space activity since the launch of Sputnik, the 7090s also performed noise-to-signal discrimination for distinguishing the noise of day-to-day space activity from the signal of a potential inbound nuclear weapon – the same noise-to-signal discrimination that was devised by the Wohlstetters from art historian Meyer Schapiro's figure to ground.[156]

[155] RAF Fylingdales archive, [uncatalogued], 'BMEWS training material sub-course L1000-2 RCA GB' .

[156] See chapter 2.

To perform the noise-to-signal task, one 7090 computer was active while the other was inactive. This allowed continuous operation that enabled maintenance to be carried out on each machine when in inactive mode. The inactive 7090 also ran the satellite information processor (SIP) programme which was used for satellite tracking and provided information on the background noise of space activity, while the active IBM 7090 computer ran the BMEWS MIP programme for tracking the signal of threatening nuclear weapons. The computers received digital tracking data converted by a complex of machinery referred to as the data take-off (DTO) unit. The DTO took raw analogue signals from the three RCA AN/FPS-49 radar dishes and changed them into digital information through a component called the video range interpreter.[157] Each one of the 112 tonne dishes manoeuvred gracefully on pedestals within the Goodyear domes constructed from Buckminster Fuller's design.[158] Two out of the three radar dishes always operated in a scan mode. One dish surveyed the sky, going up and down along the vertical axis, while the other scanned its field of vision horizontally, going from side to side.

The 7090s both calculated trajectory and impact time of objects being scanned by the radar, which they compared with corresponding data stored on their magnetic tape memory banks in order to determine if a detected object was a possible threat. The active computer would then bring the third radar into operation to track the unidentified object. If the signal still did not compare with anything in both of the 7090s taped memory banks then three threat alerts were generated, one was sent via rearward tropospheric communications array to US operations in Cheyenne Mountain Colorado, another to UK at RAF Air Command in High Wycombe, and the third was sent to a colour-coded threat console for operation crew on duty in the Space Operations Room. If the crew confirmed the threat, then a higher-level command at RAF Air Command

[157] RAF Fylingdales archive, [uncatalogued], [DVD], 'The Unblinking Eye'.

[158] Roger JC Thomas, *Historic Building Report: RAF Fylingdales,* p.2.

would start initiating the UK's response, and signal the four-minute attack warning for the United Kingdom (see Figure 3.5).[159]

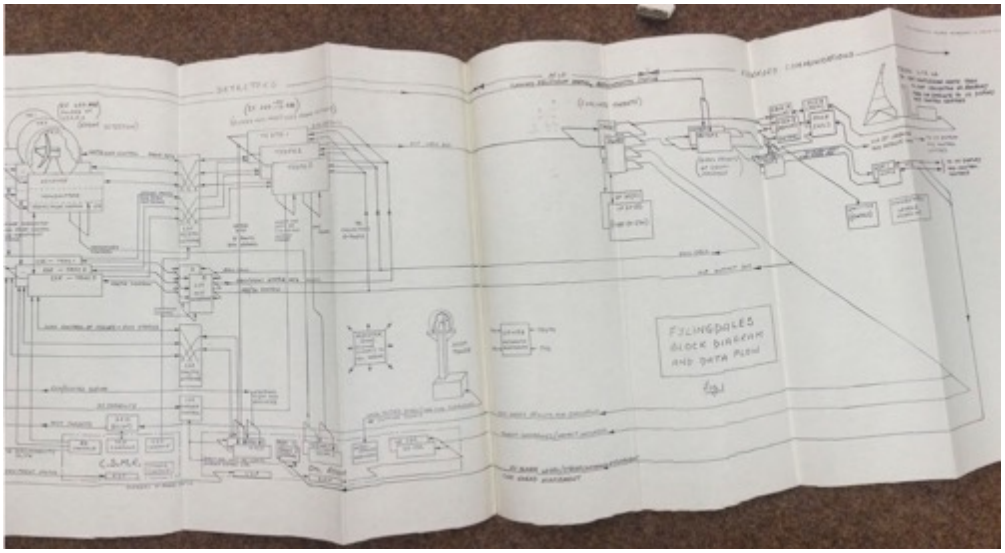

Figure 3.5 RAF Fylingdales block and data flow diagram

RAF Fylingdales had originally been designed for detection of IRBMs such as the Cuban Missile Crisis-era SS-4 and its 1970s successor the SS-20. As a result, the IRBM weapon profile became an assembled part of the MIP surveillance program known as the Missile Impact Predictor Operations Program (MIPOP).[160] The program could be updated through commands given, or new programs run, by punch cards. This was the same type of punch card that my brother used to make paper wrist intercoms. These programs were written in the programming language FORTRAN, which also ran on the ICL 2980 computers at the DHSS in Washington, and data produced as a result of operations was also kept in a large magnetic tape data bank. The programs and their

[159] Since writing this chapter, I have found new information as a result of working with English Heritage that shows the UK air attack warning originated from the situations display console in the operation room at RAF Fylingdales. The operator of the console connected directly through BT landlines to the director of the United Kingdom Monitoring and Warning Organisation at the Air Defence Operation Centre at the then RAF Strike Command, who would issue the four-minute warning from a blue device known as the WB1800, now a part of the English Heritage Cold War collection at Dover Castle.

[160] RAF Fylingdales archive, [uncatalogued]. 'BMEWS training material sub-course'.

data could be reused to construct various threat and non-threat situations for future surveillance tasks, and for constructing simulations for training radar crews. The simulations of attack situations were coded onto mylar tape and front ended into the computers from a tape reader situated in the DTO. Data from the 7090s' simulated near-future war was fed back to operators through an IBM 1401 printer (see Figure 4.1) on reams of fanfold paper similar to the stock used at the Washington Computer Centre, and onto which I also made drawings of future war (see Figure 3.7).[161]

During the time I made drawings in front of the family television in 1983, at RAF Fylingdales, the new emerging missile threat from the USSR, including the deployment of SS-20s, had finally outstripped the 7090s' capabilities to track a large-scale attack. So, the MIP 7090 computers at Fylingdales were being replaced by a Control Data Corp Cyber 170 mainframe computer that was project managed by ITT Federal Electric Corporation (FEC) – the same corporation that made the television in my family's living room. The company first connected the Cyber 170 mainframe to the DTO in February 1983 but, just like our television, the new system was prone to overheating and burning out.[162]

Neither my drawings of future war, nor the simulations of nuclear attack at RAF Fylingdales could, at the time, have been visible to each other. But these parallel accounts demonstrate Braidotti's notion of modulating patterns drawn across time and space – drawn from lines of becoming that overlap and fold back upon themselves. In the account presented, these lines were drawn by way of the DTO at RAF Fylingdales and constructed into future war by the MIPOP on punch cards, which were outputted on the fanfold readout paper (see Figure 3.6). The situation described at RAF Fylingdales in 1983 had unseen affinity with my drawings of possible nuclear war made as a child at home. There the missile threat was perceived via the television instead of the radar

[161] RAF Fylingdales archive, [uncatalogued], [DVD], 'The Unblinking Eye'.

[162] The National Archives, *AIR28/2473,* '540 Form'.

connected to the DTO and yet the construction of the future war was still actualised on the same fanfold paper. Both the RAF Fylingdales readout and the biro drawings made concrete the multi-scaled structuring affects of ICBMs and IRBMs armed with thermonuclear warheads. But Braidotti also points out that such materialisations are also drawn across time and space and arbitrarily intersect and coalesce to form new assemblages and creative variance or metamorphic transformations. These may even be the same ripples that produced the concept of the war machine and assemblage theory discussed in chapter 2, and Günther Anders' notion of the Promethean Gap discussed earlier.

Over the next few sections I show that Braidotti's ontological view of how realities emerge can be superimposed upon expanded notions of the drawing and artmaking processes. In doing so, I show that the artworks made for this PhD research actually and materially began as assemblages formed from experiences and technologies located in the War Crisis of 1983, but gradually coalesce through returns in my art practice in response to the post-Cold War era and the War on Terror.

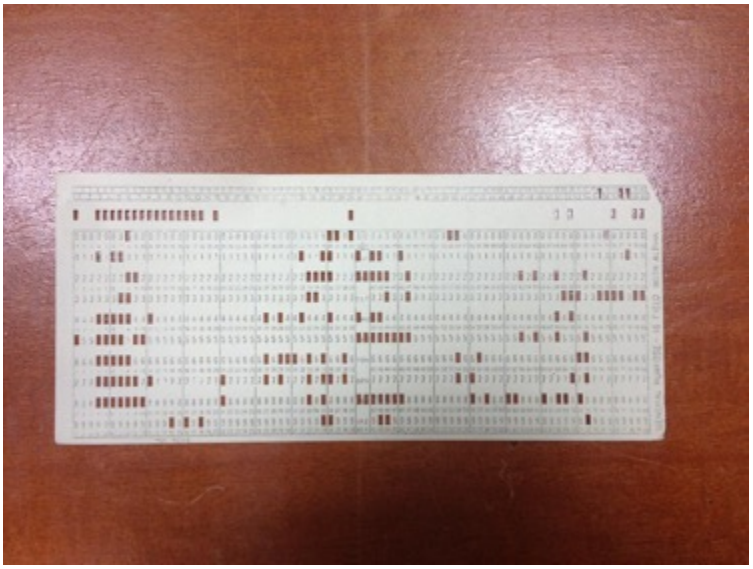

Figure 3.6 Punch card program used in one of RAF Fylingdales' IBM 7090 MIP mainframe computers

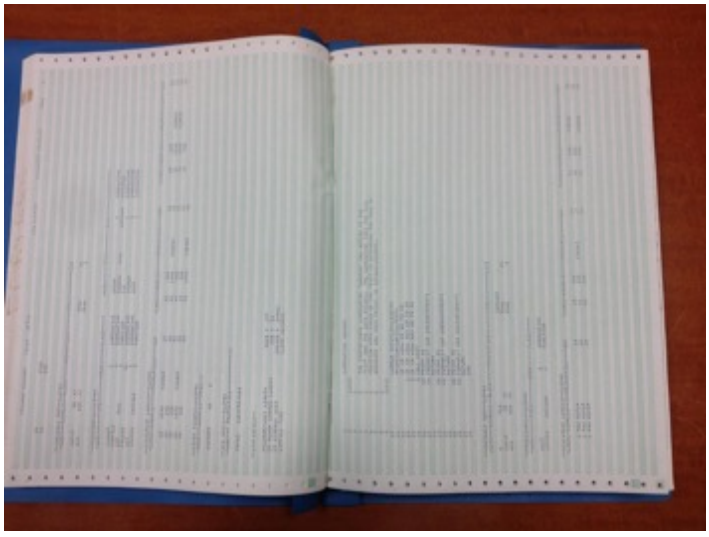

Figure 3.7 Fanfold computer printout showing program operation from one of RAF Fylingdales' IBM 7090 mainframe computers

3.4 PART III

So far, I have explained how an assemblage-theory-based approach to social analysis can unsettle ontologies based upon fixed meanings. This was done by retelling the story of *Joey the Mechanical Boy*, which showed how actual relationships between human and non-human entities, such as children and electric trams, were made invisible by symbolic representations of reality. I went on to explain how the implications of representational ontologies also masked actual and embodied geopolitical processes that are constantly interacting across social scales. I visited philosopher Rosi Braidotti's notion of patterns of becoming that are drawn as a result of activities and doings that span time and space. Out of these, it is possible to analyse the flows and structures of power to trace relationships between my formative drawing experience, operations of the MIP at RAF Fylingdales and the global Cold War in 1983. Over the next section, I explore the notion of becoming and doings as embodiments of artmaking and drawing processes in order to show that this offers a way of making assemblages and intensive flows of power visible.

3.4.1 Make without making: drawing and the war machine's creative variation

Anthropologist Tim Ingold asks, "what do drawing, writing, singing and storytelling have in common?" His answer is that they both follow a line, which is inscribed in relationships to a surface such as paper or parchment. However, Ingold goes on to explain that:

> the ways in which they were understood depended critically on whether the plain surface was compared to a landscape to be travelled or a space to be

colonized.[163]

For arts writer Jean Fisher, the space where drawing occurs is not two dimensional like a sheet of paper. Instead, similar to the way Braidotti conceives interconnecting becomings, she thinks that drawing should be thought of as a zone of spatial relationships where high and low, inside and outside, before and after do not exist.[164] Fisher invites us not to think of drawing as a discipline like painting, sculpture or installation – which presents a formalised world in its entirety, like a territory that has been mapped – but rather, as a practice that is undetermined and embedded, and which at times is difficult to grasp but, nevertheless, embodies the lived and iterative processes of experience. Fisher writes:

> Compared with a complete or installed artwork, the drawing as a "thing" tends to often appear insubstantial, lacking not only material weight but also intellectual authority – too "unfinished", too casual, or too obscure and isolated for us to follow its train of thought [...] So we may dismiss it with irritation; or we may despite ourselves be caught up in the very power of the non-signifiable that is its provocation and find ourselves in a unexpected space of imagination. To see drawing is in some sense to grasp [...] the continuous transformation process of thought itself.[165]

Fisher thinks of drawing in conceptual terms as a spatial, temporal and ongoing process that never settles on a meaning nor is bound to a two-dimensional territory such as a paperwork hung on a gallery wall. For Fisher, drawing is an actualisation of processes

---

[163] Tim Ingold, 'Trace, Thread and Surface', in *Lines: A brief history* (Oxon and New York: Routledge, 2016), p.40.

[164] Jean Fisher, 'On Drawing', in *The Stage of Drawing: Gesture and Act* eds. Catherine de Zegher and Avis Newman (London and New York: Tate Publishing and The Drawing Centre, New York, 2003) p.222.

[165] Ibid., p.218–219.

of becoming and creative variation. This description is easily relatable to Rosi Braidotti's notion of a becoming as matter being formed into new configurations through various activities and doings, and also the metamorphic transformations of the war machine discussed in chapter 2.

Fisher draws her own line of thought from the ideas of artist Paul Klee. Who explains that artmaking should never resolve into semblance; it should not be "something to be got over with" as a means to an end (as in a preparatory sketch) but rather should embody continual movement, action, activity and production.[166] This continual motion and production that forms matter into new configurations is articulated by artist Eva Hesse who expressed the desire "to make without making and to produce what is not yet known, thought, seen nor touched". Art historian Briony Fer describes how this desire materialises in Hesse's working process in her studio while making the sculptures *Untitled, 'Douglas Glass Case' 1968* (see Figure 3.8). This involved perpetually dismantling and remaking the artwork anew from bits and pieces lying around her studio. Fer describes that:

> There is a string of techniques – casting, moulding, embedding, puncturing, threading – that are used in various conjunctions. And there are any number of combinations of material – cheesecloth, wire mesh, latex, plaster, fibreglass – that sit side by side. The connections are both horizontal and vertical [...] [these make for a strange thing-scape] in which remnants of her process are kept and displayed and recycled.[167]

Hesse's approach to artmaking and her desire to make without making resonates with the way I wanted my own drawings to be thought of. Like the biro drawings I made as a

---

[166] Ibid.

[167] Briony Fer, 'Studio', in *The infinite line* (New Haven and London: Yale University Press, 2004), p.134.

child on fanfold paper, they emerge from processes that may be arbitrarily stabilised but are, nevertheless, uncompleted. I described this intention to Professor Helen Baker during an interview for the publication accompanying the exhibition we co-curated called *GRAPHITE* at Gallery North.[168] In the interview, I explained that I wanted the drawings to give the impression that they have formed as the result of a process of accumulation and that they seemed more like a found object or artefact.[169]

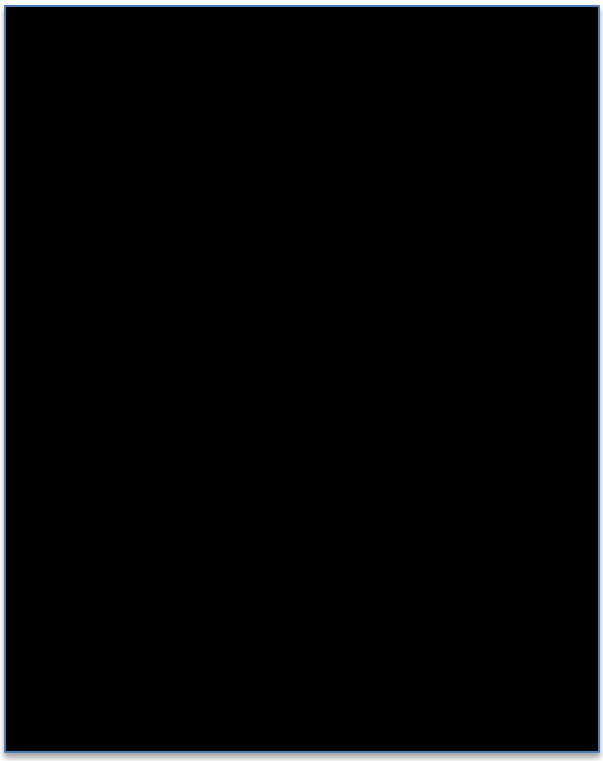

Figure 3.8 Eva Hesse *Untitled, Douglas Glass Case* (1968)

[168] Michael Mulvihill, interviewed by Helen Baker, *GRAPHITE,* eds. Helen Baker, Joe Woodhouse and Michael Mulvihill, (Newcastle: Northumbria University Press, 2011), p.?.

[169] Ibid.

3.4.2 Radioactive charcoal

In this interview, I refer to a body of artwork called *The End of History* (2008), made in graphite on paper, which I had produced during a residency at InCUBATE in Chicago during the summer of 2008.[170] The title is a reference to Francis Fukuyama's invocation of Hegel's concept of the end of history, following the collapse of the Berlin Wall in 1989. Art historian Yves Alain Bois also related the concept of the end of history to the modernist notion of the "Last Painting". So, I wondered whether drawing could be a way of holding these ideas in relational tension with my own concrete experience of an imminent end of history through nuclear warfare that I described earlier in this chapter.[171]

In a later interview with Jake Nussbaum and Richard Fleming for Clocktower Radio, during the 4th Ghetto Biennale (2015) held in Haiti,[172] I described how drawing had become appealing as a very simple way of making artwork following President George W Bush's inauguration in 2001. Early in his presidency he re-invoked the Reagan era commitment to developing a new generation of nuclear weapons and a new Strategic Defense Initiative, known as Son of Star Wars.[173] These policy commitments were announced alongside attempts to situate nuclear superpower China as the new number one menace to the free world.[174] Things and events that I thought should have been of

---

[170] The Obama leadership bid electrified Chicago during this summer.

[171] I had been interested in modernist ends such as the end of history and the end of painting as discussed by art historian Yves Alain Bois in *Painting: The Task of Mourning,* (1986), annotation by Harper Montgomery, *The Department of Art History, Chicago University,* (2004) <http://csmt.uchicago.edu/annotations/boispainting.htm> [accessed 19 February 2019].

[172] Michael Mulvihill, interviewed by Jake Nussbaum and Richard Fleming Radyo Shak at *4th Ghetto Biennale* [Radio Broadcast], Clock Tower Radio, December 2015.

[173] Ed Vulliamy, 'Bush plans space bomber', *The Guardian,* 29 June 2001, <https://www.theguardian.com/world/2001/jul/29/usa.georgebush> [accessed 21 November 2018].

[174] Derek Brown, 'The US–China spy plane row', *The Guardian* 4 April 2001, <https://www.theguardian.com/world/2001/apr/04/china.usa> [accessed 21 November 2018].

the past re-emerged, and prompted me to consider the question: from what do you make art following a nuclear war? Richard Fleming, speaking for Clocktower Radio, suggested radioactive charcoal.[175]

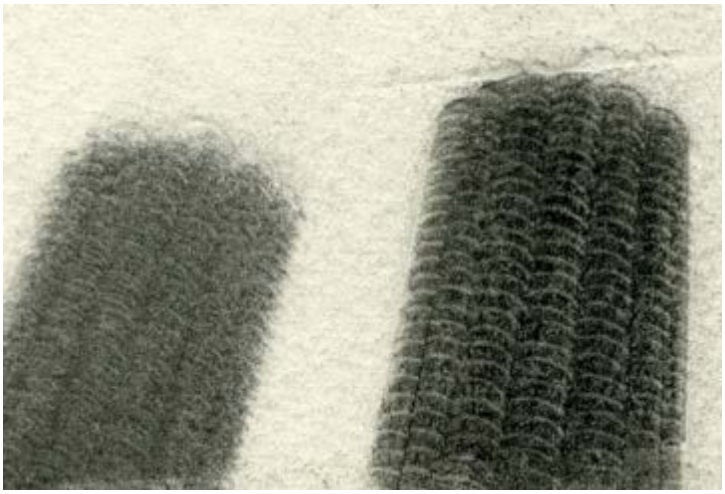

Figure 3.9 Michael Mulvihill *The End of History (Chicago 11)* (2008–2012)

The *End of History* series of drawings were made using graphite with a high carbon content, and based upon photographs I had taken during numerous bike rides around Chicago. Many of the drawings feature the Mies van der Rohe skyscrapers that populate the downtown area, including the Daley Centre where the *Chicago Picasso* (1967) stands. Back in the studio I would used the photographs as starting points to make the artworks. This involved using a variety of drawing techniques that included tracing and building perspective structures, which were inscribed onto small rectangles of paper with torn edges using a very sharp and very hard graphite pencil.

[175] Closing comment made at the conclusion of radio interview with Richard Fleming. Michael Mulvihill, interviewed by Jake Nussbaum and Richard Fleming

Afterwards, a 9B graphite stick was used to produce a dense black surface that was polished to a high shine, but it is also impossible to completely rub away, even if the drawing surface is sanded. By utilising the material capacities of the graphite, the drawing was formed into the paper through a continual process of application and rubbing away. Through this process I began to think of the artwork that I was making as an artefact emerging from a process similar to fossilisation. So, the drawing has the appearance of a piece of debris or remnant. These processes speak to Klee's notion, described earlier by Fisher, that the drawing was not about something represented but rather what the artwork actually is, and is actualised through the process of making. So for me, like Hesse, it became important that all the traces of the debris from the drawings' production, such as fingerprints or remnants of masking were left evident, which also suggested the possibility that the drawing was still subject to ongoing processes of becoming, beyond the authoring hand of the artist.[176]

3.5 PART IV

3.5.1 The body without organs: Antonin Artaud

This approach to artmaking as artefact and embodiment speaks to the letters produced by artist, poet and theatre producer Antonin Artaud. He was being treated for schizophrenia at Rodez Psychiatric Hospital, France, shortly before his death in 1947. The letters comprised mostly of drawings in the form of diagrams and gestures produced by burning, puncturing, smearing ink and gouache on the pages. Artaud felt words were inadequate to express his experience of treatment in Rodez because language consists of conventions from somebody else's voice.[177] For this reason,

[176] Michael Mulvihill, interviewed by Helen Baker, *GRAPHITE,* unedited from my own archive.

[177] Margit Rowell, 'Images of Cruelty: The Drawings of Antonin Artaud', in *Antonin Artaud: Works of Paper* ed. Margit Rowell (New York: MoMA, 1996), p.13.

Artaud's work had significant influence on aspects of both Foucault and Deleuze and Guattari's philosophy, particularly in their critique of psychoanalytical symbolisation of the body, discussed at the beginning of this chapter. Rather than Artaud's drawings being containers for representation of the unconscious, they are in Artaud's words:

> not drawings but documents. [...] that I have made by living my strokes, not with the hand only but with the rasping of the breath of my trachea and the teeth of my mastication.[178]

Artaud felt that the actual processes of living, breathing and experience of life lived were his drawing practice. Through his drawing he made visible what Braidotti may view as his own body caught in the complex material relationships of power exercised by the institutions of psychiatry. But Artaud was also acutely aware of how language and knowledge actually capture bodies in structures of power by processes of stabilisations and meaning making. Significant to Deleuze, Guattari and Foucault's critiques of state power and operations of biopolitical control, through processes of was Artaud's concept of the body without organs or, as Artaud wrote, the BwO.

This concenpt is intimately related to the war machine (see Figure 3.10).[179] In this final section of this chapter, I would like to attempt to synthesise the critique of psychoanalysis and other systems of representational knowledge, with the notion of becoming and artmaking through Gilles Deleuze, Félix Guattari and Michel Foucault's interest in the poet Artaud. Who thought of the body without organs (BwO) as a

---

[178] Ibid. p.14.

[179] Deleuze takes this concept from Artaud's radio play *to have done with the judgement of god*: When you will have made him a body without organs, then you will have delivered him from all his automatic reactions, and restored him to his true freedom. Antonin Artaud, 'To Have Done with the Judgment of God' in Susan Sontag, ed. *Antonin Artaud: Selected Writings*. (Berkeley, CA: University of California Press, 1976), p.571.

decodified, deterritorialised zone through which lines of becoming assemble into new spatial and temporal arrangements. For Deleuze and Guattari, BwOs are produced by activities of the artist, the creative process and the operation of the war machine alike.

Figure 3.10 Antonin Artaud *La projection du véritable corps* (18th November 1946)

3.5.2 Eviscerated Flesh

Deleuze explores the concept of BwO in his study of the painter Francis Bacon. For Deleuze, the painter's particular manner of applying paint to a surface seemed to contribute to a sense that the painter's models flesh was being eviscerated. Deleuze sees, in Bacon's handling of paint, an emergent zone of indiscernibility, deterritorialisation and metamorphic transformation. That through wiping, smearing and scrubbing paint away from the canvas, a BwO is produced in the disorganised zones of paint, which Deleuze observes are irreducible to any form. Deleuze states:

> In place of formal correspondences, what Bacon's painting constitutes is a *zone of indiscernibility or undecidability* between man and animal (see Figure 3.11).[180]

Just like the warrior-horse assemblage described in the previous chapter, categories of knowledge are collapsed by the activity of the painting process.[181] Daniella Voss explains that for Deleuze it is through the sensation produced by the painting process that Bacon is able to:

> capture in his paintings […] the *invisible and intensive forces*, those that act upon the body and climb through its flesh.

For Deleuze, drawing or artmaking makes visible and visceral the forces of becoming that are at work assembling the world. These forces, philosopher Friedrich Nietzsche observed, were completely invisible to analysis bound to the established epistemological ordering.[182] For this reason Nietzsche, as well as Deleuze, thought that art is a practice possesses unique critical abilities, whereby critique is actualised in assemblages of affects, and becomings, which make visible, within materials such as paint or graphite, the invisible forces that are at work producing the world. But these forces also evade articulation by predetermined language that reproduces preceding and fixed knowledge formations and so peer through processes that are constantly making the world anew.

---

[180] Daniela Voss, 'The philosophical concepts of meat and flesh: Deleuze and Merleau-Ponty', *Parrhesia,* no. 18, (2013), pp.113–124.

[181] Ibid.

[182] Felicity J Colman, 'Art', in *The Deleuze Dictionary,* (Edinburgh: Edinburgh University Press, 2010).

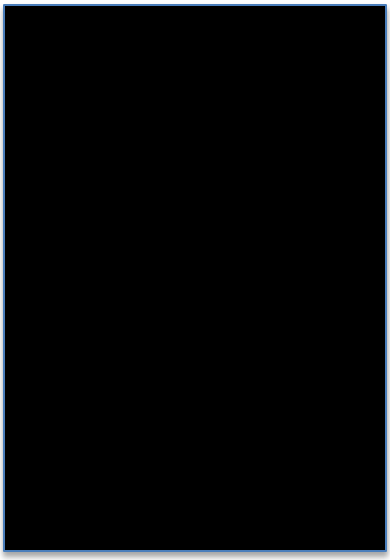

Figure 3.11 Francis Bacon *Dog* (1952)

3.5.3 The gaze of oblivion

Similarly, for Fisher, drawing and artmaking is a practice that derives its critical force through what she terms as the gaze of “oblivion”, because the affectations it produces disrupt established structures of visual language and interpretation. Fisher elaborates that this comes with the implication that artists themselves are also like a spatial and temporal zone, or BwO, through which multiple experiences are assembled and actualised as artwork. Fisher explains that:

> Any individual utterance is always to an extent a collective enunciation [...] If there is a uniqueness in the artist expression it is in the particular assemblages he or she consciously and unconsciously constructs in the selection and organisation of sources.[183]

[183] Jean Fisher ‘On Drawing’

These sources are like Artaud's documents, or Joey's drawings of trams, or my biro drawings on fanfold paper. They are composed of actual lived experiences, things and places that are dispersed in time, but which are assembled along intersecting lines of becoming that produce new kinds of worlds. For Fisher:

> Drawing becomes the mechanism that [...] gives order to the only dimension in which desire moves: space and time [...] The descendent line is that which traces the entire body of the artist.

3.5.4 The Four-Minute Warning Drawing Assemblage

By retelling a story about my own formative drawing experiences, and placing it within the context of other artists who have understood their art work as processes of becoming within assemblages of affect, I have attempted to show that drawing is a way of accessing what Braidotti described earlier as the:

> complex materiality of bodies immersed in social relations of power.[184]

But, as Nietzsche pointed out, these structures are invisible to normal epistemological organisation such as psychoanalysis because they are composed of actual and productive assemblages of affects and interactions that are always remaking themselves. This story has shown how my small-scale personal world of home and family formed intricate spatial and temporal social patterns of becoming that intersected with large-scale assemblages formed by political and military preparation for nuclear war. The assemblage of my childhood experiences of the emerging nuclear conflict of

---

[184] Rosi Braidotti, interviewed by Rick Dolphijn and Iris van der Tuin, p.30.

1983 was composed of my family ITT television, the early evening news, the drawings on fanfold paper of nuclear and space warfare, green biro and the living room of my family home. This assemblage could be superimposed upon the hardware, spatial configuration, and operations of the IBM 7090 MIP computer at RAF Fylingdales which, during training simulation, was also producing lines of data outputted on the same fanfold continuous stationery on which I made my drawings, and these readouts also depicted possible future nuclear and space warfare.

This construction of reality is not a subjective representation of Freudian childhood trauma. Instead it should be thought of as an actualisation of complex assemblages of things and experiences along spatial and temporal lines of becoming that Rosi Braidotti explains:

> does not place the thinking subject outside history or time [...]. A location is an embedded and embodied memory: it is a set of counter memories, which are activated by the resisting thinker against the grain of dominant representations of subjectivity. A location is a materialist temporal and spatial site of co-production of the subject, and thus anything but an instance of relativism.[185]

Jean Fisher shows that drawing is the actualisation of becomings that are assembled through a spatial and temporal zone of indeterminacy. In the passage Fisher positions the artist as this temporal zone of indeterminacy, or rather an embodied BwO. Deleuze thought that processes of art making could be critique whose analytic value consists of the ability to make visible these processes of affect and becoming. Processes that would otherwise be invisible to conventional modes of representation and meaning making. For Deleuze and Fisher it is within the BwO that seemingly disparate lines of

[185] Ibid.

historic trajectories intersect. And peculiarly in describing the BwO Deleuze also evokes Buckminister Fuller's geodesic domes at RAF Fylingdales:

> The body without organs […] is crisscrossed with axes and thresholds, with latitudes and longitudes and geodesic lines, traversed by gradients marking the transitions and the becomings.[186]

Across and through space and time we can see patterns of becoming being drawn between my childhood living room and the operational centre and geodesic lines of the four-minute warning at RAF Fylingdales. Along these intersecting lines of becoming, both places become deterritorialised to produce an emerging assemblage composed of nuclear weapons, military and state machinery, lived experiences of nuclear threat, formal and informal drawing experiences, and the actual architecture of the four-minute warning, which encompasses the IBM 7090, fanfold computer paper and green biros. This assemblage could be named the *Four-Minute Warning Drawing Machine* and in the following chapters I explain how this machine has been crafted from lines of becoming that intersect with childhood experiences of the nuclear deterrent, and those gleaned out of the RAF Fylingdales archive. I explain that these encounters have not produced an artwork in the conventional sense for exhibition in a museum or gallery; rather, they have resulted in a hybrid entity composed of artwork parts, memory and military hardware, ready for deployment on a mission.

[186] Gilles Deleuze and Félix Guattari, *Anti-Oedipus,* p.19.

Chapter 4: The Art of Thermonuclear War

4.1 *Jenny, Reggie, Tony and Cleo*

RAF Fylingdales documents weapon system status, Space Track and missile events, and any other occurrences at the BMEWS in what are known as the 540 operational forms. A reporting document dated 9th February 2018 written for RAF Fylingdales concerning outcomes of this thesis reads:

> Jenny, Reggie, Tony and Cleo sound like characters from 1970s British television in programmes such as *The Good Life*, or Mike Leigh's *Abigail's Party*. Instead they were the code names given to the primary and secondary explosive components of the UK's version of Polaris thermonuclear warhead known as ET.317.[187]

> This exhibition is a part of !**DRAWING**, a programme of exhibitions and events across the North East of England which aims to examine and celebrate drawing in art and design and also in the everyday areas of science, technology and engineering. !**DRAWING** is a collaboration between the region's universities, galleries, museums and other venues and organisations.

> Michael Mulvihill is an artist currently involved in practice-led research with the Art and Humanities Research Council Northern Bridge Doctoral Training Partnership with the Department of Fine Art in the School of Arts and Culture at Newcastle University. He uses drawing, sculpture and moving image to explore the seemingly incongruous imprint of nuclear weapons upon the way our lives

[187] Advanced nuclear weapons are composed of main two parts, a fission primary and a fusion secondary and are commonly thought to be based on a device known as the Teller–Ulam invention.

> are lived. The artworks in this exhibition draw trajectories between material and methods that are both used in art making, and nuclear weapon production. By doing so, new arrangements are formed that destabilise “common-sense” notions of how our world is organised.[188]

In this chapter I look at three tacit epistemological encounters that were important for developing the artworks in *Jenny, Reggie, Tony and Cleo*, which are further discussed in the following chapter. The first encounter involved developing an understanding of nuclear weapons as social assemblages, produced by skills that are transferable because of their capacity to be plugged into other social assemblages. This first describes the workings of a thermonuclear weapon and depicts their possible use against Tyneside in 1980s. Then this encounter follows Donald MacKenzie’s interviews with nuclear weapons makers who see their work as more art than science. Next is a visualisation of their work used in combat to show that battlefields are extended social assemblages, which leads to the second encounter, which looks at current art historical research that is demonstrating how the practices of artmaking and of warfare are, in many ways, interchangeable. Drawing upon examples of artist and their artwork being used in combat throughout modern history, the third encounter is explored through the story of my reconnection with a friend from art school, who pursued a military career in the Royal Marines and with the North Atlantic Treaty Organisation (NATO), with whom I explored how drawing skills became part of his battlefield practice.

4.2 First epistemological encounter: the art of nuclear war

Jenny and Cleo are both types of small implosion fission bombs, similar to the Fat Man plutonium bomb that was used against Nagasaki during WWII, and are known as

[188] Visibility of artist in residence in 540 reports emerged from a conversation with Flt Richard Weeks, 17th May 2017, RAF Fylingdales

primaries. They are used to ignite the secondary Reggie or Tony devices in the UK's thermonuclear weapon. Jenny is likely to be composed of a plutonium core that is surrounded by a tamper made from uranium 238 (U238). This assemblage in nuclear weapon design is known as a pit. The pit is enclosed by a high explosive (HE) shell which, when detonated by an electric charge, compresses the pit to a dense state called criticality, which then produces a rich environment of excited neutrons. These are absorbed by the plutonium atoms that then become unstable and split apart, which in turn frees more neutrons causing a cascading chain reaction known as fission.

Reggie or Tony were the main explosive components of the UK's thermonuclear weapons. They were likely to consist of a uranium vessel containing hydrogen fusion fuel made of lithium-6 deuteride, and a plutonium tube known as the "sparkplug". The energy that is released from the Jenny or Cleo primary as X-rays is transferred to the secondary through an intermediate material codenamed FOGBANK in W76, W88 and W80 warheads, but which could have been a polystyrene like material in the ET.317 design.[189] The material becomes a superhot plasma that compresses Reggie or Tony composed of the uranium vessel along with the fusion fuel and the plutonium spark plug. The spark plug undergoes criticality, releasing neutrons, which raises the temperature in the secondary to over 100,000,000 °C, causing the lithium-6 deuteride atoms to fuse and become tritium atoms, which in turn frees more neutrons.

[189] In w76, w80 and w88 warhead designs it is speculated that the intermediate material could be a kind of aerogel, which in earlier weapon designs such as the Polaris ET-317 may have been a polystyrene. The FOGBANK material, or polystyrene, is thought to be transformed into superhot plasma by the exploding primary. Jeffrey Lewis, 'FOGBANK', *Arms Control Wonk,* 7 March 2008, <https://www.armscontrolwonk.com/archive/201814/fogbank/> [accessed 23 November 2018] and Carey Sublette, '4.4 Elements of Thermonuclear Weapons Design', 20 February 1999, <http://nuclearweaponarchive.org/Nwfaq/Nfaq4-4.html#Nfaq4.4.4> [accessed 23 November 2018].

Both the primary and secondary assemblies are contained within a radiation case that is usually made of steel but can be varied depending on the weapon's mission.[190] The radiation case acts as a propagator for the neutrons and X-rays being produced by the nuclear interactions between the primary and secondary until Reggie or Tony ignite. The fusion stage ignition releases a thousand times more energy than the atomic bomb fission primary. The energy released as X-rays are absorbed by the atmosphere surrounding the weapon, producing a fireball and explosion.

All advanced thermonuclear weapons use a variation of a staged device composed of a fission primary like Jenny or Cleo, and fusion secondary like Reggie or Tony. They owe their conceptual lineage to the Teller–Ulam device invented by physicists Edward Teller and Stanislav Ulam. The device underwent a first weaponised test on 1st March 1954 in the South Pacific on Bikini Atoll in the Marshall Islands. The test device was known as the Shrimp and upon ignition it caused an explosion that formed a fireball 7.2 km across within one second, which was visible 402 miles away on Kwajalein Atoll. The fireball produced a mushroom cloud that rose at a speed of 870 km per hour and reached a height of 14.32 km in 60 seconds. Its TNT explosive equivalent yield was 15 megatons – five times the energy expended during World War II by all of the weapons of all the belligerents.

Despite the Shrimp being much smaller than its experimental predecessor, Mike, which looked more like a section of a chemical refinery than a bomb. Shrimp was still a large device, meaning that subsequent thermonuclear weapons, such as the 25-megaton B41 bomb, could only be delivered onto their targets by aircraft such as the Boeing B-52 Stratofortress.[191] However, through improvements in plutonium pit design, that

---

[190] Jacketing the secondary with chrome instead of uranium, or reducing the size of the spark plug in the fusion fuel component will produce neutron bomb effects. George Kistiakowsky, 'The folly of the neutron bomb', *Bulletin of the Atomic Scientists*, (Sep 1978) 34(27).

[191] The large yield was used like a hammer for destroying hardened and subterranean command bunkers, by crushing the post with seismic shock. The equivalent weapon today is the B61-11(12) that

incorporated fusion boosting techniques (to be discussed below), primaries could be made smaller and weigh less for the same or increased energy yield at a vastly lower cost.[192] As explained in chapter 2, this meant bombs could be made much smaller and lighter, allowing them to be fixed onto intercontinental ballistic missiles (ICBMs) as warheads that could be dropped from outer space onto targets anywhere on Earth.[193] As described in chapter 3, by the 1980s, the Soviet Union had deployed SS-20 IRBMs that had the capacity to eliminate NATO tactical and strategic military structures with very little warning. In response, the Western Allies deployed Pershing II missiles and ground-launch cruise missiles (GLCMs) in Europe to menace Soviet military command structures. These missiles form a body of weapons systems known as intermediate nuclear forces (INFs) that give each belligerent the theoretical capacity to swiftly decapitate their opponents military strategic structures. As discussed in chapter 3, the INF systems greatly contributed to increased mutual mistrust between the NATO Allies and the Warsaw Pact, which made the deterrent assemblages extremely sensitive to political or military miscalculation and increased the risk of nuclear war.

4.2.1 Stan Openshaw's model of nuclear war on Tyneside

In 1983, during the time of INF deployment in Europe, an IBM 370/168 mainframe computer ran a virtual nuclear attack scenario on the UK. The attack was devised by computational geographer Stan Openshaw with the help of Terry Ratcliffe at Northumbrian Universities Multiple Access Computer (NUMAC) based in Claremont

---

has very low yield but is ground-penetrating and possess greater precision. Hans M Kristensen, 'Video Shows Earth-Penetrating Capacities of the B61-12 Nuclear Bomb' *Federation of American Scientists,* 14 January 2016, <https://fas.org/blogs/security/2016/01/b61-12_earth-penetration/> [accessed 23 November 2018].

[192] Availability of plutonium and uranium and atomic weight limit how many weapons could be produced and delivered. Furthermore, hydrogen is the most abundant chemical element in the universe, therefore, the amount and size of the weapons produced are limitless. Fred Kaplan, *Wizards of Armageddon,* (1983).

[193] Space meant in the sense of not on Earth. Fraser MacDonald's, 'Anti-*Astropolitik* – outer space and the orbit of geography', *Progress in Human Geography,* 31(5) (2007), pp.592–615.

Tower, Newcastle University.[194] Just like the MIP at RAF Fylingdales, the attack simulation was outputted through the computer lab's IBM 1401-N1 line printer. The data produced by the IBM 370/168 predicted that a Soviet raid against Tyneside would involve several weapons, each performing specific missions against military and economic capacities in the region.[195]

Openshaw's model makes assumptions regarding the number and characteristics of the nuclear weapons used in the attack. These assumptions were based upon evidence available at the time about how the Soviet Union plan to fight a nuclear war, should one break out.[196] The model also makes use of 1980s trends in nuclear weaponry and deployment. The characteristics of the military, industrial and civilian targets in the United Kingdom were captured to a high resolution.[197] This was the first time that a nuclear attack upon an entire nation had been modelled, and such was the detail of the models that they were used as the basis for Barry Hines and Mick Jackson's portrait of nuclear war in Sheffield in their BBC drama *Threads* (1984). The following depiction of nuclear combat in North Yorkshire and Tyneside uses the same data, and it should be assumed that events are happening simultaneously to those depicted in *Threads*. Both scenarios start with a single weapon detonating high above the North Sea at 8.35 am, resulting in the destruction of communication and electrical power networks across the UK and Western Europe. The following description speculates that the weapon is delivered by an SLBM fired from a Soviet submarine that has managed to evade

---

[194] Michigan Terminal System that involved sharing the mainframe computer with Newcastle Polytechnic and Durham University. Established in 1957, the partnership continued until 1989. Jeff Ogden, 'NUMAC Northumbrian Universities Multiple Access Computer, UK', *Michigan Terminal System Archive,* (2012) <http://archive.michigan-terminal-system.org/discussions/how-did-sites-learn-about-and-make-the-decision-to-use-mts/3numac> [accessed 23 November 2018].

[195] Stan Openshaw, Philip Steadman and Owen Greene, 'Soviet Weapons and their Targets', chap 4 in *Doomsday: Britain after Nuclear Attack* (Oxford: Basil Blackwell, 1983), pp.58–65.

[196] The Soviet plan was to use nuclear weapons early and without restraint. Ibid.

[197] Ibid. p.66.

detection and sneak close to the North Yorkshire Coast. This would have drastically compressed the time for early warning of a nuclear attack to only a few seconds.[198]

Figure 4.1 (Left) IBM 1401-N1 line printer being repaired at Newcastle University[199]

Figure 4.2 (Right) Terry Ratcliffe operating IBM 370/168[200]

4.2.2 Nuclear warfare on the north-east coast

The scenario begins at 8.34 am when two of the three tracking radars at RAF Fylingdales detect the signal of the SLBM shortly after breaking the surface of the sea of the North Yorkshire Coast. The MIP brings the third tracking radar immediately to bear in order to obtain confirmation of a hostile signal. Confirmation is given by crews in the Space Operations Room at RAF Fylingdales just as the weapon explodes in space, high above the North Sea at 8.35 am. The explosion produces the energy pulse that destroys military and civilian communication networks, as well as producing an

[198]Conversation at RAF Fylingdales, August 2017.

[199] 'Old photographs of the Newcastle University Computing Service', <http://moca.ncl.ac.uk/oldpics/people.htm> [accessed 23 November 2018].

[200] 'Terry Ratcliffe seated at the 370/168 Main Operators Console' *40 Years of Computing at Newcastle – IBM System 370 Model 168,* <http://history.cs.ncl.ac.uk/anniversaries/40th/images/ibm370_1682/print02.html> [accessed 23 November 2018].

expanding radiation bloom that blinds the radars at RAF Fylingdales.[201] The bloom gives cover for the Soviet strategic forces to launch a massive missile barrage, largely undetected, against targets down the eastern seaboard of the United States, including New York City, and across the entire United Kingdom. With the loss of radar capacity at RAF Fylingdales, and fearing heavy losses to strategic military forces, the US initiates a massive retaliatory nuclear strike against the Soviet Union. The Soviet vessel has also attacked NATO forces across the North Sea region. Multiple nuclear detonations have been reported near several UK military sites, including Polaris nuclear forces at HMNB Clyde, and command infrastructure at RAF High Wycombe and Joint Forces Command, Northwood. Fighting with nuclear weapons has broken out across and above the northern hemisphere of the Earth. At 8.38 am, the first missiles arrive on Tyneside.

Figure 4.3 Screen capture from Barry Hines and Mick Jackson's BBC drama *Threads* (1984)

Openshaw's data speculates that weapons assigned to the Tyneside raid may consist of three 150 kiloton warheads mounted on SS-20 IRBMs launched from central Russia. The weapons are used against the strategic bomber-capable runways at Newcastle Airport and the Albemarle Barracks close to Matfen in Northumberland (see Figure 4.5). The third SS-20 warhead strikes a near hit on the Regional Seat of Government Bunker

[201] 'BMD 101', *Arms Control Wonk Podcast* [podcast], 24 March 2017.

at Hexham, destroying the town and setting fire to the surrounding pine forests.[202] The attack is followed by a raid using two Cuban Missile Crisis-era SS-4 IRBMs that are launched from Eastern Europe. The missiles are the same as those portrayed in Deimantas Narkevičius' *The Dud Effect* (2008), in which retired Missileer Evgeny Terentiev re-enacts the launch sequence of an SS-4 IRBM siloed in Soviet Lithuania (see Figure 4.4).[203] Each of the inbound missiles carries a single 2,500 kiloton warhead aimed at wrecking the socioeconomic infrastructure of Tyneside along with the region's ability to participate further in the war.[204]

Figure 4.4 Deimantas Narkevičius' still from The Dud Effect (2008) showing an SS-4 IRBM on a mobile launcher with Missileer Evgeny Terentiev

The first of the two weapons overshoots its intended aim point 1 km above Newcastle upon Tyne's Civic Centre and ignites over Newcastle University. A fireball as hot as the

[202] Openshaw points out that there is capacity in the Russian strategic forces to assign a second SS-20 in case the first missile malfunctioned. Stan Openshaw, Philip Steadman and Owen Greene, 'Soviet Weapons and their Targets', chap 4 in *Doomsday,* p.69.

[203] Deimantas Narkevičius, 'The Dud Effect' *LUX* <https://lux.org.uk/work/the-dud-effect> [accessed 23 November 2018].

[204] Openshaw on Russian military doctrine in the 1980s. Stan Openshaw, Philip Steadman and Owen Greene, 'Nuclear Strategies', chap 2 in *Doomsday,* p.15.

centre of the Sun engulfs the entire city centre.[205] The blast from the resulting explosion flattens all built structures out towards Wallsend 5 km away to the east, and Swalwell to the west. The blast wave also destroys industry used to conduct warfare including Vickers tank factory at Scotswood, the Swan Hunters Naval Shipyards at High Walker and Marconi Radar Systems in Bill Quay.

The second warhead explodes in the River Tyne, square centre between the ferry landings at North and South Shields (see Figures 4.5, 4.6 and 4.7). The explosion produces a crater with walls that entirely block access to the river, thereby denying warship repair and supply. Tyne Dock, North East Rubber Company, Plessey Electronics, the super colliery at Westoe and the coal loading staithes, which supply Mill Bank power station in London (now Tate Modern) are flashed out of existence.[206] Major chemical works and national fuel storage facilities at Jarrow and Percy Main (3.5 km) are also completely destroyed, along with central government administration at Longbenton (9.5 km away from detonation) and other structures that support the UK's capacity to conduct war and to recover after hostilities.[207]

The second weapon flattens all residential structures as far west as Heaton (an eastern suburb of Newcastle 10 km away). A tidal surge has also wrecked industry along the banks of the Tyne including shipbuilding berths for the Royal Navy's Type 42 Destroyer. The fireball has transformed my school, Hadrian County Junior School, along with everyone and everything in North and South Shields into superhot plasma.[208] My family

---

[205] 100,000,000 °C. 'Effects of Nuclear Weapons' <http://www.atomicarchive.com/Effects/effects7.shtml> [accessed 18 February 2019].

[206] Bottleneck industry, defence electronics and energy supply are high-value targets in strategic attack plans. Stan Openshaw, Philip Steadman and Owen Greene, 'Soviet Weapons and their Targets', chap 4 in *Doomsday,* p.69.

[207] Alex Wellerstein, 'Nukemap 2.6', *The Nuclear Secrecy Blog* <https://nuclearsecrecy.com/nukemap/> [accessed 23 November 2018].

[208] Stan Openshaw, Philip Steadman and Owen Greene, 'Estimating the Effects of an Attack', chap 6 in *Doomsday: Britain after Nuclear Attack* (Oxford: Basil Blackwell, 1983), pp.109–111.

home is 650 m from the weapon's target point and no longer exists. Anyone exposed to the energy flashes from the weapons used in the raid as far out as Blyth, 15 km to the North, to Seaham in the South, or Consett and Stamfordham to the west, will suffer fatal third-degree burns. Like the attack simulation run at RAF Fylingdales, Openshaw's printed readout emerges from an IBM 1401 printer in the computer lab at Newcastle University. The printout shows that the attack would result in 96.25% fatalities among the metropolitan population. Of the survivors, 98% will succumb to their injuries over the next 24 hours.

Openshaw's models were produced using data based upon nuclear weapons deployed during the time of nuclear weapon build-up of 1983 discussed in the last chapter. The model shows the possible and catastrophic results of a deterritorialisation of the nuclear deterrence assemblage that was being constructed by the superpowers of the time. In the next section, we see how the magnitude of the destruction in Openshaw's models is materially related to innovations in warhead design and the configuration of the space-rocket–thermonuclear-warhead assemblage. We will return to the discussion in chapter 2 about the operational parts of assemblages to look at how Manuel DeLanda conceives the battlefield as a relational social space connected to innovations and creative variations of the war machine occurring in weapon workshops.

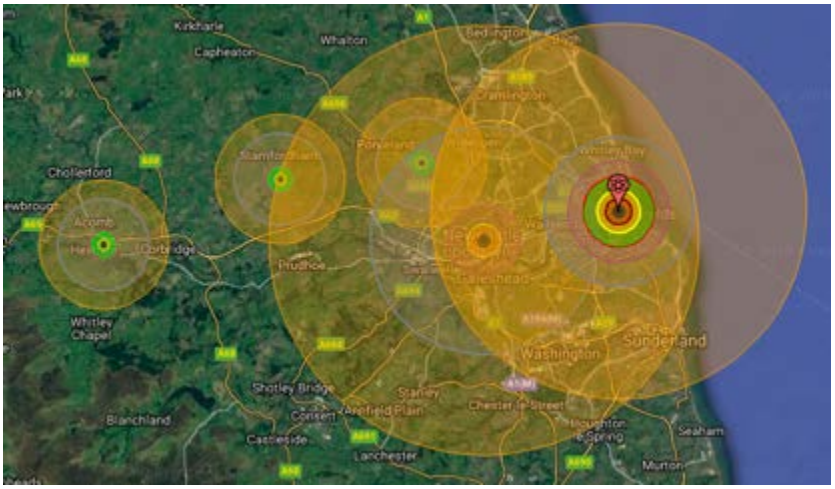

Figure 4.5 Computer model produced using Alex Wellerstein's *Nuke Map 2.5* (2017) of a nuclear attack on Tyneside. The small explosions are 150 kiloton warheads delivered by SS-20 IRBMs at targets requiring a high degree of accuracy for successful completion of mission. The two large explosions are 2.5 megaton warheads delivered by two SS-4s used against large socioeconomic targets. There is capacity for more targets to be selected in Openshaw's prediction.

Figure 4.6 Blast effect of the weapon used against Tyneside superimposed onto a recent Urban Splash infographic for the Smith's Dock housing development in North Shields (2018). 10,000 psi is the equivalent pressure four miles under the ocean. Few structures, including missile silos, would survive this force. A pressure of 20 psi is often used as the limit of absolute destruction of all heavily reinforced industrial structures.

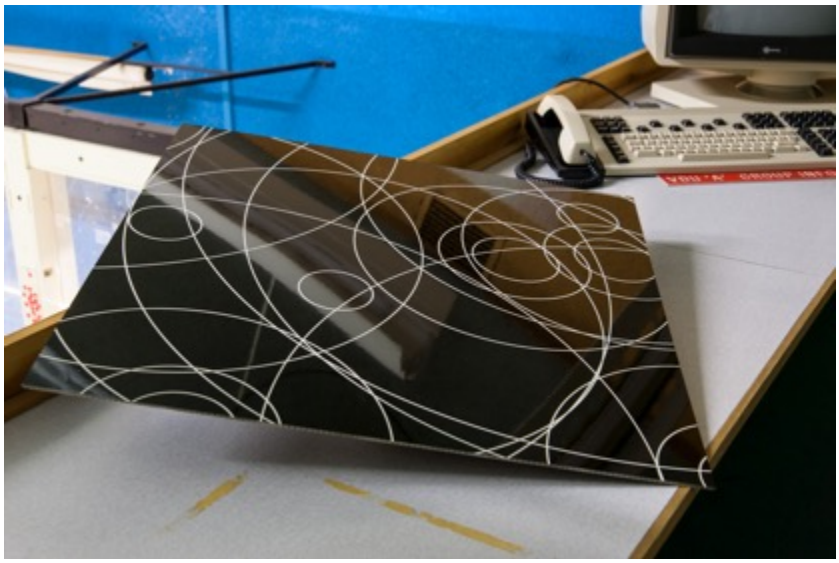

Figure 4.7 Michael Mulvihill *Mid-Century Modern (Openshaw, Wohlstetter, Tyneside)* (2015) etched traffolyte installed in situ at English Heritage 20th York HQ ROC bunker as part of the solo exhibition *Standby for the New Stone Age.* The install involved insinuating my own artworks among the artefacts on display in the York HQ bunker which, during a time of nuclear war, was intended to be staffed by civilian volunteers under the command of the RAF in order to make observations about the effects of the weapons used against the UK to primarily assess the conditions of warfighting material. Many of the former Royal Observers Corps volunteers that visited the exhibition accepted some of the artwork as part of the working fabric of the bunker.

4.2.3 A battlefield is a special social environment[209]

Manuel DeLanda writes that battlefields are intensive social environments, which are subjected to constant changes, transformations and becomings – not only through the movement of armies, but also as a result of weapon effects that are constantly recoding, territorialising and deterritorialising the space of combat. Battlefields are assemblages intimately entangled with other social spaces, particularly the arsenal and the workshops where the weapons used in battle are forged. DeLanda explains that:

[209] Manuel DeLanda, 'Assemblage and the Weapons of War', chap 3 in *Assemblage Theory,* p.77.

> A battlefield is a special social environment because of the lethality of the objects that populate it – projectiles and shrapnel; shock waves and fire – but also because it presents combatants with the problem of a situation that is in *continuous variation* […] similarly for other social environments, such as the workshops or arsenals in which the weapons of war are produced, the producers of weapons must deal with critical points of intensity in the materials they work with, like the tendency of iron to melt at 1,535 degrees centigrade, as well as with variable properties and capacities of the object that result from these transformations.[210]

DeLanda draws upon Deleuze and Guattari's example of medieval artisans who used their experience and skills to utilise, extend and differentiate the intensities and critical points of metal transitions. They do this by varying expressive properties which, as discussed in chapter 2, determine shine or sharpness, through processes such as heating and hammering.[211] Throughout the processes of making and doing, the artisan assembles a weapon from a constellation of expressive components. DeLanda explains that:

> Whatever these [expressive components] may be: the crystalline sound of metal, their shine or gleam, but also the way they express what they can do as they exercise electrical, mechanical and chemical capacities. Swords and sabres [axes and armour] are as much assemblages as the workshop of a blacksmith in which the convergence of singularities and affects that gives rise to these weapons.[212]

---

[210] Ibid. pp.77–78.

[211] Gilles Deleuze and Félix Guattari, '1227: Treatise on Nomadology–The War Machine', chap 12 in *A Thousand Plateaus,* p.471.

[212] Manuel DeLanda 'Assemblage and the Weapons of War' p.79.

The weapon, the workshop and the battlefield are therefore a nested set of assemblages with operations spanning many levels of social scale from atomic and subatomic particles that compose materials, to the varying components of large-scale social phenomena such as the planetary nuclear war. At each level of scale, the assemblages are responsive to the shifting parameters of affects and becomings at every other social component. These components are also produced by varieties of activity that includes the creation of articles of war by skilled human hands, responding creatively to material variations.[213] The upshot is that distinction based upon representational delineations collapse to show that materials, skills and knowledge flow between different social environments. Therefore, as we shall see in the next section, the same creative variations that are at work in forging a sword in a medieval workshop are also acting upon the manufacture of a plutonium core for a thermonuclear weapon.

4.2.4 Building a nuclear weapon is more art than science

Donald MacKenzie in his essay *Tacit Knowledge and the Uninvention of Nuclear Weapons* emphasises the role that tacit knowledge and artfulness have played in the design and manufacture of nuclear weapons.[214] MacKenzie, along with commentators such as Jeffrey Lewis, point out that despite the abundance of theoretical and explicit knowledge in the form of journal papers, schematic diagrams and mathematical data from supercomputers, the rate at which nation states are developing their own nuclear weapons is extremely slow.[215] For MacKenzie, this is an indication that there is more to the development of a nuclear weapon than reproducing the outcomes of existing

---

[213] Ibid.

214 Donald MacKenzie, 'Tacit Knowledge, Weapons Design and the Uninvention of Nuclear Weapons', *Knowing Machines: Essays on Technical change* (Massachusetts: MIT Press, 1996), p.229.

[215] 'North Korea Tests an H-bomb', *Arms Control Wonk Podcast* [podcast], 5 September 2017.

national weapon programmes, or the synthesis of explicit, or representational, knowledge.[216]

MacKenzie explores this idea through interviews made with nuclear weapons designers working at Lawrence Livermore and Los Alamos National Laboratories during the late 1980s and early 1990s. All of the weapons designers explain that it is impossible to achieve, through the explicit knowledge systems described above, a sufficient representation of reality in the detonation of the primary component of a two-staged thermonuclear weapon. This is because the processes involved are too dynamic and undergo complex variations. A designer explains that:

> Material physics is cleaner in the secondary[Reggie and Tony]: everything happens at high temperatures and pressures. [However,] the primary [Jenny and Cleo] involves transitions from cold metal at low pressure and temperatures to high pressures and temperatures.[217]

Like the medieval swordsmiths, the nuclear weapon designers tell MacKenzie that they must rely upon intuition about how the materials comprising the plutonium pit undergo transformation during ignition. A viable computer model of changes occurring inside a weapon during detonation cannot be made, so the designers must rely upon intuition and experience to visualise nuclear processes at the point of ignition. These transformations of cold plutonium metal to superhot and dense plasma can also be affected by the machining and milling of the primary components during manufacture.

---

[216] Discussion regarding the Indian Agni IRBM warhead design, see Ibid.

[217] Donald MacKenzie, ‘Tacit Knowledge’.

For example, the density of plutonium at critical points during heating and cooling can dramatically vary, and is liable to cracking during machining or casting processes. Hence, during the Manhattan project, a plutonium–gallium alloy was developed to even the cooling phases, giving the plutonium the (expressive) capacity to be worked and formed into pit components (see Figure 4.8).[218] MacKenzie also recounts a designer telling how the bonding of components in the W84 warhead, used in GLCMs, required a particular bonding technique that was very sensitive to its environment and that bonds could fail if the components being joined were not clamped in just the right way. Success of the adhesion could only be checked by human eye.

> Although we have tried several techniques to make this evaluation with instrumentation, we have found none equal to the human eye […] for detecting the change to a shiny, the slightly hazy, appearance that indicates a clear surface.

Like the medieval artisan forming a sword in a forge, the skills and ability to sense and respond to variation in metal, as indicated by changes in the material's expressive quality, is only gained after an extended period of embodied practice. MacKenzie is told that:

> There is "a long learning curve" for new designers. It takes a new designer, even one with a background in relevant areas of physics, "five years to become useful," and it may take ten years to "really train" one [...] in the late 1980s, there were "about 50 good designers" in the United States.

[218] Jeffrey Lewis, 'Italian Stallions and PLUTONIUM', *Arms Control Wonk,* 31 May 2007, <https://www.armscontrolwonk.com/archive/201525/italian-stallions-plutonium/> [accessed 23 November 2018].

Therefore, MacKenzie says that the weapon designers view their work as practice that is less a science and more an empirical art.[219] DeLanda points out that tacit knowledge that is used to make weapons – but also, as we saw in chapter 3, used to make artwork – while being embodied is also flexible and able to be infinitely adapted to continuous variations, or becomings, in a social assemblage. For this reason, skills learnt in one context can be adapted to many others. Due to this fluid process of making and unmaking, manufacture and destruction, practices can be uncoupled from one social assemblage that is geared for war and inserted to another assemblage purposed such as for artmaking. In the next epistemological encounter, we explore when the coded territories of war-making and artmaking blur into one another and art practice becomes a battlefield craft and process.

Figure 4.8 Plutonium–gallium alloy

4.3 Epistemological encounter two: sketching prohibited

In early November 2015, I travelled to Berlin in order to attend the *Sketching Prohibited: Military Interdiction of Drawing* conference at the Freie Universität in the former western

[219] Donald MacKenzie, *Knowledge Machines: Essays on Technical Change,* p.231.

sector of the city. The conference had been organised by art historians Ulrike Boskamp and Sebastian Fitzner with the intention of gathering together a colloquium of researchers, each of whom has insights into how drawing practice has historically been used in warfare. The purpose of the colloquium was to get a handle on the literature of art practice used as a tacit instrument of war rather than being used representationally in wartime propaganda.

The colloquium had come about when Boskamp had found accounts of artists utilised on battlefields from the early modern to modern art history. But because these artistic operations were covert, they lacked the material evidence for a systematic research of their influence upon representations of landscape.[220] In Boskamp's paper *The Artist as Spy: Artistic Mobility and the Power of Image* (2014), she explains that while accounts of artists being accused of being intelligence operatives have been looked at for their anecdotal quality, they have never been viewed together as a ensemble with similar qualities.[221] During the conference, several cogent art historical narratives of artist or artistic military deployment were mapped, where drawing was part of techno–military innovation, a system of policing and surveillance, or intelligence gathering.

The conference opened with art historian Ulrike Gehring's keynote presentation, which argued that the illusion of spatial continuity in 16th century Holland was a result of technological innovations in artillery and cannon forging. These innovations had produced the need to accurately target the new weapon across a long range.[222] This required the accurate measurement of space, which fell to artists and geographers. Gehring explained that for all intents and purposes they were same entity because of

---

[220] Conversation with Ulrike Boskamp, *Sketching Prohibited: Military Interdictions of Drawing,* Freie Universität Berlin (5 November 2015).

[221] in Lewis Johnson (ed.) *Mobility and Fantasy in Visual Culture*, (London/New York: Routledge, 2014).

[222] Ulrike Gehring 'Sketched Knowledge: Epistemic Procedures of Mapping Landscape around 1650', *Sketching Prohibited: Military Interdictions of Drawing,* Freie Universität Berlin (5 November 2015).

their similar roles in visualising territory for the Royal Court. By applying advances in triangulated measurement, the artist geographers were able to tilt cartographies through 90 degrees, thereby producing a perception of a spatial continuum through which a piece of artillery would fly towards its target. Gehring argues that these new skills produced a “magic space” or virtual space that presented a sense of receding spatial continuity. This believable space depth is demonstrated by Dutch landscape painters of the time, such as Jacob van Ruisdael, who adopted military manuals and techniques for targeting artillery into practices of artmaking (see Figure 4.9).[223]

If innovations in artillery and cannon produced new abilities for rendering believable space in landscape painting, then the tools and materials of artmaking can also be instruments of military control. Art Historian Sean Wilcox in his talk, *Image-making and Imperial Intervention in 19th Century South Asia*, explained that observational drawing was provided as part of the basic training for soldiers in the British Army, while draughtsmanship was used to embody the military discipline of Victorian soldiers. In a colonial context, drawing practice could be utilised to produce prolonged periods of observation which, according to Wilcox, are used explicitly as a technique of intimidation and surveillance.[224] Wilcox also argues that drawing, used as a colonial control tool, materialised John Ruskin’s racialised notions of the manifest superiority of naturalism over “oriental” abstraction. This enabled the British Army to deeply impress upon local populations the impression of Western imperial superiority through a performed and public exhibition of naturalistic drawing techniques.[225]

---

[223] Ibid.

[224] Sean Wilcox, ‘Image-Making and Imperial Intervention in Nineteenth-Century South Asia’, *Sketching Prohibited.*

[225] Ibid.

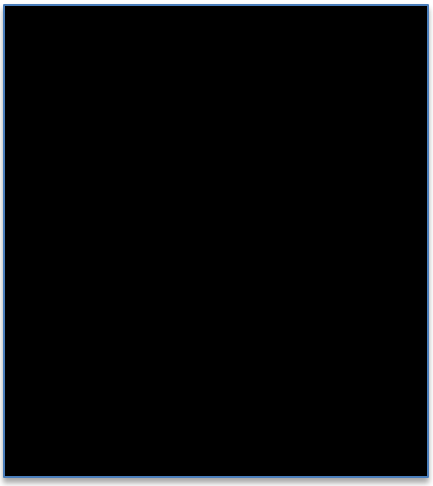

Figure 4.9 Jacob van Ruisdael *View of Haarlem with Bleaching Fields* (1665)

4.3.1 Epistemological threat

Drawing was also utilised in actual combat operations within the social space of the battle. Ulrike Boskamp, in her presentation *Mnemotechnics and the Trickery of Spies: Special Artist Strategies on the Frontlines of the Franco–Prussian War,* explained that the battlezones of the Franco–Prussian War coincided with the popular rise of *en plein air* painting and the emergence of French Impressionism. In addition to the dangerous material which, as DeLanda explained earlier, compose battlefields, Boskamp explained that the battlefield could also be populated by artists and artmaking materials. In this social space, an artist carrying pencil snubs and a small sketchbook posed an epistemological threat to operational combat units; firstly, because an artist on foot was very mobile within the battlefield environment and secondly, because they could inconspicuously collect data on bridging points and key landscape features for aiming artillery through quick sketches, or paintings disguised as poorly painted landscapes.[226]

[226] Boskamp, explains that Aesthetic Judgement by capturing militaries was sometimes used to determine if an artist was a spy. Viewing clumsy techniqueas having little intelligence value,

While not all *en plein air* artists were operating in a reconnaissance capacity, the activity of artmaking nevertheless afforded valuable camouflage. Boskamp points out that there was at the time an indeterminacy between *en plein air* painting practice and war-making activities. As an illustration, Boskamp tells a story of how French Impressionist painter Auguste-Pierre Renoir narrowly avoided execution by Versailles commandos while making a painting of a bridge over the Seine. He was saved by a Gendarme who convinced the commandos that Renoir was an actual artist and not an agent on an intelligence operation. However, it transpired that Renoir had himself assisted the Gendarme to affect an artist disguise for an intelligence mission a few weeks earlier.[227]

After the conference the contributors celebrated in a local bierkeller. During conversations, I was able to tell my own story about catching up with an old friend that I went to art school with but who had joined the Royal Marines. I thought the story had lots of resonances with the presentations in that my friend used his art experience in his battlefield practice. This is the story. However, key names and places have been redacted upon request from [redacted].

4.4 Epistemological encounter three

In a restaurant, in Paris, I eat with an old friend, [redacted] of the Royal Marines, who, at the time of our meeting, is working as [redacted] of [redacted] in the [redacted]. In this role, [redacted] helped develop NATO policies for making best use of military assets based in Europe against a spectrum of possible demands ranging from terrorism to conflict with a large state actor. However, in the restaurant, we eat and reminisce about old times as

[227] Ulrike Boskamp, 'Artist as Spy: Artistic Mobility and the Power of the Image', in Lewis Johnson (ed), *Mobility and Fantasy in Visual Culture'* (Oxon: Routeledge 2014) pp. 185 - 198

undergraduate art students at Duncan of Jordanstone College of Art and Design (DJCAD) where [redacted] studied fine art “sculpture” and I, “drawing and painting”.

We both met sometime in October 1992 during an introductory life drawing module run by the landscape painter William Cadenhead. For much of the time at DJCAD we shared a flat above the undertakers on Perth Road. We both remembered that evenings out would start with a bottle of cheap Bulgarian red and could end with [redacted] climbing a scaffold tower onto the roof of the art school, or one time attempting to swim across the mile-wide Tay estuary to Tayport. His artwork similarly incorporated both feats of endurance and adventure. [redacted] practice was influenced equally by land artist James Turrell, the conceptual artist Bas Jan Ader who lost his life in 1975 attempting to cross the Atlantic in a small yacht, and the polar explorer Sir Ranulph Fiennes. So, following a disappointing assessment of a body of conceptual artworks we produced together, born from [redacted] frustration with the Department of Sculpture, he decided to enrol for officer training in the Royal Marines.

After graduation we lost contact for almost 20 years until Facebook brought us back in contact. Then, shortly before commencing this PhD research project to use art practice to investigate the UK nuclear deterrent, we arranged to catch up and meet at the Gare du Nord in Paris. It seemed to me that this was a good time because I was now involved in critical military research with the Military War and Security Research Group (MWSRG) at Newcastle University through the Leverhulme Artist in Residence described in chapter 1. [redacted] was a senior ranking officer in the Royal Marines, working for NATO with a degree in fine art sculpture, and familiarity with the writing of Michel Foucault.[228] For this reason it seemed unthinkable not to meet again.

4.4.1 Smell and taste of the battlefield

[228] I still have [redacted]'s copy of Miller's *The Passion of Michel Foucault.*

When we finished dinner, we headed for [redacted] car parked a short distance from the restaurant. It was early summer and despite it being quite late, the evening was light and still warm. I asked casually and half in jest if [redacted]'s art education had been of any benefit to his military career. I was surprised when he answered with an emphatic yes. He thought his arts practice had given him a significant edge over colleagues because rather than viewing a landscape only in terms of explicit objectives and orders, [redacted]s sculpture training allowed him to see landscapes spatially and temporally, allowing risks and advantages to be intuitively perceived. [redacted] thought that artistic experience meant that operational goals could be gained with greater speed because they allowed for flexibility and mobility, which was denied to colleagues who approached a mission through an explicit list of orders. [redacted] also thought in broader terms that delineating the battlespace into quantitative indicators had the effect of overly simplifying conflict zones. Rather, the battlespace cannot be fully determined through inscribed geopolitical outcomes nor schematically represented because it is a complex social space. This space is populated with people that have complex cultural relationships with the landscape and the combat taking place there.[229] Also, from a combatant's point of view, the battlefield is a constantly changing sensoria of experiences composed of smells, tastes and touch as well as sight, echoing DeLanda's view of the battlespace. [redacted] therefore thought that the evaluation of the progress of a combat mission, and future successes of military interventions, should also take into account emergent intuitive, tactile and immersive sensations of the battlefield.

4.4.2 Versailles commando

After a 40 minute drive, we arrive in the western suburb of [redacted], where [redacted] lives with [redacted]. Until 1964, [redacted]

[229] Conversation prompted by an Adam Curtis documentary about Afghanistan. [redacted] had trained Special Forces units for deployment in Afghanistan on missions that were, in his opinion, futile. Paris, May 2015.

[redacted], and it is still home to NATO personnel and diplomats. [redacted] had also been the home to many of the French Impressionists, including Claude Monet, Alfred Sisley and Renoir (who depicted the commune in 153 paintings). [redacted] is a teacher who met [redacted] while working as a [redacted] from [redacted] working for NATO. The rest of the evening is spent discussing their collection of paintings by an artist from [redacted] who works in an Impressionists style. [redacted] intends to return to the arts after the military and we discuss a recent abstract he painted that sought to capture the sensation of the ascent of a mountain.

The next morning the family is up early and I am quizzed during breakfast about my name, my funny accent and my beard by [redacted], while packed lunches and PE kits are prepared for school. [redacted] has offered to drop me at a nearby Metro station on his way into work at the [redacted]. It is a brilliant and vivid morning, the air is fresh and the day promises to be hot.

As we drive through the little streets of [redacted], [redacted] points out locations of well-known Impressionist paintings and, in the intensity of the morning sunshine, the iridescent surfaces of Monet's paintings are almost viscerally evoked. I recall the last time [redacted] and I were in Paris on a wet and wintry afternoon during a DJCAD trip, when we both went to see Monet's Waterlilies in the Orangerie. The painting consists of two oval rooms each forming a diorama made from interweaving dashes of paint in vivid pinks, blues, turquoise, greens and yellows, which gave an immersive sense of air cooled by water and the dappled sunlight through trees. We also remember visiting the exhibition *L'hiver d'amour* (1994), curated by Purple Prose, which was on show at the Musée d'Art Moderne de la Ville de Paris. *L'hiver d'amour* was a large survey exhibition of contemporary artists who at the time sought to collapse the boundaries between the homogenised space of the art exhibition and the multiplicity of worlds of lived

experience.[230] I remember the exhibition had a great influence upon our approaches to artmaking, which no doubt lead to [redacted]'s collection of works that resulted in him joining the Royal Marines.

We approached the Metro station and are preparing to say goodbye, when [redacted] casually states:

> You know, Michael, that I used to have the job of protecting the UK's nuclear warheads. I'm qualified to discharge live ammunition in their close vicinity. You need to be an extremely good shot.

Figure 4.10 Purple Prose *L'hiver de l'amour* exhibition catalogue (1994)

4.4.3 Your life will be ended

[redacted] 43 Commando Fleet Protection Group, whose purpose is to provide protection for the United Kingdom's nuclear deterrent. This includes ensuring

[230] Giorgio Verzotti, 'L'hiver de l'amour', *Art Forum,* October 1994, 33 no.1, p.112.

the security of the W76 thermonuclear warhead, their D5 Trident II SLBM, the Vanguard Trident submarines, the submarine berths at HMNB Faslane on Gare Loch, and RNAD Coulport, where the warheads are stored 2 km away on Loch Long. The role also encompassed protecting the W76 warheads with the supporting convoy during their regular 709 km transportation to the Atomic Weapons Establishment in Berkshire for maintenance and servicing. [redacted] stressed that any perceived threat to the deterrent would be met with lethal force: “your life will be ended”. However, a more conciliatory or managerial approach is given to the permanent peace camp established at HMNB Faslane in 1982. [redacted] explained that this involved regular meetings with the residents of the camp. [redacted] said that everyone should have a right to show their objection to these things and security policy had incorporated expressions of protest against the nuclear weapon facility into day-to-day base security routines.

Like all primary nuclear targets, the siting of the bases near population centres sparks grave concerns about the consequences of an attack. The peace camp had been established when Trident renewal was announced in 1982, with the purpose of making visible the bases and their significance as a major military target. For example, in Openshaw’s war scenario, that was discussed earlier, Loch Long, Gare Loch, Faslane Bay and nearby Holy Loch are subjected to a massive nuclear carpet bombardment with many multi-megaton weapons used in order to destroy escaping submarines. This scenario results in the population of Glasgow, 64 km away, being drowned moments later by a tsunami of water disgorged from Loch Long and Gare Loch by the bombardment.[231]

The construction of HMNB Faslane and RNAD Coulport began in 1963 as a base for the UK’s Polaris nuclear deterrent, which was part of the same cascade of events resulting from the Sputnik Crisis that had produced RAF Fylingdales and the BMEWS.

[231] Stan Openshaw, Philip Steadman and Owen Greene, ‘Immediate Casualties and Damage’, chap 7 in *Doomsday,* p.146.

In 1968, the first Polaris submarine put to sea, armed with Polaris SLBMs that were carrying the ET.317 two-stage thermonuclear warhead composed of the Jenny primary and the Reggie secondary. Today, the site supports the Trident nuclear weapons system in partnership with the United States. The partnership agreement consists of 58 missiles being leased to the UK, which are selected at random from the US stockpiles and using only the W76 warhead designed by Los Alamos National Laboratory. The total UK stockpile consists of 225 warheads, each with an explosive yield of 100 kilotons, 160 of these warheads are operational with 120 continuously on patrol at sea. The weapons are fixed onto 24 Trident II D5 submarine-launched ballistic missiles (SLBMs) carried by one of four Vanguard SSBNs and are capable of delivering 12 independently targeted warheads (or RVs) known as MIRVs.[232] RAF Fylingdales provides detection services against surveillance satellites attempting to track the departure of a Vanguard submarine leaving the Clyde on a patrol. By knowing the time of departure it is possible to deduce an entire patrol profile of a submarine so, using the SSPAR radar at RAF Fylingdales, operators look for signs of reconnaissance satellites adjusting orbits to pass low over Faslane Bay.[233] It is claimed that to date not one of the operational Vanguard Trident SSBNs is known to have been detected by any other nation.[234]

4.4.4 The Polaris heyday

[redacted] said he had really enjoyed living in that part of Scotland because of the access to the mountains and outdoor sports, but aspects of HMNB Clyde felt strange and uncanny.

---

[232] Nick Ritchie, *Replacing Trident: Background Briefing for Parliamentarians,* (Bradford: Bradford Disarmament Research Centre, University of Bradford, 2011), p.2.

[233] Conversation at RAF Fylingdales, RAF Fylingdales, 4 August 2017.

[234] Sam Jones, 'A wonk's guide to the Trident nuclear deterrent', *The Financial Times,* 18 July 2016 <https://www2.le.ac.uk/library/help/referencing/footnote/footnote#Online%20Resources> [accessed 18 February 2019].

> ... lots of people in white bunny suits taking measurements, great if you're into that sort of thing.

But for [redacted], what was particularly peculiar was the feeling of time having been permanently suspended in the 1970s.

> You should see the Commodore's office. The carpet is brown and the curtains are still orange. It is like time has been frozen in the 1970s during the Polaris heyday.

[redacted] last statement was striking because it brought to mind 1970s television such as *The Good Life* and *Abigail's Party*. The characters of these programmes I had associated with the code names *Jenny, Reggie, Tony and Cleo* that were given to the primary and secondary components of the ET.317 thermonuclear warhead – the same weapons that had been based at HMNB Clyde during its Polaris heyday in the 1970s. I was also left for the first time with a sensation that the assemblages of nuclear deterrence crisscrossed with those of lived experience. This sense was experienced again by discovering the semblances between the drawings I made in my family living room and the MIP computers at RAF Fylingdales, which was discussed in chapter 3. These experiences are what Rosi Braidotti and Gilles Deleuze described in the previous chapter as the crisscross patterns of becoming that form geodesic lines from which new assemblages are made at arbitrary intersections of memories, experiences and materialities. This notion became the basis upon which I built my approach to artmaking as an assembling and emerging process, which I discuss in the following chapter.

Meeting [redacted] also impressed upon me that the exchanges between artmaking and nuclear warfighting were not a theoretical notion but they are embodied, they are actual

and could be tangibly experienced through living and breathing encounter. While Ulrike Boskamp's conference in Berlin had impressed upon me the theory of military and artistic exchange, meeting [redacted] in Paris showed that the war machine was not conceptual but was composed of flesh and blood – just like the friendship between art historian Meyer Schapiro and nuclear strategist Albert Wohlstetter described by Pamela Lee in chapter 2. The rhizomic fronds produced by the war machine's operations, or creative variations, can be traced through the shared memories of [redacted] and myself to reveal how this assemblage, composed of art practice and nuclear deterrence criss crosses time and space

I would also argue that the tacit relationships between artmaking and weapon-smithing – even nuclear weapon-smithing – described by Donald MacKenzie are also actual, either as the visceral fear of nuclear war, or the virtual materialisation of nuclear combat in computer simulations, or the process of making a nuclear warhead. I explore how these processes are assembled together as artworks in the next chapter through a series of dialogue based upon conversations during studio visits by supervisors or visiting artists. Throughout the conversations I explore how I have used art practice in this research to materialise the obscure, but nonetheless real, relationships between lived experience and the social productions of nuclear deterrence.

Chapter 5: Jenny, Reggie, Tony and Cleo

5.1 Introduction

Late last November (2017), curator Esen Kaya approached artist Harriet Sutcliffe and myself about producing a drawing activity for the Long Gallery at Newcastle University. The activity would be part of the region-wide Drawing Festival that announced itself as a celebration of the role of drawing in the art and culture of everyday life.[235] Esen saw the activity as a participatory event made from a series of student workshops, and culminating in the gallery becoming an artwork the following mid-January. This event became the exhibition *Jenny, Reggie, Tony and Cleo*, which was described at the beginning of the last chapter.

This chapter is a descriptive reflection about how the artworks shown in *Jenny, Reggie, Tony and* Cleo were produced through studio practice and workshop activity. It is about how the various encounters with the nuclear deterrent assemblage, such as artefacts from the archive at RAF Fylingdales, or meeting [redacted], initiated the artistic response as well as charting the flows, metamorphic and creative variations that were described in chapter 2, which occur during the artmaking process.

This reflection is written as a constructed dialogue assembled from discussion about the artwork shown in *Jenny, Reggie, Tony and Cleo* (2018). The discussion occurred during studio visits by curators, visiting artists and supervisors, as well as during public discussion, which took place at the time the artworks were being made. This chapter therefore also seeks to capture the cascades of thoughts, associations or

[235] 'Drawing North East'. <https://drawingne.org.uk/> [Accessed 21 May 2018].

deterritorialisations, becomings and metamorphic transformations that occur during studio visits that also constitute the artwork.

To do this the chapter follows a conversational style to capture a sense of the tacit, haptic and arbitrary flows that occur during the artmaking process and which directly determine the material, or actual, form a work takes upon exhibition. The conversation picks up many themes that have been discussed in the preceding chapters. It should then be taken as an embodiment of the (war machine) arbitrary processes of creative variations, or metamorphic transformations that during artmaking.

The conversations start from tacit encounter with each of the artworks that were made for the exhibition *Jenny, Reggie, Tony and Cleo*. Through dialogue focused on how the artwork came about, I retrace the arbitrary paths, lines of flight and experimentation that seem at times to have irrelevant beginnings. As described in the account of [redacted], or the MIP at RAF Fylingdales, these paths cross and fold back upon themselves to show how the artworks are actual assemblages composed from the materiality of nuclear deterrence but are formed from, what Deleuze and Guattari described in chapter 3 as the:

> crisscrossed […] axes and thresholds, with latitudes and longitudes and geodesic lines, traversed by gradients marking the transitions and the becomings, the destinations of the subject developing along these particular vectors. Nothing here is representative; rather, it is all life and lived experience: [it is all] actual.[236]

By describing the methodologies of creative practice, or practices, used in this thesis, I hope to make explicit the analytic import of creative-led research practice. An analytic

[236] Gillies Deleuze and Félix Guattari, 'The Body without Organs', chap 2 in *Anti-Oedipus.*

that reveals through processes of embodiment, activity and materialisation, the non-representational interactions that are constantly at work making worlds anew and what Rosi Braidotti described in chapter 3 as:

> the invisible yet concrete yet complex materiality of bodies immersed in social relationships of power.[237]

The discussion begins with how the exhibition title *Jenny, Reggie, Tony and Cleo* refers to the code names for parts of the UK nuclear deterrent, and how these code names offer a way of understanding the lived domestic life experience of the civil servants that were involved in planning for nuclear war and after. This discussion sets out the idea that the nuclear deterrent extends beyond the common imagination of exceptional, shadowy and covert spaces into those of lived social and cultural experience. These are framed by philosopher Adi Ophir's discussion of works by photographers Adam Broomberg and Oliver Chanarin, to explore how administrative and archival techniques were innovated through omnicidal biopolitical governance.

The conversation then explores the assimilation of the administrative into my art practice. By looking at an artwork being made, which is a response to materials in the RAF Fylingdales archive about the Radio Corporation of America (RCA) supply department and its relationship to their record division, the artwork draws upon new evidence that has emerged from this research that literally places the administration of nuclear deterrence machinery bound for RAF Fylingdales next to the clerical work for the distribution of David Bowie records at RCA House, Curzon Street, London.

---

[237] Braidotti, Rosi, Interview with Rick Dolphijn and Iris van der Tuin.

From here, discussion moves on to looking at the drawing and making process, which incorporates materiality outside of artistic intention. These include the characteristics of paper and the way it interacts with graphite to produce noise effects in the drawing. I explain that the noise events can be understood in the same way as the blur in the paintings of Gerhard Richter. I explain that the noise produces a sense of indeterminacy and emergence, which distinguishes the artwork from representation or as a carrier of content. Instead it is of itself, and an actual artefact or assemblage composed of complex interrelationships.

The notion of noise and inter-relationality is then explored through the artwork *MM-w76-FTLP-012017* (2016–2017) that is derived from photographs of the W76 nuclear warhead workshop. The discussion leads to consideration of the making process of the warhead artworks, where it becomes apparent that the skills, materials and methods are exchangeable between art production and nuclear weapon manufacture. It is explained that through the artmaking process something new, strange and unsettling was produced, leading the interviewer to think through the artworks in terms of Donna Haraway's cyborg politics, which derives in part from the biopolitics of the Strategic Defense Initiative (commonly known as "Star Wars").

This relationship is explored in a discussion about the film *MM-AV76-RCA-PP00052018* (2016–2018), which documents the production of *MM-w76-FTLP-012017* (2016–2017) alongside the operations of nuclear weapons manufacture at Sandia National Laboratories. The discussion then considers the ethics of the artwork being produced in relation to doing critical military research, which is explored through anecdotes about the relationship between self-technologies such as iPhones and Instagram and the military–technological–industrial complex.

Finally, this leads the interviewer to return to the conversation about embodied administrative practice in order to return to the notion of archivism, which is ubiquitous

to archive management systems such as PowerPoint and Spotify.[238] This opens a discussion about the tension between the accumulation of artwork and artefacts in the studio and the sifting process of curations and exhibition making. The chapter concludes by looking at exhibition making within the SSPAR at RAF Fylingdales as a part of the viva examination. What is intended by these dialogues is to capture the nuances and various paths of a studio conversation and the indeterminacy of art practice, showing how artmaking, or creative practice, follows various winding paths of becoming or tangential lines of flight that lead to new forms and possibilities.[239]

5.2 Who are Jenny, Reggie, Tony and Cleo?

They are not people, they are things.

I discovered the names in a document published by the Mountbatten Centre for International Studies called *The Real Meaning of the Words: a pedantic glossary of British nuclear weapons* by Richard Moore.[240] The title of the document really appealed because of the self-deprecating tone, and all-too-human idiosyncrasies.[241] The document title also chimed with comments that historian Peter Hennessy made regarding the various codenames given to different technical and administrative parts of the UK's secret preparations for nuclear war. Hennessy said that to him, the codes presented a picture of the lives of civil servants, educated in the arts and humanities,

---

[238] Ian Biddle, 'Archives and Archivism' (Lecture presented as part of Thinking Theories and Methods for HaSS PGR faculty training, Newcastle University, February 2017).

[239] Ben Anderson, 'The Promise of Non-Representational Theory', in *Taking-Place: Non-representational Theories and Geography,* eds. Ben Anderson and Paul Harrison (Farnham: Ashgate, 2010).

[240] Richard Moore, *The Real Meaning of the Words: a pedantic glossary of British nuclear weapons* (Southampton: Mountbatten Centre for International Studies, 2004).

[241] Dave Harris, *Deleuze for the Desperate* #8: *becoming-animal* <https://www.youtube.com/watch?v=QjWKoLdVtt0> [accessed 19 February 2019].

who may be living comfortable suburban lives yet are forced to contemplate the management of death and suffering on an unthinkable scale.[242] The code names *Jenny, Reggie, Tony and Cleo* denoted both the fission and fusion parts of the Polaris ET.317 thermonuclear warhead. Yet, these code names also evoke 1970s TV shows such as *The Good Life*, or Mike Leigh's *Abigail's Party*, which also bring to mind Hennessy's imagined lives of the civilian servants who were planning for the end of the world.

This folding of spaces associated with nuclear weapons systems onto places we think of as home resonated with my own memories of the threat of nuclear war.[243] But the moment when these experiences began to coalesce into the beginnings of an artwork, was after meeting my friend [redacted] in Paris. His statements about feeling that HMNB Faslane as being permanently suspended in time during the base's Polaris heyday in the 1970s made me think of how various relationships and experiences resonated together and this suggested the possibility of an artwork made of complex assemblage relationships and materials (see chapter 4).

But how does this connect with the way the artworks are titled? Can you talk about the titling system?[244]

Moore's document has several different coding systems. *Jenny, Reggie, Tony and Cleo* are attributable to arbitrary and whimsical encoding, or nicknames. The weapon designers at the Atomic Weapon (Research) Establishment used them.[245] But Moore points out that other government departments, such as the Ministry of Supply, had a

---

[242] Possibly attributed to an interview with Peter Hennessy by Eddie Mair, *PM,* [radio programme] BBC Radio 4, 2010.

[243] See chapter 3.

[244] Discussion with artist Stephen Sutcliffe, February 2018, Department of Fine Art, Newcastle University.

[245] Richard Moore, *The Real Meaning,* p.1.

more structured approach, which used a system based on expressions composed of colour + noun to make terms like *Blue Steel* (the code for the nuclear missile carried by the United Kingdom's V-bomber force).[246] When this department was replaced by the Ministry of Aviation in 1959, a anodyne system of

[letter][letter].[number][number][number] was adopted, hence ET.317, the Polaris nuclear warhead.[247]

What struck me at first was the arbitrariness and prosaicness of making a code name, and secondly the resemblance to the system I was using to manage picture files of artworks stored on my computer. The file names I was using are structured by initials from the first letters of the title of the series in which the artworks were made followed by a subtitle to specify an individual drawing. For example, I produced a body of drawing that was installed in the York Cold War Bunker as a part of the *Standby for the New Stone Age* exhibition.[248] These drawings originated in a series called *The Pursuit of Happiness* and depicted nuclear weapon tests by the United States, so, the files became *TPOH* + the name of the explosion, for example *TPOH Bravo* (after Castle Bravo) (see Figure 5.1). This system gradually started to form the actual titling structure of the artwork, in which I could code extra information for interpreting the artwork and the precise time a particular work was completed. This structure is used for cataloguing my artwork that is held by Vane Gallery in Newcastle.

[246] V-Bombers is a term given for the United Kingdom RAF force of strategic bombers that carried the country's nuclear deterrent in the 1950s and 1960s.

[247] Richard Moore, *The Real Meaning,* p.1.

[248] Actual name is York Group 20 ROC HQ.

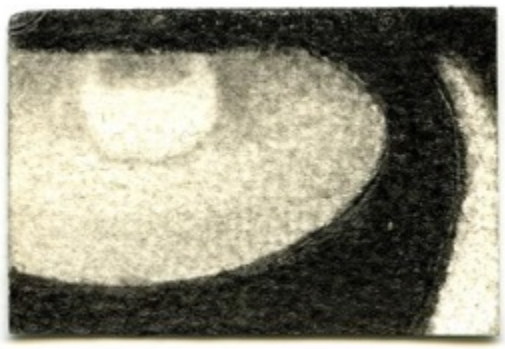

Figure 5.1 Michael Mulvihill *The Pursuit of Happiness (TPOH) (Castle Bravo)* (2012–2015)

Graphite on paper

For this body of research, I have consciously adopted this titling system and organised it into the following format:

Artist Initials-Project initials-Initials of title-series code

This chain of phrases incorporates parts of the coding systems explained by Moore with the titling structure I had been using for Vane Gallery and exhibitions such as *Standby for the New Stone Age.* However, I do not follow strictly to the structure and developed modifications over time. The key to the acronyms used for the titles of artworks in *Jenny, Reggie, Tony and Cleo* are as follows:

MM – Michael Mulvihill.

W76 or w76 – W76 Trident warhead. This remains from the original project proposal and may not possess any meaningful relationship with the content of the artworks.

FTLP – For Trump Love Putin. Title given to the emerging artwork that gave the impression of a possible gift from Russia to the new POTUS.

RCA – Radio Corporation of America. Denoting connection with RCA.

GRAPHITE – Graphite. Denoting graphite.

INPROGRESS – Work still in production.

Then what follows is a [number], which indicates a noticeable change from the previous iteration of the artwork + the [day] that the iteration number is given + the [month] that the iteration number is given + the [year] that the iteration number is given.

You say iteration, which suggests the titling is not a final statement?

Yes, I don't work towards an end point or fixed piece of work. Instead, the artwork is a product, or an artefact, of an ongoing process; I see that the artwork is constantly in the process of producing. For example, in chapter 3 of this thesis there is a really great description given by art historian Briony Fer of this kind of ongoing process. Fer explains how artist Eva Hesse's work is perpetually subject to processes of recycling and remaking until it is stabilised by mechanisms such as exhibition, or just achieving a sense of being a thing and (momentarily) resolved or stable.[249] So, the numbering refers to a key point when the work in process stabilises and achieves a certain "this-ness" or "thing-ness," or modifications that make a material difference from how the work was before.[250] I suppose I have made a bureaucracy of becoming and its process of emergence that is represented in the titling structure.

So it is a catalogue reference just like you would find in an archive or supply store?

---

[249] See chapter 3.

[250] Dave Harris, 'Deleuze for the Desperate', film, *YouTube Video*, February 2016 <https://www.youtube.com/watch?v=xvI4ezbZbFA> [accessed 8 March 2019].

I suppose there is a semblance.

New initials are introduced when the media of the artwork changes and becomes different from its previous iteration.

AV – Audio video.

AV76 – combination of AV and W76 (see above).

PP – Practice and performance. Derives from the featured title in the artwork.

RT – Richard Talbot, who presented the nuclear graphite block.[251]

xxxxxx… – Used when series numbers have not yet been given.

I think this way of working and looking at the artwork by labelling key points of production and iteration have probably been prompted by the administrative requirements of charting the PhD project for the AHRC. The take-away idea is that these artworks actually use the same administrative technology that governs PhD research, or organising documentation of artwork or cataloguing nuclear weapons systems. The artworks are not about anything, nor do they represent anything at all, nor do they make transcendent enunciations of knowing this, or knowing that. Instead, they should be thought of as configurations of parts of different social assemblages that are in the process of actually producing the world we experience. By adopting administrative technology in the production process, I am attempting to draw out the flows, fluxes and formations of biopolitical power relationships that operate at the periphery of perception.[252]

---

[251] Explained later in this Chapter.

[252] Simona Rentea, introduction to *The Routledge Handbook of Biopolitics*, Eds. Sergei Prozorov and Simona Rentea, (Routledge, 2017).

I started to think about nuclear weapons and administration a few years ago while reading an essay by philosopher Adi Ophir that accompanied a publication called the *Holy Bible* (2013) by photographers Adam Broomberg and Oliver Chanarin. The publication comprises hundreds of photographs taken from the *Archive of Modern Conflict*, which are printed, or superimposed, over pages of the King James I Bible. Ophir's essay is called *Divine Violence*, and explains how God has produced catastrophes throughout history as a tool for governance and administration. Ophir recounts that God produced omnicidal events such as Noah's flood, the destruction of Babel, or Sodom and Gomorrah to materialise and make visible divine power. Ophir goes on to describe how these catastrophes are later memorialised and reproduced in the imagination of populations as the vision of future disaster. These are reified into texts that form religious laws and governance, which enable the control of bodies in space. Among the photographs curated by Broomberg and Chanarin is a photograph of the mushroom cloud produced by Opération Licorne, the test of France's first two-stage thermonuclear weapon on Fangataufa French Polynesia in 1970. I was also looking at test shots of US nuclear weapon tests and noticed that they were also given operational code names and reference. This started me down a line of thought that reasoned: as well as producing terrifying images to represent power, the nuclear explosions are also a result of a more prosaic and familiar administrative, archival or bureaucratic paperchain. If these tests were performed today, they would also be partly composed of materials such as photocopies, laser prints, management objectives and outcomes, emails and computers, financial and budgetary codes, offices, workshops and people. So, the conduct of nuclear war and deterrence is more than just the weapon systems and their capabilities; rather, they are part of an assemblage with parts that are extremely familiar and even broadly interactive outside of their perceived delineation of nuclear exceptionality.

Can you explain how the titling structure connects with the studio practice and research?

From my experience, much of the process of artmaking has little to do with a widely held notion of creativity as a free expression, of what geographer John Wiley refers to as sovereign selfhood and subjectivity.[253] Making artwork or putting together exhibitions involves lots of clerical work such as word processing, costing and budgeting. If your work has been publicly funded, then there will be a certain amount of reporting and compliance. If you have been commissioned, then there will be quality control processes, either formal or informal. If you have your work fabricated, or have fabricated elements, such as the gold plaque in the David Bowie work here [gestures towards a drawing in progress of David Bowie alongside a gold etching], or Perspex boxes in this work here [gestures towards two Perspex boxes], then you will have to talk with the fabricators, who will issue invoices, and these are recorded in accounts for Her Majesty's Revenue and Customs. So, the idea of a studio and practice as an exceptional space becomes unsteady when you consider all the elements involved in making the artwork.[254] I think that by considering these aspects alongside the more recognised art production activities, such as drawing, casting and sculpting, there seems to be a way of tacitly engaging with how power structures are created and produced on a small scale which, as a result, are intersectional with larger formations of power such as administration of nuclear deterrence.[255]

---

[253] Geographer John Wiley argues for post-structuralist concepts to develop a creative criticality and avoid romanticism or philosophical voluntarism. John Wiley, 'Non-Representational Subjects?' in *Taking-Place: Non-Representational Theory and Geography,* Eds. Ben Anderson and Paul Harrison, (Farnham: Ashgate, 2010), p.110.

[254] The term "exceptional" is used in a similar sense, but not exactly the same way that Derek Gregory adopted the term from Giorgio Agamben to denote a zone delineated by special laws, or suspension of laws. Derek Gregory, 'Project(ion)s', *Geographical Imagination,* (2019) <https://geographicalimaginations.com/tag/space-of-exception/> [accessed 19 February 2019].

[255] Supervisor meeting 14 April 2016, Department of Fine Art, Newcastle University.

Are you arguing that the concept of 'exceptional space' is in fact flawed? Or provisional?[256]

Let me start by being clear on the use of the term exceptionality and how it is used in regard to the artist studio. I am not arguing against concepts of 'exceptional space' as articulated by thinkers such as geographer Derek Gregory, or philosophers Giorgio Agambem and Walter Benjamin. Who explain that an exceptional space is a socially constructed zone where legal norms are suspended by emergencies or conflict. These spaces facilitate state entities to repress or commit violent acts with impunity. In fact some of this concept inform my critique of the idea of the artist studio as being special place with a unique claim to expressive authenticity that lies beyond regular critique and discourse.[257]

In several places in this thesis I have demonstrated how artist practice has evolved in relationship to the 'exceptional space' of war and conflict and violence. For example: in chapter 4 the artist intelligence operations conducted on the battlefields of the Prussian war; in chapter 2 I talk about art historian Meyer Schapiro influence upon the noise to signal operations of the MIP and SIP at RAF Fylingdales; or in chapter 4 the process of creative variation occurring between assemblages such as weapon forge and battlefields as explained by Delanda in chapter 4. These assemblages are socially and historically productive. They are constituted by actual events, which form the semiotic and material conditions of the exceptional space, or what Delanda describes as the special social space of the battlefield.*[258]* My problem with exceptionality is not with concepts such as 'exceptional space', or *states of exception*. Rather it is with an art historical idea about spaces of art production that possess manifest exceptionality and distance.[259] When in actual fact this idea is serving to obscure or deflect the activities of complex power structures that construct the exceptional artistic space.[260]

---

[256] Alison Williams and Gair Dunlop viva examination 24th May 2019, RAF Fylingdales.
[257] Ibid
[258] Manuel DeLanda, 'Assemblage and the Weapons of War', chap 3 in *Assemblage Theory,* p.77
[259] For a in depth critique of exceptionalism in the arts see Arne De Boever, 'Art and Exceptionalism: A Critique' *Boundary 2* 45(4) (2018) pp. 161-181
[260] See page 139

To give an example, writer and marxist art historian David Beech, in *Art and Value* (2015), makes a claim that art is economically exceptional, and is not subsumed into a capitalist system of value.[261] Beech attempts to express this idea by saying that while 'artists on average struggle to make a living [They] are creative labourers whose personality is performed in a virtuoso display […] and tend to continue with their work, in some way when they leave their studio.' Behind this romantic description of a life devoted to an art for art sake is something I find more insidious. To my mind Beech's perception are based upon what Delanda calls a'reified generality'. Artist Hito Steyerl in her essay *Freedom from Everything: Freelancers and Mercenaries* thinks that Beech's general and romantic idea of artist practice hides mechanisms of what she calls negative freedoms. Steyerl explains that these are freedoms that "during this time of economic and political crisis" has served corporate agendas to be freed of responsibility or regulation. Such as providing stable employment, or social security. I think Beech's exceptional argument becomes ever more weakened when, elsewhere, Steyerl describes the international spread of militarized high security, concrete, tax-free art storage bunker in free ports around the world.[262] These bunkers have emerged as a result of international art fairs and biennials, where in Steryerls words "oligarchs, warlords, too-big-to-fail corporations, and dictators' hoard their art treasures".[263] While the language of cultural urgency used to events such as the recent Documenta 14 *Learning for Athens.* For me appear to advantage the social and economic state of affairs that the contemporary art biennial claims to resist.[264] What Steyerl makes clear, and what I take away from her work, is that art, rather than residing on a transcendent

---

[261] Josefine Wiksrtröm, *Art's Economic Exceptionalism* 2015 < http://www.metamute.org/editorial/articles/art%E2%80%99s-economic-exceptionalism> [Accessed 2nd September 2019]
[262] Hito Steyerl, 'Tank on Pedestal: Museums in an Age of Planetary Civil War' *e-flux Journal* 70 (2016) pp. 1-11
[263] For a development on Steyerl's argument and a critique of the inability of marxist based idealism to produce an account of the various and deep operations of capital assemblages see Maurizio and Eric Alliez 'To Our Enemies' *e-flux Journal* 78 (2016) pp.1 - 10
[264] J J Charlesworth, *Documenta against Democracy?,* 2017 < https://artreview.com/opinion/may_2017_opinion_jj_charlesworth_documenta/> [accessed 3 September 2019]

or abstract plane. It is an actual material manifestation of global, social, economic and political process that can be analysed through making art work.[265]

I think that by considering these aspects alongside the more recognised art production activities, such as drawing, casting and sculpting, there seems to be a way of tacitly engaging with how power structures are created and produced on a small scale which, as a result, are intersectional with larger formations of power such as administration of nuclear deterrence.[266]

Expand on this – I'm not sure that the leap between sorting out admin and power structures is clear in the abstract[267]

I think what I'm trying to get at is that nothing actual exists in the abstract. The production of art as being exceptional and transcendent is a social construction made out of ideas that are culturally reproduced and represented. Ideas such as artistic genius, or military exceptionality are powerful methods of social stabilisation by delineating structures of meaning (see chapter 2). However, as Deleuze, Guattari, DeLanda, Braidotti and Susan Leigh-Star explain, these are symbolic structures that render invisible the actual productive activities that are taking place outside of policed epistemological categories or ontological abstraction (chapters 2, 3 and 4). So, in terms of making these visible in my art practice, I have taken a very fine scale, emphasising the production processes in studio practice and paying attention to administrative process. The upshot of doing this is that delineated boundaries that mark out normatively constructed art worlds are deterritorialised. Through doing that it is possible to see that art production process is superimposable onto other manufacturing and administrative activities, from accounting to supply management and logistics. From this

[265] See page. 139
[266] Supervisor meeting 14 April 2016, Department of Fine Art, Newcastle University.

[267] Comment made by Rachel Woodward on 18 September 2018 as a comment in a draft version of this chapter.

point of view artmaking is not an exceptional activity. However, by deterritorialised administrative and manufacturing flows, art practice is used to make new arrangements, and the activity of making becomes the analytical instrument of making visible how power actually flows across boundaries and produces socially.

For example, in the archives at RAF Fylingdales is a collection of magazines called *Scan* that were produced for the RCA's (Great Britain) civilian contractors who were employed in the operation and maintenance of the radar. The early magazines are very simply stapled and typed newsletters containing crosswords, recipes, interesting stories about local attractions, short stories and funnies.[268] I suppose *Scan* contributed to building a sense of community among the engineers and their families who are living and working at RAF Fylingdales, which is quite a remote place. Progressively, through the 1960s, *Scan* became much more like a glossy brochure and on 3rd March 1969, RCA (GB) underwent a rebrand to become RCA Limited. The RCA supply department seems to have also been moved from RAF Fylingdales to a brand-new building: RCA House on Curzon Street near Park Lane in London, next door to RCA's Curzon Cinema (see Figure 5.2).[269] And, if you flip over a copy of David Bowie's *Heroes*, or *Sound and Vision*, you'll see this address at the bottom of the record sleeve. What this shows is that process and procedures used in the supply of parts for key pieces of infrastructure of MAD are interchangeable with all other RCA Limited supply activities, and that includes installing stereo sound systems in UK cinema, providing intercom and electronic systems for hotels and equipping the new ITV television channel Yorkshire Television.[270] In fact, an NTSC colour broadcast system was tested at RAF Fylingdales in 1965.[271] So, while RAF Fylingdales is both culturally and socially represented and

---

[268] RAF Fylingdales archive, [uncatalogued], 'Scan: weapons contractors magazine for Site III RAF Fylingdales, edition 4'.

[269] RAF Fylingdales archive, [uncatalogued], 'Scan: Autumn 1969', p.3.

[270] Ibid.

[271] The author of the article thinks that colour television is unlikely to catch on in the UK. RAF Fylingdales archive, [uncatalogued], 'Scan: no. 14, November 1964', p.18.

perceived as an instrument of nuclear deterrence, which it actually is, it is also a place of social and economic intersectionality, where the exceptional mechanisms and administrative technologies of nuclear warfighting are folded and multiply through many different social spaces. So, there are representations of nuclear deterrence embodied by RAF Fylingdale on the one hand but, on the other, they are lines of affect radiating through the station's supply chains that are actual mechanisms for other social production and world making.

Figure 5.2 *Scan* magazine feature about RCA Great Britain Ltd operations from RCA House on Curzon Street, London

So, is this what you're talking about? The gold David Bowie piece here?

Yes, the David Bowie drawing has emerged from the archival research of *Scan* magazine. The work consists of a drawing of the cover for David Bowie's *Heroes* single and a fabricated gold rear etched plate of overlapping concentric circles. Inscribed along

the edge of the gold plate is RCA AN/FPS-49 and RCA PB 1121. The first set of numbers are the RCA serial number for the old BMEWS tracker radars used at RAF Fylingdales. The second number is the RCA serial number for the David Bowie *Heroes* single. These components will be framed and hung like a gold record that you would expect in a recording studio. Instead the work is intended to be installed in the Space Operations Room in the SSPAR radar building at RAF Fylingdales. This is the nerve centre of UK and US space surveillance and ballistic missile early warning operations. I hope that by situating the work in the Space Operations Room, it produces a deterritorialisation, in the form of a question, or some kind of surprise response from the visitors or staff that work in the SSPAR. In order to begin a process of making visible the relationships between the enclosed Space Operations Room and social spaces outside of the perimeter of RAF Fylingdales.

Figure 5.3 Michael Mulvihill *MM-w76-DB/H/V2S-RCA-PB 1121-AN/FPS-49-INPROGRESS* (2018–2019)

Graphite on paper, back-etched gold on Perspex

Not exhibited

I though the David Bowie drawing was actually a photocopy. I can see how you are using the placement of the object to disrupt the conventional understanding of social constructions. But I'd like to explore why the image is made, or drawn, rather than presenting a photographic reproduction. Why do you make drawings of the images?[272]

I have made closely observed drawings from photographs for a long time. I began drawing from photographic sources because for me they seemed to strongly evoke materialised memories and experience. For this reason, I started making drawings that had the same dimensions of 6x4 inch snapshots photographs. But the drawings shrank as I began using digital photography that led to using archival images and documents retrieved from Google – The David Bowie *Heroes* cover was found online. I don't have any particular criteria for selecting images other than that certain pictures have a resonance. Artist Vija Celmins described becoming obsessed with a photographic image before she makes a drawing. Using the David Bowie *Heroes* cover seemed at first like such a blunt instrument because the desire to use the image was so immediate. It is also such a well-known photograph. However, this was probably why I could not look away and it seems very correct for where it will be situated in the ops room. Because the image itself embodying the sociocultural construction of David Bowie will be subject to a reciprocal deterritorialisation by the Space Operations Room.

I think that by drawing the photographs, a different physical relationship to the image is produced. I like to think that the drawings are deposited onto surfaces by processes similar to fossilisations. These gather all sorts of noise elements, such as tearing and scuffing, from their environment. The fossilisation process as I explained in chapter 3 is produced through a process of applying graphite then rubbing it away using regular

[272] Conversation with artist Stephen Sutcliffe, 6th February 2018, Department of Fine Art, Newcastle University.

erasers, sandpaper, or lifting material with tape. That's how the drawing became torn [pointing at the torn David Bowie drawing]. Also, because of graphite's reflective qualities, the drawing cannot be seen from certain positions. I think of the drawings as artefacts, which have a physicality and tactility like a sculpture.

What do you mean by noise?[273]

The notion of noise in the drawing and making processes originates in a drawing called *Mid-Century Modern* made during the summer of 2015, depicting participants in the Los Angeles County Museum of Art's (LACMA) *Art and Technology* exhibition from 1971.[274] I was making the artwork while reading Pamela M Lee's essay *Aesthetic Strategist*, about Albert Wohlstetter, who modified art historian's Meyer Schapiro's ideas on ground and support into the noise and signal used by USAF to sift intelligence (see Figure 5.4).[275] I began to think of the slight errors that occur in the drawing process not as mistakes to be corrected, but as noise elements that have the effect of introducing distortions in how the image that is drawn is perceived, or received. The result is the production of blurry and indistinct zones in the drawings, which give the appearance that the images are coming into view, or a sense of the pitch-shifting effect of a tuned signal on a single sideband (SSB) radio set.[276]

Strangely, this seemed to give the drawings a different mode of realism as they shimmer into view like a radio being tuned. The effect is similar to Gerhard Richter's description of the blur in his paintings. For Richter, the blur draws attention to the

---

[273] Ibid.

[274] see chapter 2.

[275] As I discovered through sifting the archive at RAF Fylingdales, this was adapted into the operational programs for the MIP and SIP computers. (See chapters 2, 3 and 4.)

[276] I am a qualified SSB radio operator with call sign: Mike Three Hotel Whisky November Uniform.

materiality of the painting, which he explains are not representations or reproductions of the photographic image. Rather they have materialised the technical glitches and become a different reality from the photograph.[277] The image emerges as an effect of the painting process that, for Richter, gives the impression of the artwork being unfixed and suspended in between states.[278] This is similar to the way Deleuze writes about the smearing and wiping effect in Francis Bacon's paintings as a form of becoming and emergence.[279] Rosi Braidotti further explains that in Deleuze's conception of creativity, there are signals instead of signs, expression instead of representation and codes instead of interpretation that are organised into assemblages of intensities and affects.[280] The photographic sources are entangled in the material and intersectional process of making, becoming something completely new, real or actual.[281] The process of becoming different or new is produced by the actual, real and physical activities of making a drawing.

[277] Oskar Bätschmann, 'Landscape at one removed', in *Gerhard Richter: Landscapes.* Ed. Dietmar Elger, (Cantz, 1998), p.34.

[278] Gerhard Richter, 'Note 1985', in *The Daily Practice of Painting*. Ed. Hans-Ulrich Obrist (London, 1995).

[279] See chapter 3.

[280] Rosi Braidotti, 'Affirming the Affirmative: On Nomadic Affectivity', <http://www.rhizomes.net/issue11/braidotti.html> [accessed 14 July 2018].

[281] See chapter 3.

Figure 5.4 Michael Mulvihill *Mid-Century Modern* (2015)

What produces these noise elements?

There are lots of external things that effect and affect how the drawing emerges, such as effects produced by the paper surface, or the indistinct area of the tracing used to make an initial drawn outline, or when the pencil graphite shatters while it is being drawn over a surface. These affects are produced by the intensive interaction of materials and events that are external to artistic intention, yet have a great influence upon the way a drawing emerges. This is especially so at the small scale that I work, or have worked. I think these noise elements make clear that the artwork is actual because it is a composition from the material traces of complex interactions and relationships. The drawing activity itself – it is not being used to produce representational content. The drawing is actually what it is and does not represent anything other than itself.

These noise effects are very evident in the artwork *MM-w76-WH-06032016-2017* (2016–2017) which is an A0 laser print enlargement of a ceramic smoke-glazed warhead I have been making. If you look closely at some of the warheads you can see the genealogy of their production (see Figure 5.5). Details produced by the making process have only become visible when I scanned and laser printed the warhead to near the same scale as the W76 Trident warhead.

Figure 5.5 Michael Mulvihill *MM-w76-WH-06032016-2017* (detail) (2016–2017)

Cashmere carpet and carbon electrostatic print

But the print is not a representation of the W76 warhead. Through the process of producing the print, the object appears like a territory, or a geological surface or an animal bone – it is unfixed and different from the W76. I see the artwork as a new and complex product emerging from an assemblage composed of drawing and artmaking materials along with processes of administration such as the electrostatic carbon printing. As discussed earlier in regards to the titling process, the artwork has been made from assembling together what are thought of as distinct domains of the nuclear, administrative and artistic and by doing this, I think it produces a tacit way of understanding how these seemingly different domains can, or do, interact beyond socially inscribed perception. Historically, this has occurred with Buckminster Fuller's geodesic domes, or Schapiro's notion of figure and ground becoming co-opted into the operational and global biopolitical organisation of MAD (see chapter 2).

Can you talk through how *MM-w76-FTLP-012017* (2016–2017) was made (see Figure 5.6). There are lots of different parts to the artwork made from elements and materials that are very tactile, could you speak about the processes involved?[282]

MM-w76-FTLP-012017 (2016–2017) also started from a photograph I found online of technicians working with the W76 nuclear warhead, which is the type that is used on the UK Trident missiles. It is likely that the technicians are handing the outer re-entry vehicle or RV section of the warhead. What struck me about the photograph was the similarity between the workspace at Lawrence Livermore National laboratory where the photograph has been taken, and the metal workshop in the Department of Fine Art at Newcastle University. From these photographs I deduced the size and proportions of the warheads using the technician's hands and faces as a guide for measurements. I

[282] Supervisor meeting, 30 July 2017, Department of Fine Art Newcastle University.

liked to imagine that this approach had similarity to the way espionage data might be used to recreate a classified weapon.[283]

This process produced a sense of indeterminacy between the art studio and weapon workshop, and what really helped blur this delineation was finding minutes to a talk given by Kate Pyne to the Tadley Historical Society. Kate Pyne was the historian in residence at the Atomic Weapons Establishment, which is situated on the edge of the town Tadley in Berkshire.[284] The author of the minutes conveys the surprise of the audience at being informed that the Polaris nuclear warheads were tipped with birchwood.[285] Later, Flt Lt Richard Weeks at RAF Fylingdales confirmed that hardwoods are known to be used as heat shields on spacecraft, the idea being that the wood turns to charcoal, which breaks up and carries heat away from the spacecraft or warhead.[286]

This confirmation did not diminish my own surprise that familiar materials that are experienced as part of our everyday lived lives can also be components of exceptional and lethal object like nuclear warheads.[287] I thought that by using hardwood or birchwood I could collapse everyday familiar experience into the operational workings of a thermonuclear warhead, but also actually materialise a nuclear weapon without having to deal with dangerous substances like plutonium, or tritium. All the individual elements that make up the work *MM-w76-FTLP-012017* (2016–2017) are a result of different processes emerging from the production of the hardwood warhead.

---

[283] 'Senate Bill Cuts Warhead Funding', *Nuclear Threat Initiative Project*, (2013) <http://www.nti.org/gsn/article/senate-bill-cuts-warhead-funding/> [accessed 12 July 2018].

[284] Rosemary Bond and Jim Coles, *TADS meeting report: July AWE Aldermaston, 1981-2000 and more by Kate Pyne,* (2002) <http://www.tadleyphotos.co.uk/tads/> [accessed February 2019].

[285] Ibid.

[286] Conversation with Flt Lt Richard Weeks, 28 June 2016, RAF Fylingdales.

[287] This discovery preceded work on assemblage theory, Deleuze and unconventional ontologies.

Figure 5.6 Michael Mulvihill *MM-w76-FTLP-012017* (2016–2017)

Walnut, bronze, wood, 3D print, charcoal, smoke-glaze ceramic, beech, with cashmere sound installation carpet (matched to RAF Fylingdales' Space Operations Room)

I would really like to know more about the stages involved in producing this work, so that I can grasp how you position making as a critical framework for your practice. For example, when was the first of these warheads made?

I think that I explained earlier that the origin of the artwork is often fractured and made of different experiences, encounters and re-experienced memories, such as meeting [redacted]. However, thinking back to early stages of the artwork, there were a few experimental processes also going on. So, the origins of the work are quite amorphous. Once I had deduced the W76 warhead measurement from the photographs, I made a 3D CAD model to produce an STL (stereo lithography) file, which was used to make a 3D-printed warhead in PLA (polylactic acid). I thought that this would be a really quick way of mass producing the warhead cones; but, they took a long time to print and the

printers were prone to mechanical errors, such as the printer nozzle blocking with the PLA extruding material.[288]

It was suggested by casting workshop technician Burnie Burns that a quicker way to produce lots of the warheads was by slip casting them in ceramic from plaster moulds. This was appealing because the process suggested stoneware that strongly resonated with the sense of the 1970s evoked by the code names *Jenny, Reggie, Tony and Cleo.* However, Burnie thought the PLA cones would be unsuitable for making the mould because the material they were made from is water based and could start to break down while the mould was being made. Burnie suggested I make a wooden cone polished to a high finish with bee's wax in order to help remove the object out of the mould.

The mass production of cones was followed by some thought about how a dream is composed of bits from waking experience that are rearranged in the mind of the sleeper. I was thinking about materialising a dream I had in which thousands of nuclear weapons are produced accidentally by a photocopier error. This notion had come about while thinking about President Jimmy Carter who was dedicated to reducing nuclear weapons; however, he actually dangerously increased the number of warheads due to misunderstanding about the implications of MIRV technologies. This thought produced a body of experimental artwork that included the production of thousands of bound laser-printed images of drawings made from W88 warheads, and macro photographs of pencil graphite that also resemble weapons. Footage of the photocopies being produced have become part of *MM-AV76-RCA-PP00052018* (2016–2018), which I will discuss later, but these processes also influenced the idea of using 3D printing to materialise mass-produced warhead-like objects.

For the production of the wooden cone, I worked with woodwork technician Joseph Sallis to produce the hardwood cone for making the casting mould. We used an old beechwood square table leg. The table leg was prepared as a blank for turning in the wood lathe by planing away the right angles. This kind of carpentry was completely new to me, but it was also novel for Joseph who had little experience of using the lathe to produce cones.

We set the beechwood blank into the machine and everything started quite well. Joseph explained the basics of using the handheld chisels for taking away wood and after this initial training I set to work making the cone. But after a week of constant work, the cone was only partially emerging from the wooden blank, which was also becoming unstable in the lathe. The blank eventually flew out of the machine and we were unable to re-centre it back into the chuck jaws, meaning we were unable to complete the cone. Despite abandoning this job, I was able to salvage the very tiny cone that had appeared from the end of the blank and this became an element in the finished artwork (see Figure 5.6).

A better approach we found was to use the computer numerical control (CNC) router based in the School of Architecture, Landscape and Planning's wood workshop. This machine used the same data supplied by the STL file to mill an exact cone from another block of beechwood, this time within a few hours. Once the cone was milled, it needed to be cut from the blank and finished using sandpaper. This meant that tiny distortions in the shape of the cone were introduced by the hand finishing – evoking the milling defects that the weaponeers describe in their conversation with Donald MacKenzie in chapter 4. I had also thought that the sanding process would erased some of the strange digital patterns and faceting that had been retained on the wood from the STL file but, as I explained earlier, this reappeared as noise elements in the later polishing stages and in the laser prints made from the sculptures.

Can you talk about the slip casting process and how you arrived at this tortoise shell or tusk-like finish?

I slip cast the warheads in the casting workshops at university. The process involved quite a lengthy procedure of constructing a three-sectioned mould. Each of the sections were cast from plaster of Paris and they each took about a day and a half to make, with another week set aside for the plaster to fully set (see Figure 5.7). Once the mould was ready, liquid stoneware clay, known as slip, was poured into the mould and left to stand for a few minutes. Then the excess slip is poured off and what remains is the slip cast, which is removed from the mould and left to air dry before the first firing in the kiln. The kiln heats the clay over a period of 24 hours to a maximum temperature of 1,180 °C and the clay transforms into ceramic (see Figure 5.8).

Figure 5.7 Slip casting warheads in plaster of Paris mould (right) with second mould under construction (left)

Figure 5.8 Cast warheads prepared for first firing at 1,180 °C

After firing, the stoneware ceramic is very white and I had the notion of using the warhead cones as a drawing surface with charcoal I was making at a secret woodland site. But the result was a bit underwhelming and the process of drawing on the warheads seemed too deliberate and contrived. I didn't get the sense that I was producing a surface or fossilisation, but rather deliberately inscribing the ceramic warheads with an image. This felt really unsatisfactory when compared to the way I normally produce a drawing. However, I was being helped by ceramicist Helen Brown, who had been in the industry for many years and observed that if I was drawing on them with the charcoal, then it was obvious to her that the warhead/cones/weapons should be fire glazed.

Helen explained that this was a very early glazing technique but still widely used in artisan pottery, where flames and smoke are used to produce effects on the surface of pottery. Helen also explained that the process was really easy and involved digging a shallow pit in to which the pottery to be fired are placed. These are then covered with wood and sawdust that is set alight. Then, once the flames have died down, the pit is covered with a sheet of corrugated metal and left overnight. Alternatively, and this was a method Helen said she used quite a lot, you could:

fill a cardboard box full of sawdust with your pots and bung it on a bonfire.

The process cannot really be controlled but after the fire glazing the surface can be polished with a smooth pebble to produce a high finish.

I choose Helen's box technique as a firing method and packed the warheads into a box full of sawdust. The packing and preparation of the warheads for fire glazing was done in the studio and driven by car to the firing site in the forest.

Once at the firing site, I constructed a bonfire from the pine, larch and birch around the box of warheads. I lit the bonfire using cotton wool balls, larch branches and firelighters, immediately creating a very tall vortex of fire (Figure 5.9). Afterwards, I kept fuelling the fire for a few hours by cutting up fallen trees in the wood before letting the bonfire die down. I was really struck by the intensity of labour involved in maintaining the fire; you are constantly in motion finding wood, sawing wood, carrying wood, or fanning and blowing the flames to keep the temperature of the fire high. At the end of the day my body felt smoked and the smell of the fire seemed to ooze out of my skin. Hours later I could taste smoke on my breath as I breathed out. The warheads were recovered from the ashes of the bonfire after a few days. They looked blackened and sooty as if they'd actually fallen from space or been used in combat (Figure 5.10).

I transported my warheads along the same stretch of A1 and A1(M) that is used to transport W76 Trident warheads from the AWE production site in Berkshire to their operational store at RNAD Coulport in Scotland. In this respect, the woodland has a

similar role to places like the White Sands Missile Test Ground, or AWE Foulness – it became an administrative blank spot to hide activity.[289]

Figure 5.9 (Left) Fire glazing first batch of warheads

Figure 5.10 (Right) Warheads after fire glazing

Could you say something more about this woodland site?

Yes, it is a wood that is privately owned by one of my supervisors. The wood is in the middle of County Durham and is relatively inaccessible and remote so that I was able to establish an experimental pit firing site. So, in a sense, through the process of making the small warheads, the requirement for covert places of manufacturing seemed to spontaneously occur, which has resonance with actual weapon production. However, the warheads are not the same as the W76 warhead. They have been drastically shrunk by production machinery, costs and availability of space. They are materially different with an appearance, touch, smell and taste like animal horn or tusk – they are becoming

[289] Trevor Paglen, *Blank Spots on the Map: The Dark Geography of the Pentagon's Secret World,* (Penguin, 2009), p.138.

something other through metamorphic transformations of war machine's processes. Nevertheless, some semblances to the W76 warhead remains.

I can see that they look like what Deleuze would describe as a becoming-animal. Or, what Donna Haraway would think of as a cyborg made of the bodily and technological aspects of the nuclear deterrent to become something other?[290]

The work also looks like they'd make you dirty or cause contamination and I wonder if this is metaphoric of working in proximity to your subject.[291] **Can you describe the preparations of these glazes and how this activity might draw out ideas of becoming animal or cyborg?**

The first batch of warheads were inserted into the box full of sawdust, which was mixed with blood and bone meal powder and fat balls that you feed the birds with in the winter.

From Helen's description of the fire-glazing process, these glazing agents should undergo chemical transformations in the bonfire to produce quite striking colours. However, the interior of the box did not achieve the temperatures required for these chemical changes to occur because, rather than serving as a fuel, the sawdust packing acted more like an insulator. While the bonfire itself burnt very fiercely, the sawdust within the box smouldered at a much lower temperature. I know this because there were bits of fat intact and unburnt sawdust still evident when the warheads were removed

---

[290] "Modern war is a cyborg orgy, coded by C3I, command–control–communication–intelligence, an $84 billion item in 1984's US defense budget". See Donna J Haraway, 'A Cyborg Manifesto: Science Technology and Socialist Feminism in the late Twentieth Century', in *Manifestly Haraway*, (Minnesota: University of Minnesota Press, 2016), pp.6–8.

[291] Supervisor meeting 30th July 2017.

from the remains of the bonfire a few days later. The glazing effects that you see currently are caused by soot impregnation and are probably not true fire glazes.

I prepared a second batch of warheads but this time thought that I would imbibe them with the glazing materials by placing them in a sealable bucket filled with fat, milk, butter, blood and bone meal. The bucket was sealed with gaffer tape and I left the warheads to soak, or marinade, for a week during the summer in the studio at Newcastle University (Figure 5.11).

When the lid was taken off, the warheads were immersed in this extremely foul-smelling ricotta-like cheese, which was a real problem to dispose of. In the end, the liquid was poured slowly down the sink under a rapidly flowing stream of water, while the clumps of cheese-like substance were doubled-bagged before being disposed of with regular waste. But the process had produced a very bad smell that clung to the studio. An attempt to vent the space had pushed the smell throughout the reception level of the Department of Fine Art, and was noticeable for a day or two. Fortunately, this event occurred during the summer so it caused little disruption and went relatively unnoticed. This I thought was interesting, if you bear in mind what has been said earlier about the warhead production sites, such as the woodland site, or how the actual process of making involves a similar administrative procedure to other manufacturing and supply processes. Now, after the incident in the studio, it was obvious that artmaking and other manufacturing also sometimes produce errors and accidents, which also have environmental consequences. In this case, it was a bad smell that was covertly dealt with, under other arrangements it could be a more harmful product of manufacture such as plutonium.[292] Hence, health and safety legislation does not differentiate between any

292 The Pangbourne Pipeline, until 2005, ejected waste water from AWE Aldermaston into the Thames at Pangbourne. See David Griffith of the Environment Agency's presentation to: Nuclear Awareness Group, *NAG Spring Meeting: The Untold Story Of Radioactive Discharges From The Atomic Weapons Establishment* <http://nuclearawarenessgroup.org.uk/content/nag-spring-meeting-untold-story-radioactive-discharges-atomic-weapons-establishment> [accessed 19 February 2019].

workspace, either art studio or warhead producer. It was a lesson learnt in health and safety.

Saying that, the warheads were nevertheless fired in an improvised pit at the woodland site beyond the gaze of H&S. But again, the fire did not reach the required temperature and the result was a glaze that was brown and yellow like burnt cream. They gave off a pungent smell and were slightly greasy to the touch. Only on one of the warheads was there some trace that a high temperature in some part of the pit had been achieved because there were beads of a green glass-like substance on one of the warheads. This has been the last firing at this site to date, and four of the warheads were left in the woods and are now completely covered by moss, like they are becoming part of the forest.

The use of materials such as blood and fat came from a line of thought that was influenced by the code names *Jenny, Reggie, Tony and Cleo* and considering how the names reminded me of a character from *The Good Life.* As explained earlier and in chapter 4, this was a BBC situation comedy from the 1970s that had given me the idea of a nuclear weaponware ceramic. I thought the notion did two things: first, it evoked the arts, craft and homeware of the time; and second, it collapsed the boundary between home environments and those of nuclear deterrence, like the experience I had talking to [redacted] about Faslane.

This idea was the basis for an unsuccessful application for a visual arts residency at Cove Park, which is situated about 1,500 m from RNAD Coulport. After that, I parked the idea until Burnie suggested using ceramic slip casting to mass produce the warheads. I thought at first that I would lava glaze the warheads, which evoked both the weapon being heated by the atmosphere as they descended upon their targets and 1970s pottery. However, Helen said that unless I was going to drink out of the

warheads, lava glazing was probably too complicated for what I needed. She explained that fire glazing can be effected by all sorts of materials including dung, fat or blood.

These bodily substances reminded me of an account in WG Sebald's *On the Natural History of Destruction* describing the visceral, and grisly, effects of Allied bombing on German cities during World War II.[293] One of the accounts describes recovery crews using flamethrowers to clear the cloud of black flies out of air raid shelters, while their footings slipped and slid on the fat that had been rendered out of the dead by the intense heat of the fire storm.[294] There is similar imagery in Raymond Briggs' *When the Wind Blows* when the book's characters, Jim and Hilda Bloggs, emerge from their shelter after the nuclear attack.[295] Jim, in an attempt at jovial stoicism, surmises that the smell of roast meat in the air must be because everyone has decided to have a Sunday roast dinner following the attack. So, the use of these bodily glazing materials was a way to embody the grim promise and biopolitical intention of strategic weaponry, and create a relationship between the bodies under threat and the weapons systems fixing them.

---

[293] WG Sebald, *On the Natural History of Destruction,* Trans. Athena Bell*,* (Munich: Carl Hanser Verlag, 1999), p.35–44.

[294] Ibid.

[295] Raymond Briggs, *When the Wind Blows,* (Penguin, 1982).

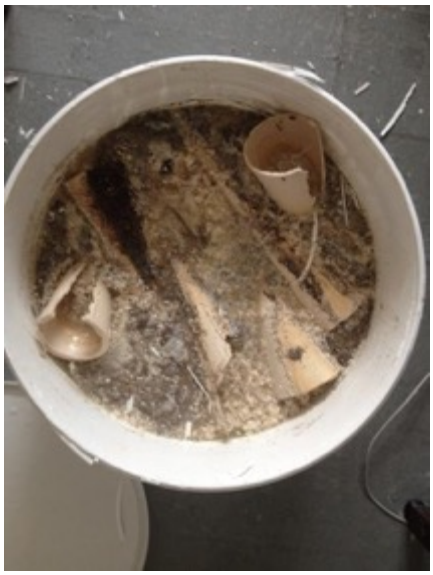

Figure 5.11 Warheads in glazing agent made from milk, blood and bone meal

The process you describe reminds me of Paul Virilio's assertion that a technological invention also produces a corresponding accident. Maybe we could understand, in a very creepy way, that the occurrence of spatial phenomena like the firing sites in the woods and corresponding accidents, are themselves noise elements like those that occur in your drawings, which have somehow been drawn out of history by the artmaking process.

I think the important point to understand is the artwork is not about representation, nor a container for symbolic or meaningful content; these notions render invisible the process and relationships produced by activities, including administration. These activities form a kind of background noise, or fluff that is easily disregarded as irrelevant by knowledge systems that are seeking meaningful and stable identities or what Rosi Braidotti says is privileging the noun over the verb. But, as we have seen, doing administrative activities, for example, permeates all kind of spaces that are otherwise thought of as separate – such as the art gallery, university and SSPAR radar station. Each of these spaces has events and materiality that are transferable to one another; for example, all of these spaces I've just mentioned have a post room, with rubber bands, A4 laser printer paper

and a photocopier. My interest is not what one thing or another means, or establishing a meaningful context, rather I am interested in what can be *actually*, and *not symbolically*, made from the material that flows between all of these spaces. The artworks that are new arrangements of material in the form of *actual* assemblages.

So all representation is disavowed?

No, but symbolic abstraction is treated as an affect of the coding mechanisms of DeLanda's assemblages with knobs on, which were described in chapter 2. The dials' function is to give the assemblage their individuated identity and functionality, which is never completely fixed but changes according to activity and circumstance.

Can you say something about the presentation of the warheads on the wooden platter? It reminds me of a cheeseboard.

Recently my supervisor, Phil Steinberg, sent me a picture of desserts and pastries from a Norwegian Airlines flight magazine (Figure 5.12). They looked exactly like *MM-w76-FTLP-012017* (2016–2017). I don't think I have articulated this food element to my supervisors but we have talked about contamination and bodily threat. I was interested in both these aspects, especially in regards to the cheese that was made from the glazing agents. The photograph I think implicitly filled the gap in the dialogue. It was in a similar manner that the presenting of the warheads on the wooden platter – like after dinner cheeses – emerged by a more implicit than explicit desire to draw out these associations. They materialised after I was scrolling through Francis Fukuyama's Twitter feed and I came across a few posts about a Nakashima dining table he was making. I was more familiar with Fukuyama's essay *The End of History and the Last Man* that was published during the end of the Cold War around the time of the fall of the Berlin Wall. It was strange but compelling to see Francis Fukuyama as a carpenter making a

dining table in his garage out of this really beautiful piece of natural-edged timber in the style of George Katsutoshi Nakashima.[296]

Like Vija Celmins, I had become a little obsessed with the photographs in the feed that suggested a way of presenting the warheads. I had spent some time polishing a few of the warheads that were removed from the bonfire; at first with a very smooth pebble, that began to bring out patterning (or noise) on their surface, and I then used silicon rubber colour shapers to refine the emerging patterns which were finally brought to a high finish with a polishing disc attached to a power drill. The process had really changed the quality of the ceramic, which felt very organic to the touch and smelt like horn or Victorian tusk. The polishing process seemed very like a process of becoming-animal or other. I wondered if presenting the warheads on a platter could be a way of presenting the warheads as an artwork that drew on connotations of food and the bodily harm we have discussed.

I bought the closest size of waney edged timber to what thought I needed from eBay, and spent a week sanding, varnishing and polishing the wood until the surface achieved this appealing appearance of fire. I attached four brass ball feet to the base of the platter and, when I placed the warheads onto the Nakashima style platter, I thought the result looked monstrous and grotesque.

---

[296] Francis Fukuyama, 27 July 2014, <https://twitter.com/FukuyamaFrancis/status/493451867922255872> [accessed 20 February 2019].

Figure 5.12 Photograph of desserts from an in-flight magazine sent to me by Professor Phil Steinberg

Explain more about this – because that's not the sense I get having seen it

The artwork was so different from the monochromatic appearance of my drawings I had been making, such as *The End of History* series described in chapter 3, or the mid-century aesthetics from the traffolyte work made for *Standby for the New Stone Age* at the York Cold War Bunker. These artworks I suppose were situated in the stable and reproducing geopolitical orders of the Cold War, Post-Cold War and War on Terror that continued into the Obama administration.

This order has been upset by the inauguration of Donald Trump, which happened a year into this research. The Trump presidency had/has disturbed the seeming inevitabilities and legislative order of international relationships. What has been particularly disturbing to me, given the research area of this thesis, was the way in which international protocols around nuclear arms control and deterrence partnerships, such as through NATO, are being destabilised. Especially during a time when both Russia and the United States seem to be testing the limits of the INF treaty. The treaty

had controlled the proliferation of a class of nuclear weapon systems such as IRBMs and GLCMs since 1987. Now Russia was starting to field new systems such as the R-28 Sarmat, which arms control expert Jeffrey Lewis states is a clone of the 1980s SS-20 IRBM, except it is capable of delivering ten half-megaton nuclear warheads onto any target anywhere on the planet.[297]

As explained earlier, the old Cold War mechanisms, such as MAD, were the circumstances from which, on a personal level, my drawings have been made, and on a geopolitical scale, from which foreign policy has evolved until then. But, different and unknown relationships and political assemblages were emerging, not least the apparent friendliness between Donald Trump and Russian President Vladimir Putin. I wondered if the strange object that I had produced could be the sort of thing Donald Trump might gift Vladimir Putin for the Kremlin. The artwork marked a dramatic change in the look of my work, and in doing so seemed to embody the unsettled time. The artwork became titled *From Trump Love Putin*, which was coded into the titling system as *FTLP* in *MM-w76-FTLP-012017* (2016–2017).

I now like the work because of its strangeness and monstrous appearance. The works seem to exceed the aesthetic norms that I had judged my artwork against for decades. I like to think of the work as a kind of blasphemy that Donna Haraway speaks about at the beginning of *The Cyborg Manifesto.* The work has all these different hybrid elements such as the polished wood platter, tusk, or animal-like warheads, 3D-printed elements, that all sit awkwardly together. For this reason, the work is really compelling because it is not a reproduction of skills and understanding that have gone before, but rather it is a different and new configuration of things that should not go together.

[297] 'Russian Nuclear Doctrine', *Arms Control Wonk,* [podcast], March 2018.

I am reminded of several quotes from The Cyborg Manifesto that seem relevant at this point, which I think encapsulate the genesis of the work. The first:

> **The most terrible and perhaps the most promising monsters in cyborg worlds are embodied in non-oedipal narratives with a different logic of repression, which we need to understand for our survival.[298]**

Also:

> **The main trouble with cyborgs, of course, is that they are the illegitimate offspring of militarism and patriarchal capitalism, not to mention state socialism. But illegitimate offspring are often exceedingly unfaithful to their origins. Their fathers, after all, are inessential.[299]**

And:

> **The cyborg skips the step of original unity, of identification with nature in the Western sense. This is its illegitimate promise that might lead to subversion of its teleology as Star Wars. [Strategic Defence Initiative] […] modern war is a cyborg orgy, coded by C3I, command–control–communication–intelligence, an $84 billion item in 1984's US defence budget […] the cyborg [is] a fiction mapping our social and bodily reality**

---

[298] Donna J Haraway, 'A Cyborg Manifesto', p.6.

[299] Ibid. p.9.

and as an imaginative resource suggesting some very fruitful couplings. Michel Foucault's biopolitics is a flaccid premonition of cyborg politics.[300]

We have talked about very complex material and affective relationships that compose the artwork *MM-w76-FTLP-012017* (2016–2017), which you say are actual things in themselves rather than symbolic representations or interpretations, and we have discussed the work in terms of cyborg assemblages made from organic bodily material, administrative technologies and weapon parts.

Can you talk about the digital video *MM-AV76-RCA-PP00052018* (2016–2018), because it shows many stages of the production of the warheads from *MM-w76-FTLP-012017* (2016–2017) in a particular documentary style alongside nuclear weapon manufacture at the Sandia National Laboratories?

The film started as an actual document for an annual progression review (APR) in 2016. The film was made by splicing together video and photographs using my phone, which I had used to document stages of *MM-w76-FTLP-012017* (2016–2017) production as a methodological record (see Figure 5.13). Because of the document's straight cinematography, which needed only to capture information about the making of the warheads, I discovered the film I had made had very similar qualities to footage released the same year by Sandia National Laboratory demonstrating the capabilities of the new modifications to the B61-12 nuclear bomb.[301] The Sandia film showed various tests of the non-explosive or nuclear components of the weapon in matter-of-fact

---

[300] Ibid. p.6.

[301] The weapon has full ground-penetrating capabilities, making it controversial as it requires a smaller-yield nuclear explosive that many think lowers the threshold of first use. Hans M Kristensen, 'Video Shows Earth-Penetrating Capabilities of B61-12 Nuclear Bomb', *Federation of American Scientists,* (2016) <https://fas.org/blogs/security/2016/01/b61-12_earth-penetration/> [accessed 21 February 2019].

sequences showing stages of the weapon design and testing. What was appealing about the Sandia film was the prosaic way it had been made; it was artless and matched my documentations for the APR. I also noticed that the bomb workshops were, in appearance, superimposable onto the Fine Art Department's metal workshop and so, as discussed earlier, the symbolic distinction between spaces collapse when considered as places of general activity.

So, I edited the footage I had taken of my warheads into the Sandia film of the B61-12 testing. I also included photographs of the W76 being handled at Lawrence Livermore National Laboratories. Again, there are similarities between the W76 workshop and the metal workshop in the Fine Art Department at Newcastle University. I also incorporated footage from a documentary film made in the late 1990s by the USAF Space Warfare Centre called *Impact Kwajalein.* This film is composed of edited highlights of a test flight of a Minuteman III ICBM from a launch site at Vandenburg AFB on the California coast to a target site 6,000 miles away at the Kwajalein Missile Ranges in the South Pacific.[302] The footage of the Minuteman III flight is interspersed with pictures of languid waves crashing on shore of the missile's paradise island target. Although, what is striking about the film, is the use of Talk Talk's *It's My Life* (1984) and *Children* (1997) by Robert Miles as the soundtrack. These additions are very ordinary and at odds with what we'd normally associate with ICBMs, making the documentary appear strange in its apparent ordinariness.

The shared visual style between my APR documentary footage and the Sandia bomb workshop, which are usually thought to be distinct, meant that both footages could be almost seamlessly spliced together to reveal interconnection between the materiality of one space on top of the other, even if what they represent is distinct. It also makes visible the social extensions of a weapon workshop that DeLanda discussed in chapter 4. The filming approach also reminded me of an essay by Fraser MacDonald,

[302] Space Warfare Centre, now Space Innovation and Development Centre, used to date the film.

Klaus Dodds and Rachel Hughes that analysed the role that PowerPoint played in producing evidence for supporting the Invasion of Iraq in 2003. It made me think about PowerPoint as a visual management tool that also crosses workspaces. They explain that PowerPoint is such an embedded component of the "infrastructure of business, government [military] and education" that it has becomes invisible.[303] Elsewhere, PowerPoint has been linked to the Space Shuttle Challenger disaster because it produces a standardised and privileged mode of visual representation, so that managers simply could not differentiate the importance of the message being conveyed from any other of the PowerPoint presentations they sat through in the course of their work. Indeed, General James Mattis banned the use of PowerPoint in military briefings during the US campaign in Afghanistan because its standardisation of information, for Mattis, "makes us stupid".[304]

So PowerPoint, like laser paper and photocopying, crosses all kinds of workspaces and its look, or similar software platforms such as iMovie that employ standardised effects and formatting, can be used to fold seemingly distinct places together.

---

[303] Fraser MacDonald, Klaus Dodds and Rachel Hughes, 'Introduction: Envisioning Geopolitics' in Fraser MacDonald, Klaus Dodds and Rachel Hughes (eds),*Observant States: Geopolitics and Visual Culture* (London: I.B. Tauris and Co. 2010) pp 7–8.

[304] Elisabeth Bumiller, 'We have met the Enemy and he is PowerPoint', *New York Times,* (2010) <https://www.nytimes.com/2010/04/27/world/27powerpoint.html > [accessed 21 February 2019].

Figure 5.13 Michael Mulvihill *MM-AV76-RCA-PP00052018* (2016–2018)

Digital video and flat-screen television

Several commentators have been disturbed by the films because they make an implicit connection between artmaking and the production of nuclear weapons[305]

A common response to the digital video work *MM-AV76-RCA*-PP00052018 (2016–2018) is disquiet at how artmaking, which is usually associated with things that are good, are put next to images of nuclear weapons manufacture, which are thought of as bad objects. But these types of binary ethical positions also hide the way assemblages operate because they also rely upon categories that are inscribed by representation. By incorporating the vernacular of films, such as the one produced by Sandia National Laboratory to document the production of *MM-w76-FTLP-012017* (2016–2017), hidden

[305] Question from a fine art undergraduate during the exhibition *Jenny, Reggie, Tony and Cleo,* January 2018, Long Gallery, Department of Fine Art, Newcastle University.

processes and roles, such as taken-for-granted things like PowerPoint, can be grasped.[306]

For example, a few years ago, I was a director of a small arts and wellbeing social enterprise, and in this capacity I was invited to a two-day workshop called *Building the Social Enterprise City* organised by Gateshead Council and Newcastle University's business school. The workshops were premised upon the idea of using Design Thinking to embed "resilience" and entrepreneurial approaches into the business models of voluntary sector social care providers.[307] The workshops were led, and keynote speeches given, by special guest presenters from the Centre for Design Research (CDR) at Stanford University.

The participants were composed of councillors, academics and invited third-sector organisations. We were organised into groups and taught to use creative practice and Design Thinking methods to identify the problems that needed solutions in our sectors. The process involved lots of tape, marker pens, Post-it notes, pitches and presentations. As a result, at the end of the day, we were a very well bonded group with a collection of artworks. The workshop was punctuated by presentations that explained how Design Thinking methods are applied in CDR's Mechatronic Systems Design ME210 course. The teams that produced the iPhone, Google, Cisco Systems and Instagram are direct results of students and alumni of ME210 and Stanford University's CDR. It was explained that the alumni of CDR circulate around companies and organisations such as Apple Computer, Hewlett Packard, Palo Alto Research Centre, Lockheed Martin Advance Development Programmes (that produced the F-111 Nighthawk Stealth Bomber), and the Defense Advanced Research Projects Agency

[306] Dr David Spittal, Rough Cut, Tyneside Cinema.

[307] Building the Social Enterprise, 2014.

because their skills and know-how are transferable across domains through social relationships.[308]

So, in *MM-AV76-RCA-PP00052018* (2016–2018) elements that would normally be invisible because they are considered as supports only for the film content, are considered as the actual components to the artwork. They are the material and real outcomes of the flow of labour between the tech and military tech companies described above. These materials and components, which include the smart TV, or Apple iBook as well as software applications such as QuickTime, all form part of the same materiality of the military–technological–social assemblage that is also depicted in the film. So, the artwork is not mimetic, nor does the work represent the W76 warhead in a meaningful way, instead it assembles something different out of components that are common to military, nuclear weapons and artistic productions such as CNC milling, PowerPoint and Apple Computers and are relatable to administrative technology of universities such as annual progress reporting. Also, the university as an institution, for example Stanford but also much of Newcastle University, is attributed to finance from naval shipbuilder and arms manufacturer Lord Armstrong. By shifting between the artwork manufacture, weapons production and military practice, I think the film creates a zone of indeterminacy, or a deterritorialisation, which we have seen described by DeLanda in chapter 2. This unsteadies normative social organisations based upon discrete categories and representational modes of knowledge.

How do you feel about the connections you are making with what is commonly termed the military–industrial complex and the seemingly prosaic every day?

[308] See DeLanda on the social space of the battlefield in this thesis chapter 4.

I have expressed discomfort to my supervisor Rachel Woodward about the research from time to time. Particularly when I began the artist residency at RAF Fylingdales, which seemed at the time like standing in the teeth of the military war machine. We arrived at several points about doing critical military research, in which I see my art practice as being situated.[309] Firstly, it is impossible to do critical military research without being close to or engaging with militaries; otherwise it is impossible to know or have experience of the way militaries operate in details other than a general overview.[310] Secondly, not all military activities are about dealing death; after all, armies are composed of individuals with different motivations for joining that do not involve killing.[311] At a fine-grained social level, militaries begin to appear as heterogeneous arrangements with broader cultural and social affinities than would be imagined, this has been my experience of working at RAF Fylingdales.[312] However, the productions of death-dealing military war machines are everywhere, every day and unexpected in their occurrences. And this is precisely the point in doing the research in the first place. [313]

The graphite block seems to be a complete thing in itself and does not have the same heterogeneous look or feel that the other artworks in the exhibition have. Can you talk through this?

MM-w76-GRAPHITE-RT-30112017 (2017) is a ready-made block of graphite but still, in its materiality, blurs and unsettles the distinction between art and nuclear military

---

[309] Supervisor meeting with Rachel Woodward, 30 July 2017, Department of Fine Art. Also Alison Williams et al., *Routledge Companion to Military Research Methods,* (Abingdon: Routledge, 2016).

[310] Rech et al., 'Geography, military geography, and critical military studies', *Critical Military Studies*, 1(1) (2014), pp.47–60.

[311] K McSorley, 'Towards an Embodied Sociology of War', *The Sociological Review,* (2015), Accepted Author Manuscript, accepted for publication, (2014) pp.9–15.

[312] Supervisor meeting with Rachel Woodward.

[313] Ibid.

production (see Figure 5.13).[314] For this reason it is related to the warheads but comes much closer to the production process of nuclear weapons. And the best thing about it, is that the block of graphite arrived completely unannounced.

I had been away from the studio for a few days at RAF Fylingdales for a celebration to mark 25 years of the SSPAR radar operations and at Hospitalfield in Arbroath for AHRC training.[315] When I returned to my studio, this block of graphite [points towards a large block of graphite] was lying on the floor. I immediately picked it up and started thinking around using the block as a possible interesting base for a sculpture that I had been working through. But something is not right, and I get quite anxious that it is not graphite but a block of lead, which I've been handling without gloves. The foul milk had been a lesson in how a wide area can be affected by an accident, even if it was just a smell. But the block left black marks on my hands, and the edges were soft and brittle, suggesting that it is in fact graphite. This assessment is confirmed the next day by my friend and colleague with whom I share my studio. Harriet [Sutcliffe] tells me it was left in the space by Richard Talbot, who is the head of fine art research at Newcastle University. Richard had been given the graphite block by his brother to use to make drawings. But, the block is unwieldy and his work requires very fine details so he gave it to me. Harriet explained that the graphite had come originally from the Lake District. This made sense because graphite was mined around Borrowdale at Seathwaite, and the pencil industry began nearby in Keswick.

But the block looked like it had been industrially produced and milled for a purpose other than drawing. I ask Harriet if Richard had said where in the Lake District the block had come from. Harriet tried to remember:

---

[314] Tate, *Art Term: Readymade,* [n.d.] <https://www.tate.org.uk/art/art-terms/r/readymade> [accessed 8 March 2019].

[315] See following chapter for RAF Fylingdales SSPAR.

Erm, I think somewhere called Wind… er… something… I can't remember.

I offered Windscale?

Yes, that was it, Windscale.

While graphite's material properties, in the manner they are discussed by DeLanda in chapter 2, mean it is a very good drawing material, graphite also has good material capacities to slow down neutrons released from neutron bombardment of uranium 238 (U238) in order to produce nuclear fission. A by-product of U238 fission is plutonium 239, or weapons-grade plutonium, which is used to construct the pit of fission primaries in two-stage thermonuclear weapons described in chapter 4. Plutonium and tritium (used as fusion fuel in thermonuclear weapons [chapters 2, 3 and 4]) had been made in the Windscale reactor piles that had been built only for the UK nuclear weapons programme. Each of the Windscale piles consisted of 2000 tonnes of graphite to form a block measuring 7.3 metres high and 15.2 metres in diameter into which the fuel rods of U238 for plutonium manufacture were inserted, and lithium–magnesium for tritium. Any graphite that had been in the core would be fiercely radioactive. I was pretty sure that this particular block of graphite had not been part of the reactor piles because once the graphite had been installed in the reactors, it would remain an integral part of the reactor until decommissioning. After that, the block would be stored on site as long-term and extremely dangerous radioactive waste.

However, having an artefact with a provenance claim to the Windscale reactor piles and the UK's nuclear weapons programme sitting on the table in my studio is nevertheless unsettling. I contact a friend, Dr Rebecca Alexis-Martin, whose previous job had been with Dorset County Council who developed plans for radiological emergencies. She reassured me that the block could not be dangerous and a major nuclear disaster was

not currently happening at Newcastle University. Becky advised that I could run a radiological survey meter over the block.[316] I was happy that the block was okay – after all, Richard had been driving around with it in his car for weeks and looked absolutely fine.

Richard later told me more about the block. He said that while the block had been manufactured for the reactor pile at Windscale, it had spent time as a teaching aid in the engineering department of Newcastle Polytechnic,[317] before making its way into the possession of sculptor Nicolas Talbot (Richard's brother), where it had languished in his shed for 30 years. Then the block was passed onto Richard and it sat in the back seat of his car for several weeks before being deposited onto my studio floor.

I think some more work needs to be done on investigating the provenance of the block because, according to AWE historian Lorna Arnold in *Windscale 1957*, the design of the piles does not fit the block in the studio. However, Arnold also describes an earlier design that had been cancelled but for which a large amount of the reactor core graphite had been produced by Union Carbine. This could be one of those blocks because the description is a better fit.

What I find amazing about the block is that it could be used to make drawings, even if this wasn't the intended purpose, and plutonium that might still be supplying the UK nuclear weapon stockpiles. The block is an absolutely and actual embodiment of what I have been attempting to achieve with the warhead sculpture, or the films I described earlier, or the attention I have paid to administrative and manufacturing process. It is an artefact that, through its journey from, maybe, Windscale, to a shed, to Richard's car, to the studio floor has undergone a deterritorialisation and crossing between the domains

[316] Dr Rebecca Alexis-Martin, Geographer at Manchester University.

[317] Now Northumbria University.

of art and weapon production. For this reason, it speaks to Donald MacKenzie's discussion about the Lawrence Livermore weapon designs, and Manuel DeLanda's extensive and extended battlefield social space. But crucially, it is an actual and real embodiment of the complexity and far-reaching interactivity of the military–industrial–nuclear social assemblage.

Figure 5.14 Michael Mulvihill *MM-w76-GRAPHITE-RT-30112017* (2017)

Industrial graphite (for plutonium production in a reactor similar to the Windscale piles)

Plywood, cashmere carpet

You mentioned in passing how the residency at RAF Fylingdales came about?

The residency placement at RAF Fylingdales came about during the opening reception for *Standby for the New Stone Age* at English Heritage Group 20 Royal Observer Corp York Headquarters Museum, otherwise known as the York Cold War Bunker. I had been invited to respond to the bunker that coincided with the 70th anniversary of the detonation the world's first nuclear device on 16th July 1945. The exhibition also marked the culmination of a body of practice-based research as Leverhulme Artist in

Residence with the Military War and Security Research Group based in the School of Geography, Politics and Sociology at Newcastle University.

I produced some artworks that were a direct response to the administrative materiality of the bunker space, such as the etched black traffolyte artworks. These large etched plates are a result of conceptually collapsing the friendships between art historian Meyer Schapiro and nuclear strategist Albert Wohlstetter, discussed in chapter 2, into the data sets produced by geographer Stan Openshaw (see chapter 4).[318] This resulted in quite formal abstract and modernist artworks that spoke to previous drawings I had made about the end of painting and the end of history (see chapter 3).

Other artworks were insinuated among the bunker artefacts to produce affinities and resonance with the Cold War space. For many people visiting the exhibition, including those who had worked in the bunker as members of the ROC, there was no distinction between the artwork and artefacts. One ROC veteran thought an installation of small drawings of nuclear weapon tests called *In pursuit of an improved NHS* (2012–2015) had always been part of the fabric of the bunker.[319]

But it was during the preview event that I talked to Dr Faye Prior at York Museum Trust, who told me about RAF Fylingdales building a Cold War museum on site. I was really intrigued, but at this point I had an expectation that the museum might consist of a few display boards of photographs and the NBC suit in a Nissen hut somewhere on site. Faye put me in touch with Flt Lt Richard Weeks, who would be responsible for building the museum, and who invited me to visit during February 2016.

---

[318] See chapter 4.

[319] Anecdotal feedback from English Heritage guides.

The museum and archive far exceeded my expectations. It is situated in a large storage facility that was originally the RCA maintenance and supply building. As explained earlier, the supply part was shifted to Curzon House during the 1970s. The archive contains all sorts of materials, from large control consoles and radar machinery, to hundreds of photographs relating to important visitors and the construction and operation of the site since 1960. There are also documents and paperwork, training manuals, even sections of the old geodesic domes. So, after a three-hour tour, Flt Lt Richard Weeks asked what I wanted to do with the archive. I suggested an artist in residence. Richard said if that could be explained simply on one side of A4, then the proposal could be submitted to RAF Air Command for approval. He made the point that if the proposal was too complicated, they would just say no.

Approval was given and the residency commenced the following September.

So, are these speakers from RAF Fylingdales?[points to speakers in room]

The speakers are from RAF Fylingdales and were part of the tannoy system that was installed in 1963 that is still being used. The speaker in the exhibition is one of a pair that were going to be thrown away due to water damage, but were rescued by Richie Weeks, who wondered if they could be turned into an artwork. A serial number on the inside of the speakers shows that they were made at the RCA Camden plant in New Jersey, which is better known for making gramophones, televisions and stereos; it was the given name of RCA Camden which, during the 1950s, made the vinyl for Elvis Presley records. We keep looping back to widely held cultural symbols like Bowie or Presley actually being produced by the same machinery of deterrence. Today, like many of the RCA holdings in New Jersey, including the other plants that built RAF Fylingdales, they are now owned and operated by Lockheed Martin. This point again

crosses with the materialities of *MM-AV76-RCA-PP00052018* (2016–2018) of everyday electronics being functioning parts of military complexes.[320]

The artwork as it appears in this exhibition is an assemblage composed of the RAF Fylingdales RCA speaker, and an Apple mini mac that streams a Spotify playlist made of music released by RCA records. The playlist was originally made to run as a soundtrack played on Spotify for the film *MM-AV76-RCA-PP00052018.* But this arrangement changed for the exhibition *Jenny, Reggie, Tony and Cleo* in the Long Gallery at Newcastle University. The gallery is a corridor-like space made of one long wall, a short wall and windows. So, I needed to play around with the curation of the work. This meant separating the moving image component of *MM-AV76-RCA-PP00052018* for display on a large smart TV, while the sound component of *MM-AV76-RCA-PP00052018* became a new work *MM-w76-INPROGRESS-xxxxxx* (2018) (Figure 5.15). Music played from *MM-w76-INPROGRESS-xxxxxx* (2018) became the soundtrack to *MM-AV76-RCA-PP00052018* and is like piped music being played throughout the exhibition space. I really enjoyed that the sound is carried from a speaker that might have broadcast the message that RAF Fylingdales and the Western World was under nuclear attack.

[320] Hoag Levins, 'A hundred years of Camden's RCA Building 17: Former Employees Pack Centennial Event in Famed "Nipper" Landmark', *Historic Camden County* (2009) <http://historiccamdencounty.com/ccnews140.shtml> [accessed 21 February 2019].

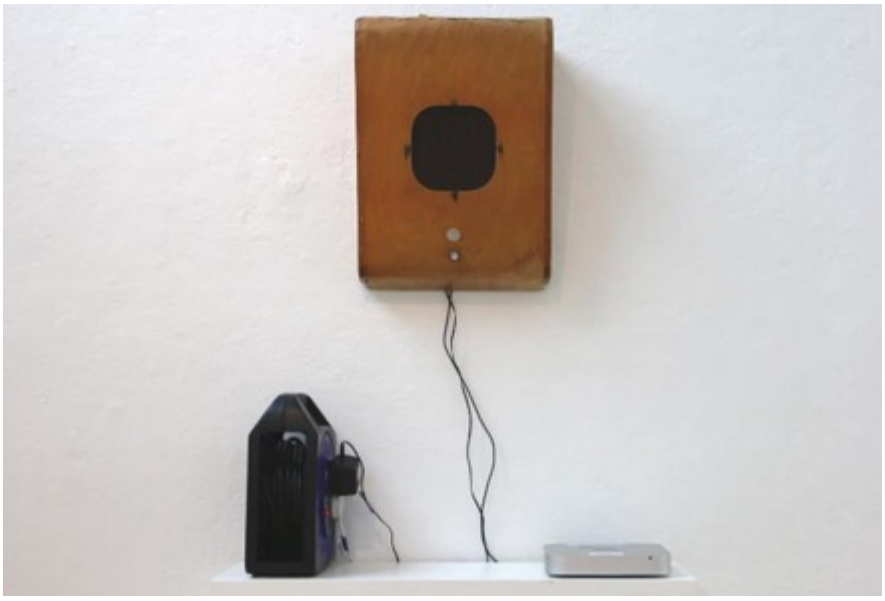

Figure 5.15 Michael Mulvihill *MM-w76-INPROGRESS-xxxxxx* (2018)

RCA speaker from RAF Fylingdales in operation until 2017. Apple Mini Mac, Spotify running selected playlist of RCA records

We seem to have returned to talking about records, as in vinyl. But at this point, can I bring up the archive because the work has been made in response to RAF Fylingdales. It strikes me that archives, cyborg administrative technology and assemblage are all interchangeable concepts that inform your practice. Ian Biddle describes a contemporary phenomenon of archivism, where the everyday is structured by archival management systems, such as Spotify, which you mentioned, that curate data from electronic archives. And this seems to fit with the notion of transferability of practical know-how between social spaces of cultural experience and nuclear warfare. I am reminded of a quote from Michel Foucault's *Archaeology of Knowledge and the Discourse on Language* (1972) used in an essay by Okwui Enwezor to accompany his exhibition *Archive Fever*, which I think captures this tension between undetermined becoming and the administrative meaning making of curating an exhibition:

> The archive is first the law of what can be said, the system that governs the appearance of statements as unique events. But the archive is also that which determines that all these things said do not accumulate endlessly in an amorphous mass, nor are they inscribed in an unbroken linearity, nor do they disappear at the mercy of chance external accidents; but they are grouped together in distinct figures, composed together in accordance with multiple relations, maintained or blurred in accordance with specific regularities; that which determines that they do not withdraw at the same space in time, but shine, as it were, like stars, some that seem close to us shining brightly from far off, while others that are in fact close to us are already growing pale.[321]

I have been conscious that the artworks should emerge as a result of accumulation and happenstance and are not the result of some kind of overarching and singular artistic vision. Instead, the artwork is made over extended periods of discontinuous time, and is more like a process that assembles archive material composed of encounters, memories, different materials and other sense data, such as smell, into an embodied processing such as drawing and artmaking. Jean Fisher articulated this approach really well in her essay *On Drawing,* particularly when she says that drawing is unfixed by a single plane but rather it spans dimensions in space and time (see chapter 3). It is not just about marking paper – drawing is an expansive activity, meaning it is also an activity that requires time to fixate on experiences or images. Earlier, Vija Celmins described the process as like falling in love, and I suppose it is similar because it is marked by intensities and experience as much as thought or reason (see chapter 3).[322]

The warhead work *MM-w76-FTLP-012017* (2016–2017) took over a year to complete because it proceeded through feelings, instinct and a desire to work with those strange

---

[321] Michel Foucault, quoted in Okwui Enwezor and Willis E Hartshorn, *Archive Fever: Uses of documents in Contemporary Art,* (Göttingen: Steidl, 2008).

[322] Vija Celmins.

cones, allowing them to emerge and change through the process of making, without any clear idea of a destination. As a result, the process of the artworks' manufacture is fractured and discontinuous, where some parts were recycled to become new elements. For example, as well as using clay to slip cast, I also made wax that I never used. One day, I sliced up one of the cast wax warheads. The bits had a resemblance to ballistic orbit cones, and because they were wax I felt that these fragments of the warhead should be cast in bronze for no discernible reason other than anticipating how the object would feel in terms of weight and even smell.

Unfortunately, because I had made the wax warheads from paraffin wax, I could not use the lost wax technique commonly used for bronze casting. As a result, I spent an entire month working five days a week making a mould of compacted sand. The casting sand smelt, not unpleasantly, of petroleum and needed sieving over the wax warheads to create a layer about 50 mm deep before being compacted down to a hard, thin layer. The process was repeated until one half of the mould was made, then the entire block of sand, which is encased in a steel box, is flipped over, dusted with chalk, and the other half of the mould is made, incorporating venting holes and a pouring channel for the molten bronze (Figure 5.16).

The bronze casting was delayed for a couple of months during the lead up to the undergraduate degree shows, when the workshop is heavily used. But in June 2017, the bronze was poured and when the metal cooled it looked not unlike poured military grade plutonium oxide in that both metals have olive yellow appearance (Figures 5.16, 5.17 and 5.18). But this resemblance, like the rest of the work, is a result of an emergent practice, which comes about through a sometimes arbitrary accumulation of materials linked to experiences, knowledge and desire. Like the process of fossilisation described in chapter 3.

Figure 5.16 (Top left) 5.17 (Top right) and 5.18 (Bottom left) Bronze smelting in the Department of Fine Art

Figure 5.19 (Bottom right) Weapons-grade plutonium ingot

This meant that for a while, the studio had the look of an intense pile of stuff, which included emerging artworks, photocopies of RAF Fylingdales archive material, video being played on my laptop along with Spotify playlists and, recently, the block of nuclear graphite. All these different bits seemed undifferentiated and for a while I had the idea that the artworks should be shown as miscellany of material.[323] Phil Steinberg enjoyed the pile of material saying that he thought there was a layering of complexity occurring, commenting that it was becoming more than a traumatic childhood memory about the possibility of nuclear war.[324] This view is similar to Sharon MacDonald's description of

[323] Ian Biddle, 'Archives and Archivism', lecture delivered at Newcastle University, 13 February 2017.

[324] Supervisor meeting, 17 May 2017, Department of Fine Art, Newcastle University.

heritage sites as memory complexes, which are assemblages of practices, affects and physical things that include memorial services, nostalgia and history artefacts.[325] This observation overlaps Jean Fisher's notion of an artist as a zone through which spatial and temporal experiences combine, which superimposes over Deleuze's notion of the BwO (Figures 5.19 and 5.20).

Assembling the exhibition *Jenny, Reggie, Tony and Cleo* was a sifting process, and I have described the way that consideration of the Long Gallery architecture resulted in the decoupling of *MM-AV76-RCA-PP00052018* and *MM-w76-INPROGRESS-xxxxxx* into two separate artworks. It also influenced a formal decision to adopt a museological approach to displaying the artworks and enclosing *MM-w76-GRAPHITE-RT-30112017* (2017) and *MM-w76-FTLP-012017* (2016–2017) (the warheads) into Perspex cases. The boxes were intended to provide protection for the artworks because the Long Gallery is actually a heavily used corridor. However, I think they help emphasise that the artwork is an artefact in the sense in which the drawings or letters of Antonin Artaud are documents of the poet's lived bodily experience (see chapter 3).

It seems that artefact and document are treated as the same?

That is entirely correct. What I've been trying to stress throughout this thesis is that the artwork in not just an object of contemplation. Rather it is an actual artefact, or of what Simondon calls *techno-aesthetics* (chapter 2), or Deleuze and Guattari articulate as becoming (chapter3), or Delanda calls creative variations (chapter 2 and 4). The art work is a document, or artefact of actual materialisation experience and tacit encounter from which analysis is made. I refer to Artaud in chapter 3 because he make very clear how a document more than a general idea of a piece of paper work. Rather it is a record of actual bodily encounter that is probably worth requoting at this point. Artaud says that his letters are:

> not drawings but documents. [...] that I have made by living my strokes, not with

[325] Sharon Macdonald, *Memorylands*: *Heritage and Identity in Europe Today,* (Abingdon: Routledge, 2013), pp.5–6.

the hand only but with the rasping of the breath of my trachea and the teeth of my mastication.

This is precisely the sense in which I use the term artwork. The artwork is an actual historic artefact of tacit encounter and experience. It's critical import derives from the processes of change it undergoes. Also as articulated at the beginning of this interview I see administration in terms of the technology of bio-political organisation. An extending from Artaud I think of administration concerns records of the tacit and political coercion of materials and bodies in space. Furthermore, from a conservation point of view the distinction between an artefact, artwork or document is meaningless. All are subject to material interactions that cause them to decay and conservation is a kind of administration of an objects historic material deterritorialization.[326] So I make no distinction, or have the urge to classify administration, artwork, artefact, or document into terms of what Delanda calls 'reified generalities' (see chapter2). I think also this is very clear when you see the work in exhibition with the other RAF Fylingdales objects, both become parts of the same geo-historic assemblage, or a Four Minute Warning Drawing Machine made of artwork, admins and parts of nuclear deterrence.[327]

Figure 5.20 (Left) Studio at Newcastle University

Figure 5.21 (Right) RAF Fylingdales collection store

[326] From September 2018 to May 2018 I was assistant curator for English Heritage's Cold War archives. Artefacts and the artefact's documentation accounting for its provenance are both subject to deterioration as such they should be viewed in terms of historic materiality.
[327] See Unblinking Eye: 55 years of space operation on Fylingdales Moor exhibition Whitby Museum August – November 2019

Can you talk more about this approach to exhibition making, and the disquiet I sense you have about exhibition making? *Jenny, Reggie, Tony and Cleo* has been really well received and some have commended it as "a handsome exhibition."[328] The equivalences being drawn between nuclear weapons production and artistic craft resonated strongly with many visitors who expressed disquiet at the proposition. On the whole, *Jenny, Reggie, Tony and Cleo*, as an exhibition, seems successful.

I suppose after I had produced the exhibition *Standby for the New Stone Age* (2015) I found it difficult to return to the formal white-walled exhibition spaces. My practice comes from a background of institutional critique and socially engaged practices except that I make art objects, which are in themselves intersectional discursive sites.[329] This practice was viewed as idiosyncratic by social practitioners I worked with in Chicago, such as AREA Chicago. Their approach is to view the crafted art object as commodifiable and therefore an operation of state capitalism.[330] Yet, the methods that I was using to form the drawings and their critique aligned with their concerns while at the same time being out of reach of their experience.[331]

Can you explain a bit more?

---

[328] Professor Andrew Burton, comment during *Jenny, Reggie, Cleo and Tony,* January 2018, Long Gallery, Department of Fine Art, Newcastle University.

[329] Miwon Kwon, *One place after another: site-specific art and locational identity* (Cambridge: MIT Press, 2002), p.103.

[330] Claire Bishop, 'Participation and Spectacle: Where are we now?', in Nato Thompson ed., *Living as Form,* (New York: Creative Time, 2012).

[331] Arts Council England, supported residency at InCUBATE, June–August 2008, Chicago.

I think this was the time when I started to take on concerns and practices of geography as much as fine art. AREA Chicago was a contributor to Nato Thompson and Trevor Paglen's *Experimental Geography* (2008) exhibition, with their community-based engagement *The People's Atlas.* Thinking back, this project probably drew upon the geographer Bill Bunge's work. The notion of a city as a spatial, interactive and social domain was a strong influence on artists and activists in Chicago at the time, so I would spend the day cycling around Chicago or taking the "El-Train" downtown collecting digital photographs, which became the drawings for *The End of History* series. As explained in chapter 3, the drawings came about through consideration of intersections between the Cold War narratives I experienced in the 1980s, the War on Terror and an "endist" teleology in modernism. I directed these discourses upon the urban space of Chicago, which contributed to discussion around themes that were emerging from the *Experimental Geography* project focused on disaster capitalism and urban militarisation.[332]

But the Leverhulme Artist in Residency with the Military War and Security Research Group (MWSRG) presented a new way of looking at space which, from my own experience up until then, had been to look at space as intertextual and socially constructed,[333] or as a static space into which inscriptions and meaning are projected. The understanding I gained from the MWSRG was that space is in constant production through all kinds of human and non-human activities, which are actual rather than abstract. The main focus of MWSRG concerns are spatialities produced by interactions between military and civilian activities such as in airspace, or by military training, or how military securities become coded into everyday lived experience.[334]

---

[332] Nato Thompson and Trevor Paglen, *Experimental Geography,* (Brooklyn: Melville House, 2009).

[333] Miwon Kwon, p.159.

[334] See Alison Williams et al., *Routledge Companion to Military Research Methods* and Stephen Graham *Cities Under Siege: The New Military Urbanism,* (London: Verso, 2010).

While working on the Leverhulme Residency, I was reading Pamela M Lee's *Aesthetic Strategist* (see chapter 2) and was really interested in two films by Hito Steyerl, *Guards* (2012) and *Is the Museum a Battlefield* (2013). In *Guards* two former servicemen revert to their military training while working in their new role as guards in a gallery, while in the performance lecture *Is the Museum a Battlefield*, Steyerl engages in a fine-detailed institutional critique of the contemporary art museum. The film develops the idea of constellations of social relationships between a bullet made by Lockheed Martin, which had killed Steyerl's friend, Andreas Woolf, a fighter for the Kurdistan Workers Party on a battlefield in Turkey, and the installation of a new artwork in a wing of The Arts Institute of Chicago that was also funded by Lockheed Martin.[335]

Ana Teixeira Pinto observes that Steyerl critiques aesthetics that elevate artworks from their social form and labour of production.[336] This process of elevation actually needs to be manufactured by the art institution through socio-administrative technologies.[337] I was interested in this observation because it reframes the gallery not as a space of exceptional and refined art experience, but as one that is coded by exactly the same administrative assemblages comprising emails, spreadsheets, word processors and emulsion paint that are used to codify nuclear military spaces such as the Space Operations Room at RAF Fylingdales, or geography and fine art departments in universities. Except in a gallery, the emulsion paint is often white, or black for a space showing video, or sometimes grey. By contrast, in clerical spaces, or in a university, or in spaces of nuclear deterrence, the typical emulsion is magnolia; yet, they all amount, in some degree, to the biopolitical organisation of bodies in spaces and time.

---

[335] Museum Battlefield, 'Is the museum a battlefield', (2013), *Vimeo,* <https://vimeo.com/76011774> [accessed February 2019].

[336] Ana Teixeira Pinto, 'Hito Steyerl's "Left to our own devices"', *Art Agenda,* (2015) <https://www.art-agenda.com/reviews/hito-steyerl%E2%80%99s-%E2%80%9Cleft-to-our-own-devices%E2%80%9D/ > [accessed 21 February 2019].

[337] See chapters 2 and 3.

Jenny, Reggie, Tony and Cleo I think goes some way towards making visible the socio-administrative technologies of exhibition making, and shows previously invisible social relationships of the nuclear military war machine. I had thought of painting the entire Long Gallery in magnolia emulsion but I settled for doing this only on the far wall and on the two plinths that supported the warheads and graphite block artworks. The tone I chose was an oat white but still had the possibilities of a tone used by Carillion, who then maintained RAF Fylingdales, and it is the tone of paint I have seen used in the SSPAR. However, I think the notion of folding the military space into a contemporary art space is limited by the deep art historical inscription of contemporary art spaces. Anything that is put in these spaces is captured or appropriated by the operational discourse of contemporary art. The appeal of deploying artwork into RAF Fylingdales is that there is an opportunity, as Guattari says, to draw upon art's abilities to generate other, more paradoxical, criteria.[338]

RAF Fylingdales is less conventionally coded for showing artwork and the way this space is understood is up for renegotiation by activities that are outside the terms of its ascribed military meaning. For me, this raises interesting questions about what kind of encounters occur when critical art practice takes place at a BMEWS? What affects are produced by lived memories and experiences such as those described in this thesis when they are assembled among the actual technology of nuclear deterrence? What kind of memory complexities or nuclear cyborg war machine will be made?

[338] Claire Bishop, 'Participation and Spectacle'.

Chapter 6: The Four-Minute Warning Drawing Machine

Flt Lt Richard Weeks looked a bit perturbed and slightly worried. I had mentioned that I will be leaving the archive early to take advantage of the warm and sunny afternoon and explore the countryside around RAF Fylingdales. I knew I hadn't made myself clear because I was stumbling over unfamiliar names of bridal and public paths that lead from the Hole of Hollcum, past Lille Cross, which is close to RAF Fylingdales' perimeter fence, and towards Robin Hood's Bay on the coast. Instead, it seemed I had given the impression that I was proposing to walk through the security area, out of the electric gates and make an immediate right hand turn to walk around the security fence.

> I think it is a great idea for you get the sense of how the station sits in the landscape, but we need to make sure you don't get yourself bundled in the back of a van and never seen again.[339]

I presumed Richie was joking but he still looked serious and thoughtful.

> I'll make a few phone calls and let everyone [security] know what you are intending to do and why. Otherwise it may take some time to extract you if you're picked up by a patrol.[340]

I tried to backtrack and said if the suggestion was causing trouble it did not matter but Richie thought it was a good idea and I'd see parts of the SSPAR that the public do not get to see.

---

[339] Conversation occurred during a visit to RAF Fylingdales, 31 May 2017.

[340] Ibid.

We walk back into the Station Head Quarters (SHQ), a single-storey prefabricated building designed to sit underneath the pulsed energy beam from the SSPAR radar.[341] The SHQ is one of the original buildings from when RAF Fylingdales was built, but now has a pitched room that was added in the 1990s. Once inside, we go into Richie's office, shared with MOD assistant Natalie Bliss, which overlooks the staff car park and the SSPAR radar building.

> Hi, this is Flt Lt Richard Weeks, just letting you know our artist in residence will be walking on foot around the perimeter within the next hour. We think that it is a good idea that he gets a sense of the station in the landscape. Just to let you know, it is a friendly forces operation that will be completed in one hour's time. Repeat: friendly forces operation. Okay, thanks, bye.

> Right, Michael. If you leave through the first gate and make yourself known at the guard house then they'll open the outer gate. Turn immediately right and you can follow the path along the perimeter fence. I would make sure your security pass is in your pocket and not clipped onto your clothes just in case you drop it, because you'll need it to identify yourself to a patrol. Please don't take photographs, security really won't like that and they can see everything on the CCTV. But we can arrange for photographs to be taken later if you make a note. However, if you see any adders please do take a photograph for conservation and don't worry if you get bitten; security will see you drop on the CCTV and have a patrol to you in seconds.[342]

---

[341] Observed by Professor Richard Clay at RAF Fylingdales during recording of *Two Minutes to Midnight* with Elle Clifford from Whistledown Productions, August 2018, see *Two Minutes to Midnight,* [Radio programme], BBC Radio 4, 7 September 2018.

[342] RAF Fylingdales visit, 31 May 2017.

6. 1 Introduction

When the event described above occurred, I had been travelling to RAF Fylingdales on a monthly basis for almost one year. By assigning the artist in residence as a friendly unit for the next hour, I became aware of being entangled in the rhythm and routine of RAF Fylingdales.

In chapter 2 we looked at Manuel DeLanda's idiosyncratic assemblage theory by his additions of control nobs; however, DeLanda also states that no assemblage will assemble with other assemblages unless they want to.[343] Deeply territorialised and policed assemblages do not freely connect with other assemblages that do not fit with their social coding, so boundaries remain closed. Nevertheless, assemblages are shifting and evolving structures that are never actually stable, and change with circumstances, which adjust parameters of coding and territorialisation.

In this chapter I present a thick descriptive account of events and encounters experienced during field work as the artist in residence (AIR) at RAF Fylingdales. Through a situated account, I hope to show that RAF Fylingdales is a zone of intersectionality; although coded by its operational tasks of ballistic missile early warning and space surveillance, it is nevertheless composed of different social parts that form a productive and creative assemblage which I call the *Four-Minute Warning Drawing Machine*. In order to make this assemblage visible, I tell this story through a portrait of Flt Lt Richard Weeks, media engagement officer at RAF Fylingdales, otherwise known as Richie. He has not only been crucial in making the AIR happen but has, through events and activities of his role, become curator of RAF Fylingdales Cold War collections and archive. The account will also chronologically follow my activities in the

[343] Manuel DeLanda, '*Assemblage Theory, Society and Deleuze',* 2011 <https://www.youtube.com/watch?v=J-I5e7ixw78> [accessed 11 February 2019].

RAF Fylingdales archive, which contains the materialities that compose the FMWDM. As well as describing how the FMWDM assemblage operates by co-production to make an exhibition in the SSPAR radar building for the viva examination.

This account of social and creative encounter at RAF Fylingdales should also be read alongside the experiences of meeting [redacted] that was told in chapter 4 in order to ascertain the creative flows in the apparatus of nuclear deterrence that produce new social assemblages that make lived experiences.

6.2 Flight Lieutenant Richard Weeks

When I first met Flt Lt Richard Weeks on a foul February morning in 2016, he was huddled against driving sleet as he emerged through the inner electric security gate at RAF Fylingdales where I was sitting in the police station within the security zone. The desk sergeant, who spoke with a distinct West Yorkshire accent, had taken my security details and issued me with a laminated red cardboard identification pass, which indicated that I would be under escort at all times during the visit. The door of the police station hissed open as the bristles of the draught excluder brushed against the doormat and Flt Lt Richard Weeks stepped through, extended a hand and said in a softened Lancashire cadence:

> Hello, Michael, welcome, I'm Richie Weeks. Is that your car? We'll take it down to the archive.

Richie lives in Leeds but grew up in Oldham, and is striking by his informal manner that runs against the regular expectations of military perfunctoriness. He began his career in RAF intelligence before retraining to become an operations officer in the Space

Operations Room at RAF Fylingdales. After several years as a regular Richie retired to take up a reservist position as media relations officer at RAF Fylingdales. While this role does exactly what it says and involves working with local media to raise awareness of the station's operation. Richard's work also consists of public engagements that take him across North Yorkshire meeting with local groups such as the local Rotary Club, visiting schools, and organising public and state visits to the SSPAR (Figure 6.2). These groups are diverse and range from members of Yorkshire CND, groups of young Vloggers and Professor Brian Cox, who had given a presentation to school groups about cosmology and led an Aquajet rocket workshop shortly before my visit.[344] However, Richie's role has extended into an archivist and curator of RAF Fylingdales' Cold War material cultures. Until 2018, Richie was supported in this role by Natalie Bliss, who was employed by the MOD as RAF Fylingdales' public relations assistant. Natalie had been an army reservist working in payroll at GCHQ Scarborough and was part of the security detail at the 2012 Olympics in London.[345] Like Richie's, this role partly evolved into that of an archivist – sifting, recording and stabilising the accumulation of RAF Fylingdales' artefacts and materialities in the archive.

Richie now has his own office that looks out over the North York Moors. His desk is clear but has several choice items on view. These include family photographs, certificates for coaching an RAF youth basketball team, a model of a V2 rocket from the La Coupole museum in northern France and a small folded paper replica of the SSPAR radar. In the corner of the office is a dog bed where Poppy, a six-year-old black Labrador waits patiently to be taken out for a walk around the station.

We take the car down to the archive.

---

[344] First visit to RAF Fylingdales, February 2016.

[345] Since writing this chapter, Natalie has changed roles therefore this account should be taken as the state of affairs at RAF Fylingdales between February 2016 and the beginning of 2018.

Richie explains that over the past three to five years they have spent time sorting the materials to make a record of the artefacts in the archive. Richie and Natalie had managed an outreach effort to recover material from former service personnel and employees of RCA who had worked at RAF Fylingdales and a significant effort was made to recover artefacts, which include large consoles from the tracker site control room and sections of the golf ball radomes from Neatishead Air Defence Radar Museum. Richie hoped that these could be reassembled to create an interactive visitor experience of the old tracker Space Operations Room, on which space launch and satellite surveillance operation would be recreated. Richie's ultimate vision is for a museum experience, like that at RAF Cosford, which will map the history of RAF Fylingdales alongside the station's tasks in space surveillance, nuclear deterrence and the Cold War.[346] There is also a large collection of documents and photographs, which Richie sees as forming the basis of a study and research room for local communities and international academic researchers. Richie then directs a question at me, "So, what do you want to do with all this?" I had expected a short visit with no opportunity for a follow up, based upon normal perception of RAF Fylingdales as an enclosed and secure site. However, the meeting about the potential of the collection and archive had lasted three hours, and so, prompted by Richie, I pitched the idea of the AIR.

Figure 6.1 and Figure 6.2 Flight Lieutenant Richard Weeks, media and engagement officer at RAF Fylingdales (@RAFFylingdales)

[346] *National Cold War Exhibition,* [permanent exhibition], RAF Cosford.

6.3 Project Vigilamus

The proposal was successful and RAF Air Media agreed with Richie's recommendation that an artist in residence at RAF Fylingdales would be beneficial to the station. Following permission granted by RAF Air Media in June 2016, Richie invited me to join a group touring the SSPAR radar as an introduction preceding the start of the AIR in September. Before the visitors arrived, there was a little bit of time to go to the archive again and I took the chance to ask Richie "why have an artist in residence and an archive on a sensitive site that is a component of the Western World's nuclear deterrent?" Richie replied that there is nothing really to hide because all the security sensitive systems are embedded out of view, deep within the electronics of the radar. And, the SSPAR is the prominent landmark in the North York Moors National Park. However, the perception of an enclosed and secretive site has persisted since the end of the Cold War and, in recent years, media stories have appeared that included many inaccuracies that made it increasingly difficult for RAF Fylingdales to fulfil operations.

From the beginning of the station's construction, RAF Fylingdales has been a thing of controversy in the landscape of the North York Moors. Early in RAF Fylingdales' operations there were concerns voiced that the radars could set fire to the moors, or that the energy beams would impair homing pigeons' abilities to navigate. Today, there remains a persistent anxiety about radiation produced by the radar's energy field and the damage this might do to many biological systems. Despite studies at other early warning radar such as the PAVE PAW phased arrays at AFB Beale, California and AFB Cape Cod, they have been unable to confirm a causal link between radars' operating energy and cancer.[347] During the 1960s, the perception of the unearthly and invisible threat of the radar's energy beam was made visceral by coach drivers taking

[347] The National Academies of Science Engineering and Medicine, *Available data do not show health hazard to Cape Cod residents from Air Force PAVE PAWS radar,* (2005) <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11205> [accessed 22 February 2019].

holidaymakers to Whitby who would tune their radio into the pulse of the tracker radars.[348] I remember my mum recounting this same story when I was young and explaining that the three domes were deeply unsettling because, over the radio, they sounded like something from *Doctor Who and the Daleks* (1965), or *The Quatermass Experiment* (1955) *.* The experience she described followed shortly after the Cuban Missile Crisis and the invisible radiation that could be heard on the radio seemed to embody the feared after-effects of nuclear warfare.

Artist Gair Dunlop explains that according to writer Ken Hollings, British science fiction films such as *The Quatermass Experiment* appropriated the architecture of the emerging atomic industries as alien architecture;[349] in particular, the new spherical shapes of the plutonium-producing fast-breeder reactors at Dounreay and Windscale, or the domed bunkers of the AW(R)E warhead assembly facility at Burghfield. RAF Fylingdales, perhaps as a legacy of its three radomes, is also often perceived as a storage facility for alien technologies (Figure 6.3). These technologies include parts of spacecraft, time machines and wormhole generating equipment.[350] A retired tracker and SSPAR radar operator explained that in recent years, stories of alien technologies had been bolstered by awareness of a deactivated post for reporting unidentified objects existing at RAF Fylingdales. The single post holder's task involved logging reports of "strange lights in the sky" and reverse plotting the sightings against known missile and space launch events. Mike explains that space launches produce fields of debris that are composed of tiny paint flecks from rocket casing, nuts, bolts and payload spacers. These are too small for the radar to detect but look the same as a warhead re-entering the atmosphere, so it is important to have an account of unusual phenomena as another

[348] Recollection of my mum, which is also stated in Scan magazine in RAF Fylingdales archive, Pickering, [uncatalogued], 'Scan magazine collection'.

[349] Talk given by Gair Dunlop at a screening event, Aldermaston, see *Yellowcake: How we use to work* [film screening], The Floating Cinema, Aldermaston Wharf, 17 June 2015.

[350] Content of a package delivered to RAF Fylingdales and addressed to Flt Lt Richard Weeks opened during a visit in November 2017.

safety against accidental nuclear war.[351] However, during restructures of the civil service in 2010, the desk was reviewed and as a result made redundant.

Figure 6.3 Tracker two radome at RAF Fylingdales 1963

RAF Fylingdales Collection and Archive

But the most pressing controversy for RAF Fylingdales has been the perception of the site being used to silo ground-based interceptor missiles as a part of the United States' National Missile Defense (NMD) plan. The program was once known as "Son of Star Wars" when it was announced under the administration of President George W Bush. Instead of using orbital space stations to defend against Soviet ICBM attack, NMD planned to meet a then-perceived missile threat from Iran by crashing a kinetic payload, called a kill vehicle, launched from a ground-based rocket into an attacking weapon. In the early 2000s when the scheme was announced, it was reported across mainstream media, including the BBC, that RAF Fylingdales would serve as a basing for the ground-based midcourse defense (GMD) missiles.[352]

---

[351] Conversation during visit to RAF Fylingdales, 4 August 2017.

[352] BBC News, *MOD denies US missiles set for UK,* (2004) <http://news.bbc.co.uk/1/hi/uk/3750294.stm> [accessed 22 February 2019].

The GMDs were actually intended to be stationed in Poland, but this basing was withdrawn by the Obama administration in 2009. This was an attempt to mitigate Russian concerns that the GMDs invalidated their deterrent by threatening their ICBM forces and giving the United States a first strike capability. The GMDs are currently stationed at Fort Greely in Alaska in order to meet the North Korean ICBM threat, and are operated by the United States Army under the command of the Missile Defense Agency (a direct successor to Reagan's 1980s SDI).[353] While infrastructure and capabilities of the 21st SW were upgraded in the early 2000s to provide early warning of emerging threats, they do not form direct command and control structure operating the GMDs.

Nevertheless, the media reports resulted in an increase in opposition to RAF Fylingdales and a burgeoning of conspiracy theories about covert missile silo construction. In 2007, Station Commander Nicky Loveday decided to actively engage the public by opening the site to anyone, subject to security clearance, the idea being that they could see the site, the radar and the activities and roles performed by staff at RAF Fylingdales for themselves.[354] In 2013, Station Commander Rayna Owen extended this initiative with Project Vigilamus, which instituted the Visitor Centre and the Heritage and Learning Archive. The initiative coincided with RAF Fylingdales' 50th anniversary and aimed to give the public access to the material records of RAF Fylingdales missions and operations, covering the entirety of the station's history. Richie was tasked with this job and ever since, artefacts relating to RAF Fylingdales have been located, gathered and roughly sifted on site. But the fine indexing and cataloguing of the material still needed to be done and, hence, for Richie, the value of artistic and

---

[353] Jefferey Lewis, *2020 Commission Reports on the North Korean Nuclear Attacks Against the United States,* (London: Penguin, 2018).

[354] The Yorkshire Post, *RAF Fylingdales opens its doors to dispel fears,* (2007) <https://www.yorkshirepost.co.uk/news/raf-fylingdales-opens-doors-to-dispel-fears-1-2465817> [accessed 22 February 2019].

academic intervention at this stage in making RAF Fylingdales visible and interpretable was without question.

6.4 Archive of the four-minute warning machine

My research set out to use art practice to explore the notion that nuclear weapons were social and spatial producers. The research approach had been informed by implicit insinuations of affects from the nuclear weapons assemblage through my encounter in lived experience, such as my reunion with [redacted] in Paris or being caught in commuter traffic leaving AWE on the A340 leading to Aldermaston Wharf. These encounters constituted only glimpses of the productions and affects of a nuclear deterrence assemblage, whereas the AIR at RAF Fylingdales offered direct access to a vast archive of materialities relating to the socio–technical machinery of the four-minute warning. As described in chapter 3, this was the FMWDM assemblage that spans time and space, that had influenced my run from school and produced reams of green biro drawings on computer paper of future nuclear warfare.

The AIR in the RAF Fylingdales archive was an unexpected and crucial development in the research project that made visible the articulations of the FMWDM. Access to the archive also presented the possibility of creatively and critically interacting with the assemblage in order to produce different affects and new possibilities at RAF Fylingdales. The most pressing problem was understanding what was in the archive, and there was the question of time for these materialities to become artworks in the time required for research funding.

I spent a lot of time during the winter of 2016 exploring the content of the archive, which had been sorted into stacks divided between three rooms. The largest of these rooms is a load bay that contains unsorted large items of hardware including: the tracker radar

control console; a Raytheon operation terminal from early SSPAR operations, which is missing the screen; a heavy safe; various large pieces of equipment that were part of the data take-off (DTO) assemblage, discussed in chapter 3, which carried the energy waves from the tracker radars along heavy brass conduits to the MIP tracker radar status control console; a model in a vitrine of what the new SSPAR radar would look like alongside the old tracker site, which is depicted using actual golf balls; a section of the bullring gearing systems that supported the tracker radars; and various Chloride Gent clocks and pink telephone receivers. The standout artefact is a section of one of the original geodesic domes made by Goodyear Aerospace with Buckminster Fuller, constructed out of cardboard and fibreglass.

Also in the loading bay was a large caged storage area that incongruously contained a drum kit, guitars, a smoke machine and several George Foreman grills.[355] There was also a very large mural of a Yorkshire Village (Pickering) painted in poster paints by Whitby based watercolour artist John Freeman, which used to decorate a wall in the old mess facility. Other artistic items in the archive include a printing block milled out of copper depicting a stylised representation of the three radomes. The item would have been used to print the logo for the service personnel newsletter *Triball* and was manufactured in either the supply building or in the engine workshop at the power station (Figure 6.4).

[355] I found out later that this area is used to keep the belongings of service personnel moving to a different post.

Figure 6.4 Wood and metal printing block from RAF Fylingdales archive

The second room is the former Test Equipment Laboratories, where faults in RAF Fylingdales' electronic instrumentations would have been diagnosed and repaired (Figure 6.5). This is now the main space for the Visitor Centre and Archive, and around the outer edges, Richie has sorted items to make into wall-based displays (Figure 6.6). These include: coated MDF boards showing different types of Soviet Era ICBMs and the USAF 21st Space Wing early warning network; collages made by Richie and Natalie of photocopied press clippings about RAF Fylingdales along with large-format digital prints of images from the photographic archive. Also on the walls are large PVC information banners explaining RAF Fylingdales' role in space surveillance and guardianship of the International Space Station. These banners prominently feature astronauts Helen Sharman and Tim Peake and their respective missions to the Mir Space Station in 1991 and the International Space Station in 2015.

Dispersed around the room are several large tables and chairs dating from when RAF Fylingdales became operational in 1963.[356] On these tables are sorted large binders

[356] These types of chair and table can also be seen in the background of scenes from *Doctor Strangelove* (1963) featuring the character Group Captain Lionel Mandrake (Peter Sellers) and General Jack Ripper,

issued by RCA Service Company, Riverton New Jersey that relate to technical procedures and schematic layouts of RAF Fylingdales and BMEWS subsystems. One of these is a detailed computer-printed catalogue of parts and assembly instructions for the radomes and the AN/FPS-49 radar set. Other technical manuals include illustrated catalogues of components with supplier ordering references. There are also a number of files containing press release material, such as a document called *Ballistic Missile Early Information Kit* issued by the USAF. This is a spiral-bound folder, containing relevant press releases for: Electronic Systems Division (Air Force Systems Command); Royal Air Force; NORAD; RCA; Western Electric Company, which produced the rearward communications facilities; and other subcontractors including General Electric, IBM and Goodyear Aerospace. The room also contains heavy pieces of equipment such as a cut-open klystron amplifier used to boost the signal from the tracker radars, a control console from the power station and the ECCM console discussed in chapter 2, with a leatherette swivel chair. On a tailor's dummy is an RAF tunic decorated with a space operations badge that looks similar to the arrowhead on Captain Kirk's uniform and propped in the corner of the room is a dummy, arms outstretched and legs akimbo, dressed in the nuclear chemical and biological warfare suit that was the subject of the conversation between Richie and the conservators of York Museum which, as was noted in chapter 1, led to the residency.

Figure 6.5 (Left) Test Equipment Laboratories at RAF Fylingdales c1963

---

see *Doctor Strangelove: Or how I stopped worrying and learnt to love the bomb*, [film], dir. Stanley Kubrick, (USA: Columbia Pictures, 1963).

Figure 6.6 (Right) RAF Fylingdales Visitor Centre in the former Test Equipment Laboratories 2016

The third room is windowless and has polystyrene tiles lining the walls that are covered in accumulative layers of magnolia paint. This room is the designated photographic and document archives. The photographs are collected in box files and photograph albums charting the entire construction and maintenance of RAF Fylingdales, including the SSPAR. Many of these albums were compiled as progress reports and include pictures of sappers clearing ordinance from the moor in 1960, large sections of the radar antenna yoke passing through the North Yorkshire town of Pickering, stages of radome construction from 1960 to 1963, the installation of the IBM 7090 MIP in 1963, and the activation of RAF Fylingdales on 17th September 1963. There are also albums dedicated to visitors to RAF Fylingdales that includes Prince Philip, who experienced a training simulation of a four-hour nuclear attack upon the United Kingdom. Other photograph albums can be cross-referenced to stories that appear in *Scan* and *Triball* magazines.[357] *Triball* is similar to *Scan* and started as a newsletter called *The Triball News* that was aimed at service personnel and their families. Like *Scan*, its focus was on light, local interest and family-focused events and later became a glossy publication. The magazine was rebranded to *Pyramid* after 1992 when the SSPAR radar became operational. The magazines are also stored in box files that are kept in a metal filing cabinet. The filing cabinet also contains lever arch files of 540 reports documenting RAF Fylingdales' operations in the early 21st century. I looked at these files towards the end of the surveying of the archive because their Microsoft-formatted documents seemed to be too "in the present", compared with the older material in the collection; yet, from a glance at their content, there seemed to be a way of accessing the vast array of materials in the archive for artistic activity, to draw out the relationships and interactions in order to construct the FMWDM.

[357] See chapters 4 and 5.

6.5 540 forms

Key to building the FMWDM was the 540 reporting document for RAF Fylingdales. The 540 is a document that seeks to capture all events that occur on all RAF stations. At RAF Fylingdales this includes: tracking scheduled missile and space launch events; engineering and maintenance; staff and operation crew training; visits by representatives of military and government organisations, as well as local community organisations; special events and announcements; and, recently, current activities in relation to Project Vigilamus. These documents are an important record of operations so, to ensure that they are actually read, they are written in a jocular and breezy style. The failure to submit the 540 document carries a penalty against RAF stations, such as the withholding of station commander promotion or blacklisting. At RAF Fylingdales, the 540 document is compiled from various contributors; for example, Richie's contribution comprises accounts of monthly media and public engagements. Each contribution is signed off by the station commander before being transferred to RAF Air Historical at RAF Air Command High Wycombe. The documents are released to the public after 30 years. Currently, the National Archives at Kew hold all 540 reports up to December 1988, except for one outstanding, which is in the RAF Fylingdales archive (Figure 6.7).

I visited the National Archives in August 2017 to examine the 540 reports for 1983, the year of Ronald Reagan's Star Wars speech, the shooting down of Korean Airlines 007, the War Scare of 1983 and my run home from school described in previous chapters.[358] The tone of the 540 reports shows nothing of the rising Cold War tension between Western Allies and the Soviet Union. Instead they describe RAF Fylingdales' operations in the same engaging, but professional, manner indicative of all other 540 reports. Although, the document does note a 50% increase in United States space activity for 1983 and several of the United States space launches are notable for carrying classified payloads. The 1983 540 documentation also describes the replacement of the IBM

[358] The National Archives, *AIR28/2473*, 'RAF Fylingdales 540 reports 1983'.

7090 MIP and SIP with a Control Data Corporation Cyber 170 mainframe computer (Figure 6.9). As explained in chapter 3, the computer's role was to discriminate missile signals from the noise of orbital space activities and to provide impact time estimates of hostile-looking signals. Because of this function, I came to understand the MIP as the materialisation of the four-minute warning. So, I was surprised to discover that the 540 document showed that the contract for installing the computer was held by ITT Federal Electric Corporation, the same company that made the television I watched as a child (Figure 6.8).

The 540 explains monthly problems encountered during the installing of the new MIP computer. On one occasion the MIP overheats and causes a small fire. Similarly, overheating was also a common occurrence with our television that always needed its burnt-out components replacing. These semblances between my childhood home and the MIP computer were later underscored by finding a bundle of punch cards and reams of fanfold printout in RAF Fylingdales archive. I realised that the archive could be used to materially span different places in time and space by incorporating artefacts, such as the RCA speakers, into the artmaking process, as articulated in the previous chapter. Crucially, the process of incorporating and connectivity is always ongoing and emerging, so I thought artwork produced in the studio could be inserted or re-inserted into RAF Fylingdales as an exhibition or intervention. I liked to think of resonances between the warheads that I made in the studio and those that RAF Fylingdales was designed to identify. Except, as explained in chapter 5, the relationships, expressivity of materials and coding had been greatly changed by creative variations and metamorphic transformations. Richie also explained that the artist residency was also being historically logged in RAF Fylingdales' current 540 reporting form.[359] He explained that future historians would be able to find out that RAF Fylingdales had an AIR doing research for Newcastle University. This would be seen among all of the other station duties including missile and space launch detection. What Richie was explaining

[359] Conversation with Flt Lt Richard Weeks during visit to RAF Fylingdales, 31 May 2017.

reminded me of Deleuze, Braidotti and Jean Fisher's articulation of the BwO discussed in chapter 3. The 540 reporting form seemed like it could be a BwO, where trajectories of practices and experiences between the AIR and RAF Fylingdales assemble in, as Deleuze terms it, "geodesic" crisscross patterns. The upshot would be that through the 540, the operations of the *Four-Minute Warning Drawing Machine* assemblage could be made visible to future historians of nuclear deterrence at Kew.

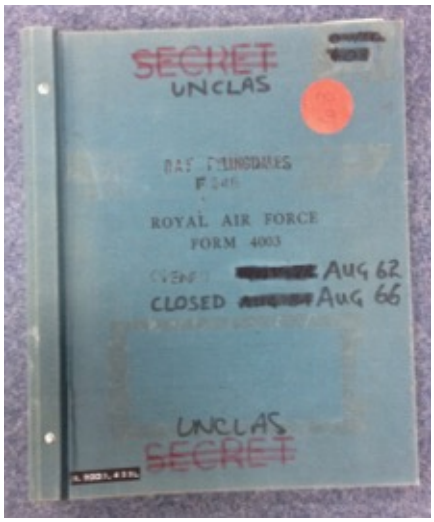

Figure 6.7 Binder of 540 reporting forms for activities at RAF Fylingdales from 1962 until 1966

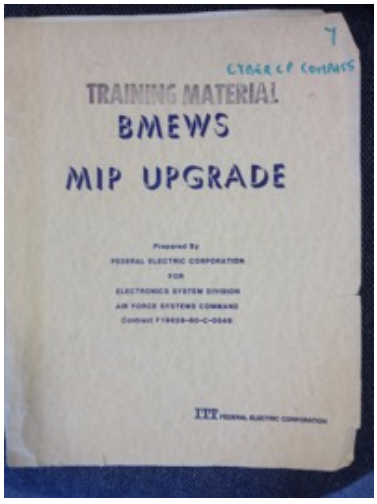

Figure 6.8 BMEWS MIP upgrade training manual prepared by ITT Federal Electric Corporation

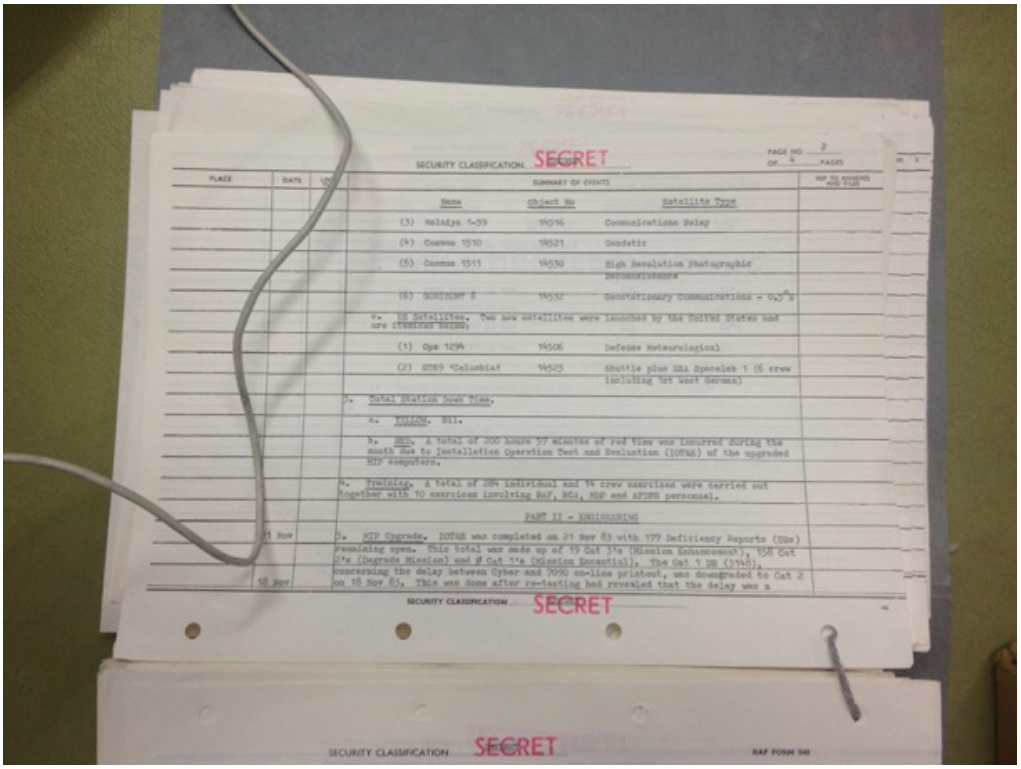

Figure 6.9 540 reporting entry for November 1983, reporting on the switch over from the IBM 7090 to the Cyber 170 MIP.

6.6 The Other Night Sky

Returning from Kew, I told Richie about what I had found in the 540 reporting documents. We were looking at Trevor Paglen's monograph *Invisible*. Richie turned the pages of the book and talked about the satellites that Paglen captured in the photographic series *The Other Night Sky*. Richie explained that the satellites that Paglen depicts were mostly defunct, although one or two belonged to the 21st SW. He said that just the week before, the deputy director of the National Reconnaissance Organisation (NRO) had paid a visit to RAF Fylingdales. The NRO is a user of the station's satellite collision and warning services, and he pushed the NRO challenge coin across the desk towards me. I picked it up and turned it over in my hand. Richie really

liked Trevor's photographs and was wondering if I had anything planned for the art produced as a part of the PhD? I said I had been considering showing artwork within the SSPAR as part of the viva examination because I was interested in how the artwork would interact with the actual space of the four-minute warning. Richie liked the idea and thought it would mark a significant milestone in the history of RAF Fylingdales as both the outcome of the station's first AIR and my doctoral examination. But he also liked that the work came with an element of critique and discussion, although he worried that very few people would see the exhibition other than future historians at Kew. I said I wasn't worried because the opportunity to place artwork in dialogue with the SSPAR was too great an opportunity.

6.7 The after dark stag

Richie informally proposed the exhibition and viva to Station Commander Darren Whitley the morning after the 25th anniversary of SSPAR operations. The event was meticulously organised, "with military precision", by Richie, who thought the station's AIR and academic researcher should be there to represent two firsts for RAF Fylingdales and he had arranged for me to stay overnight at RAF Fylingdales in the emergency accommodations. The anniversary took the form of a full mess uniform and black tie after dark stag in honour of the SSPAR. This consisted of a three-course banquet, with toasts to the Queen and the President of the United States (some around the table wondered if the President's toast should be taken on one knee). There were after dinner speeches led by Station Commander Darren Whittley and given by three of the assembled 12 former station commanders who included: Mike Speed, who had commanded RAF Fylingdales during the transition from the RCA tracker to the Raytheon SSPAR;[360] Nicky Lovedale, who had first initiated the public engagement

[360] During his talk, Mike Speed reflected upon the trajectory that had brought him to command RAF Fylingdales, beginning with a childhood memory of dread of ballistic missile bombardment during WWII from the V2 rockets – the forerunner to the SS-20 and R12 IRBM – during RAF Fylingdales 25th Anniversary Stag, October 2017.

programme; and Rayna Owen, who had established the archive and visitor centre under Project Vigilamus. Also present was USAF Colonel Devin R Pepper, current commander of 21st Operations Group of the 21st Space Wing based at Peterson AFB, Colorado (Figure 6.10).

Other guests included long-serving representatives of: SERCO, formerly RCA and Turners, who run the station's power station; MOD administration staff; and the station's fire brigade. I was seated opposite Richie and beside me was the vicar of the parish of Goathland. To my other side was Graham, who was formerly with RAF Space Operations but now works for SERCO, and beside Richie was Chris McCormack, who designs the simulator exercises for radar ops crew. Chris, like my friend [redacted] from DJCAD, was training to be an artist at art school prior to joining the RAF. While those days seemed a long time ago, Chris said he still took an interest in the contemporary arts and he talked to the table about Anish Kapoor's *Oracle* (1990–2002). Richie described to the table how I had been making really small drawings of photographs from the archive and producing large-format prints, so that they looked like landscapes viewed from space. The guests nodded and thought the work sounded unusual. Richie explained that we were talking about an exhibition in SSPAR as a part of the PhD viva examination. Chris thought it was a great idea because nobody looking at the SSPAR from the outside could expect it to be harbouring an exhibition of artwork and everyone said they'd look forward to it.

Figure 6.10 Guests of the solid state phased array radar (SSPAR) 25th Anniversary stag.

Courtesy of the Royal Air Force

Centre bottom row is Station Commander Darren Whittley, sat next to former Station Commander Rayna Owen to the left. On the very end of the row to the right is former Station Commander Nicky Lovedale and forth in is former Station Commander Mike Speed. Also in this room, to the left of Rayna Owen, is USAF Colonel Devin R Pepper, current Commander of 21st Operations Group of the 21st Space Wing. Directly behind is Michael Mulvihill and one in on the right is Flight Lieutenant Richard Weeks, while one in on the opposite side is Flight Sergeant Keith Burt.

6.8 Inside the SSPAR[361]

Following the SSPAR 25th anniversary dinner, Station Commander Darren Whitley ensured that the SSPAR exhibition and viva become part of the orders for RAF

[361] The description is made from a composite of visits into the SSPAR from June 2016 until the present.

Fylingdales. With the exhibition and viva becoming a small part of station operations, a number of site visits were carried out in the SSPAR. Close up, the SSPAR is an eight-storey three-side truncated pyramid clad in blue grey corrugated metal. The pyramid is formed from three square faces separated by three triangular sections. On each of the square faces are 2,560 transmitting and receiving modules arranged in a circle that constitute the SSPAR radar (Figure 6.11). The SSPAR building is surrounded by another security fence and visitors are buzzed through a turnstile beside a guard hut. The ground between the security perimeter and the SSPAR is filled with racks of razor wire and the area is under heavy surveillance. The air is filled with the hum of the SSPAR refrigeration system used to cool the radar assembly. Just before entering the building, there is a brick trough filled with sand, which was intended for guards to empty ammunition rounds into before entering the building.[362] The building is electromagnetically sanitised against radio frequency (RF) interference, so phones and electronic devices must be deposited in lockers in a glazed porch. The entrance to the SSPAR is through the red metal door, which hisses open revealing an RF airlock that leads into the SSPAR.

Figure 6.11 RAF Fylingdales SSPAR building (@RAFFylingdales)

[362] It is unlikely that this was used and could be a remnant of the USAF design specifications.

6.9 The decontamination complex

Since the SSPAR became operational on 3rd October 1992, changing geopolitics and developing technology had altered spaces inside the SSPAR. The SSPAR upgrade of RAF Fylingdales was commissioned during the Reagan administration military investment of Financial Year 1983 that was described in chapter 3. The upgrade addressed a threat posed by Soviet ballistic missile submarines in the Atlantic, which the old AN/FPS-49 radars could not see. It was widely believed at this time that if hostilities did break out with the Soviet Union, chemical and biological weapons would initially be used against targets such as RAF Fylingdales. For such circumstances, the SSPAR was equipped with a complex of decontamination chambers. The chambers incorporate showers, changing rooms and observation rooms. Richie explained that because the Cold War ended before the SSPAR became operational, the decontamination facilities immediately became surplus to requirement and are now used as a complex of fitness gyms for the operations crew. He thought that it would be possible to move the gym equipment to make an exhibition space. Some of the decontamination chambers had audio and video capabilities because the crews like to listen to music while doing their training.

6.10 The armoury and former museum

Another option for an exhibition space was the former armoury next to the RF airlock, through which we entered the SSPAR. The former armoury consists of two rooms: one is a concrete box, painted magnolia, with a stainless-steel sink a beige linoleum flooring and a rifle serving hatch (Figure 6.13); the other is carpeted with blue hard-wearing carpet tiles and has a window with a stainless-steel frame running along one side of the room, and looks onto the interior door of the RF airlock. On the walls are large junction boxes and in the middle of the floor is a server unit with rows of flickering green diodes. Richie is not convinced that this would be a good space for an exhibition. The room had

been previously used as the station museum but Richie said the lighting was awful (it is lit by fluorescent light that has a greenish cast) and everyone ignored the museum as they just walked straight past and into the SSPAR.

Richie had previously shown me the room when I visited the SSPAR as a part of a guided tour with Mike Speed the day after the stag. Then, it had really appealed to me because it reminded me of a shop-front gallery. I had imagined an exhibition title written in dry vinyl along the window, and the visitor's surprise at an unexpected contemporary art space. However, standing in the armoury now, I began to feel that the amount of work needed to turn the room into an exhibition space was not feasible given the extreme security of the building. Any preparation work and installation would tie up Richie for a time that could not be predetermined accurately. The room also contained the blinking server that belonged to the MOD police and could not be moved because the building's security systems were routed through the device (Figure 6.12). Furthermore, to make a contemporary art exhibition space required an imposition and inscription upon the SSPAR that I felt sat uncomfortably with the relational and discursive approach I had taken in my studio work and described in chapter 5. Richie said he had a few more places to show me and we moved on.

Figure 6.12 (Left) SSPAR guard room and former station museum with MOD police's server on the floor

Figure 6.13 (Right) Flt Lt Richard Weeks at the unused weapon serving hatch in the former SSPAR armoury

6.11 The foyer

The foyer space is situated between the RF airlock, armoury and a metre-thick blast door that leads into the SSPAR. Visiting groups to the SSPAR gathered in this space as they waited for everyone to passed through the RF airlock. I had thought these could potentially constitute an audience for any interventions in the space. Like the York Bunker had for the exhibition *SFTNSA* (2015), the foyer space offered the opportunity for artwork to be placed among the wall decorations of the foyer, which includes USAF 21st Space Wing shields, RAF Fylingdales insignia and framed photographs of space shuttle launches. In the foyer, there is a noticeboard of events, including a line dance evening, and hung on concrete pillars is a polished steel ceremonial spade that was used to break the ground for the construction of the SSPAR (Figure 6.14). Richie was happier with this space being used because the artwork would be much more visible to operation crews passing through and into the SSPAR. Also, artwork could be pointed out easily to visiting groups. But Richie wanted me to have a look at the Space Operation Briefing Room deeper inside the SSPAR, which he thought was much more suitable in terms of lighting, being exhibition-ready and supporting an audience (Figure 6.15).

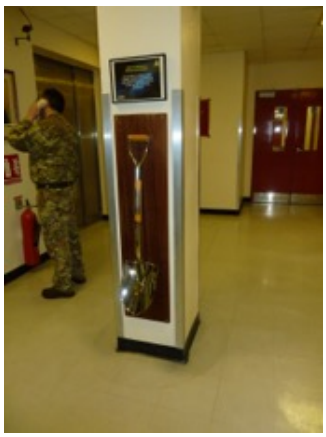

Figure 6.14 (Left) SSPAR foyer with the ceremonial spade used to break the ground for the building. In the background, Flt Lt Richard Weeks is informing the Space Operations Room to expect visitors

Figure 6.15 (Right) SSPAR foyer seating area and blast door entrance to the operations bunker

6.12 Behind the radar wall

The strange triangular interior of the SSPAR can produce a sensation of vertigo. This sensation is exaggerated behind the sloping back of the radar wall. The radar wall is covered in silver foil and black boxes similar to Wi-Fi routers. These are attached to the 2,560 transmitting and receiving antenna that can be seen outside. The radar electronics are cooled by water running through copper pipes and give the impression of an elaborate central heating system (Figure 6.16). The arrangement of radar components forms the bottom of a disc that could be seen on the faces of SSPAR as we entered the building. The space in which the radar wall faces is painted magnolia and has a painted concrete floor. The rest of the SSPAR building is carpeted in blue hard-wearing office carpet, but the corridor walls are also painted magnolia and the skirtings and doors are waxed beechwood, exactly like the small wooden warhead I made for slip casting. On the walls in the corridors hang photographs of successive qualified operational crews arranged in neat grids alongside historic pictures of the BMEWS radars at Thule and Clear, photographs of astronauts, space shuttle launches from Cape Kennedy, and images of the International Space Station. Along the corridors are small side rooms with post dockets, laser printers, photocopiers and stationary cupboards containing reams of A4 and A3 paper, which is not dissimilar to the photocopier room in the Fine Art Department where, as explained in the last chapter, I photocopied my warheads. Nor is the building unlike the architecture of the School of Geography, Politics and Sociology where, in the early 1980s, Stan Openshaw computed nuclear attacks upon the United Kingdom. The corridor and side rooms embody Dunlop's observation about spaces of the UK nuclear energy industry, where the most spectacular devices are found in the most unassuming rooms.[363]

[363] Gair Dunlop, *Nuclear Art and Archives,* (2017) <https://vimeo.com/216806746> [accessed 22 February 2019].

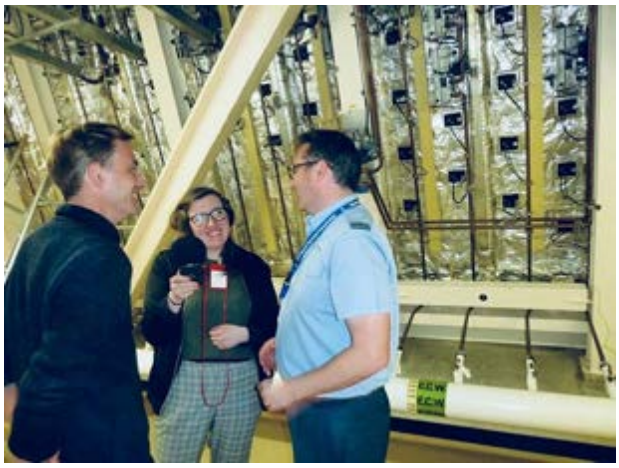

Figure 6.16 SSPAR radar with (left to right): Professor Richard Clay, Ellie Clifford of Whistledown Productions and Flt Lt Richard Weeks. (@RAFFylingdales)

Notice cooper cooling pipes and radar modules in the background.

6.13 The Space Operations Room

Along a side corridor is a dog-leg that leads to the Space Operations Room. The walls of the dog-legged corridor are panelled in blonde wood on which hangs a large insignia of the USAF 21st Space Wing. For me, more than anywhere else on the RAF Fylingdales site, this corridor has the strongest sense of being in the United States of America, for reasons that are hard to pin down. It could be that through an open door I glimpse a large steel coffee percolator, similar to one used by customers of a bank that I used while I was an artist in residence at the Contemporary Art Centre in North Adams, Massachusetts, or maybe it's a star-spangled banner that hangs at the end of the corridor.

At the end of the corridors are a set of closed double doors behind which is the Space Operations Room in which a crew of RAF operators monitor outer space. Richie knocks at the door and it opens slightly, we are greeted by a cheery officer who says "can you

give us a moment to clear the screens". The door closes and a moment later it reopens and we are able to step inside the Space Operations Room.

The entrance is to one side of a row of four or five large flat-screen televisions, all of which have been switched off, except for one that shows a computer-generated representation of the Earth with a radar hemisphere extending from RAF Fylingdales for 3,000 km in all directions, and overlapping with other radii from monitoring sensors of the 21st Space Wing (Figure 6.17). The room is divided by two large computer desks where the operation crew work at desktop computers displaying real time visualisation of objects being tracked by the SSPAR. A windowed room facing into the Space Operations Room contains a computer server that is looked after by SERCO technicians. The computer is performing the same task as the MIP but with thousands of times the computing power and taking up a fraction of the space.

The walls of the Space Operations Room are lined with a beige soundproof carpet material so that conversation cannot be heard outside of the room. This is like the carpet I used to line the cases of *MM-w76-FTLP-012017* (2017) and *MM-w76-GRAPHITE-RT-30112017* (2017). Over the carpeted walls are hung pictures of the Apollo 10 lunar module in orbit above the Moon, astronaut Edwin Aldrin standing on the Moon with his visor reflecting Neil Armstrong, and a Saturn V standing on its launch pad. It is among these pictures that I would like to install the David Bowie drawing. However, given the sensitivity of the room, I feel reluctant to propose the idea even to Richie, despite the convivial atmosphere and the feeling of professional ease. After a while, we are politely ushered out of the room so that the crews can return to work unencumbered and the doors to the Space Operations Room close behind us. We backtrack down the dog-leg corridor towards the Space Operation Briefing Room situated in the centre of the SSPAR operations level.

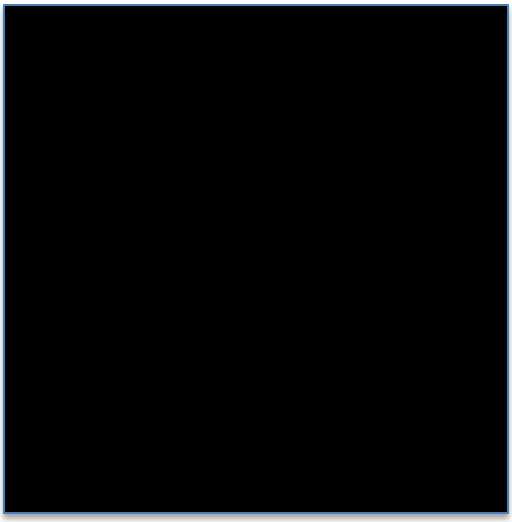

Figure 6.17 Computer representation of 21st Space Wing global radar coverage, which is similar to displays in the Space Operations Room

6.14 Space Operations Briefing Room

Richie switches on the light of the briefing room. The room is a triangular space lined with the same soundproof carpet as the Space Operations Room. Like the Space Operations Room, on the wall, framed pictures of spacecraft and launch vehicles are hung. Among these pictures are a collection of photographs taken of London from the International Space Station, which was donated by UK astronaut Helen Sharman. One end of the triangular room is truncated by a large video screen behind a glass window, and on each side are metal plaques of the insignia of the Royal Air Force, RAF Fylingdales, 21st Space Wing and USAF Air and Space Command (Figure 6.18). To the left of the screen is a podium with a microphone and audio-visual controls. Under the screen is a low table displaying awards, including a model of a Saturn 1b space rocket and ball bearings that carried the old tracker radars (Figure 6.19). Along either side of the room are two large tables, each pushed against the walls opposite to each other. One of the tables is completely empty, but the other displays models of the International Space Station, the space shuttle, Skylon, and a set of Soviet ICBMs from the 1980s. There are rows of seats facing the screen and Richie explains that the room is used

mainly for station briefings, but all visiting dignitaries (such as senior officers from USAF Air and Space Command, NORAD, the NRO, or ministers) and public groups will be given presentations about RAF Fylingdales in this room. Richie adjusts the light to demonstrate different lighting options and explains that if I want to hold the viva here there is complete privacy provided by the soundproofed walls, and refreshments can be supplied too. Richie explains that the space is very flexible and that I can replace the pictures and that furniture can be moved out or rearranged in any way that I like.

So, what do you think?

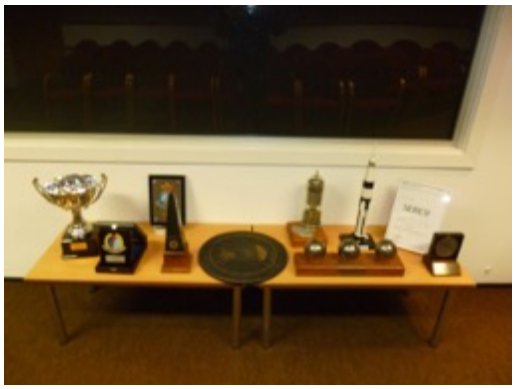

Figure 6.18 (Left) Space Operations Briefing Room with Flt Lt Richard Weeks and Professor Rachel Woodward inspecting various items relating to RAF Fylingdales space monitoring and early warning activities

Figure 6.19 (Right) Briefing room screen with various awards and articles related to RAF Fylingdales space and early warning mission

[SPECULATIVE 540 entry for Project Vigilamus that will be declassified for Public Record Office release 2048]

Operation Viva: mission outline

The exhibition planned for viva will involve the insertion of the artworks that have emerged as a result of the practice-led research, among the objects that are already on display in the SSPAR briefing room. The aim is that the artworks will produce new dialogues and possibilities in the SSPAR, which have emerged, and make the complex social relationships between lived experience and nuclear deterrence visible.

Operationally, the exhibition, or intervention, will be installed and deinstalled in a relatively brisk manner in order to avoid putting strain upon the day-to-day work patterns of the SSPAR radar. And, it has been unanimously agreed, that SSPAR briefing room is ideally suited for these purposes, both conceptually and practically.

The pencilled date for the viva will be May 2019, following submission of Michael Mulvihill's PhD thesis in March. Once submission is confirmed, RAF Fylingdales will begin making preparations for the arrival of the viva committee composed of an external examiner, an internal examiner and chair from Newcastle University.

The examination group will be joined by a member(s) of the research supervisor team and will be under escort by Flt Lt Richard Weeks. Flt Lt Weeks will also organise refreshments at the SSPAR and lunch and dinner at the station's mess facilities, as well as a full tour of the SSPAR, including the Space Operations Centre and the Visitor Centre and Archive.

Station Commander Alun Walton suggested that the event could be run in connection with the RAF Fylingdales annual VIP day. The event mustered over two hundred service personnel and dignitaries, including local councillors, and is accompanied by the RAF string quartet along with a flyby of the RAF Battle of Britain Memorial Flight flown from RAF Coningsby in Lincolnshire,[364] although Flt Lt Weeks thought that an RAF veterans event and a viva occurring on the same day would not be in Michael's interest for optimum performance of an examination. He suggested that the SSPAR exhibition should be kept open for a week, with events organised to follow and celebrate the viva and completion.[365]

[364] Details suggested by Flt Lt Richard Weeks at Whitby Museum Fylingdales exhibition planning meeting 4th October 2018.

[365] Discussed during a meeting with Flt Lt Richard Weeks, Professor Rachel Woodward, Wing Commander Alun Walton and Michael Mulvihill, RAF Fylingdales, 9 August 2018.

Epilogue

On the 28th January 2019, *The Guardian* newspaper reported that the first batch of a new, low-yield variant of the W76 warhead was being rolled off the production line at the National Nuclear Security Administration's Pantex Plant in Texas.[366] This is the first new nuclear weapon to be made by the US since 1991 and was ordered by the Trump administration Nuclear Posture Review (NPR) in February 2018. The weapon is a variant of the device from which I derived *MM-w76-FTLP-012017* between 2016 and 2017 as described in chapter 5. The W76-2 fulfils a requirement outline in the NPR for a low-yield nuclear option in the range of 5 kilotons (instead of the 100 kiloton capacity of the W76). Many believe this has been achieved by using only the primary portion of the warhead which, in chapter 4, was described as the *Jenny or Cleo* components of the Polaris thermonuclear warhead.

According to NPR 2018, the weapon is supposed to give greater credibility to the United States' nuclear deterrent because it provides a reply to Russian deployment of low-yield battlefield nuclear weapons. However, shortly after publication of the NPR 2018, President of Russia, Vladimir Putin, revealed to the world new "invincible" nuclear weapons systems based on very-high-yield nuclear warheads.[367] Putin accompanied his annual state of the nation speech with an animation of eight warheads descending on Donald Trump's so-called Summer White House at Mar-a-Lago – unnervingly evocative of the artwork *MM-w76-FTLP-012017* that I discussed in chapter 5.

---

[366] Julian Borger, 'US nuclear weapons: first low-yield warheads roll of the production line', *The Guardian,* 28 January 2019 <https://www.theguardian.com/world/2019/jan/28/us-nuclear-weapons-first-low-yield-warheads-roll-off-the-production-line> [accessed 24 February 2019].

[367] BBC News, *Russia's Putin unveils 'invincible' nuclear weapons,* 1 March 2018 <https://www.bbc.co.uk/news/world-europe-43239331> [accessed 24 February 2019].

Political scientist Vipin Narang, writing for the security and defence blog *War on the Rocks,* argues that the W76-2 makes no sense and claims that the warhead would actually make the US deterrent unstable and more likely to cause an accidental nuclear war.[368] Narang explains that this is because there is no way of distinguishing between a Trident SLBM armed with one low-yield W76-2 or 12 high-yield nuclear W76 warheads. As explained in chapter 2, the problem of threat identification has been fundamental to RAF Fylingdales' operations because, as reiterated in chapter 6, who said that without knowledge of what is being launched, from the point of view of the SSPAR radar, everything in orbit looks like a nuclear weapon.

Figure 7.1 For Trump Love Putin? Still from an animation of Russian nuclear warheads descending on Mar-a-Lago, Florida

E.2 The 1983 War Scare

Just three years ago, when this research had begun, nuclear arms control and weapon reduction was assumed to be an international norm, meaning that the outcomes of this project would reflect upon the effects of a particular point in time. However, as this work

[368] Vipin Narang, 'The discrimination problem: why putting low-yield nuclear weapons on submarines is so dangerous', *War on the Rocks,* 8 February 2018, <https://warontherocks.com/2018/02/discrimination-problem-putting-low-yield-nuclear-weapons-submarines-dangerous/> [accessed 24 February 2019].

draws to a conclusion, not only is the US bringing online the new W76-2 nuclear warhead (that did not exist last year), but also, at the end of 2018, the Trump administration announced its withdrawal from the INF treaty. This treaty was signed by US President Ronald Reagan and President of the Soviet Union Mikhail Gorbachev in 1987 and has formed the cornerstone of arms control ever since. The treaty outlawed weapons systems such as the GLCM, Pershing II, R-12 and SS-20 IRBM which, as explained in chapters 3 and 4, brought the planet to within a breath of nuclear war in 1983. In an episode of the *Arms Control Wonk Podcast* Dr Jeffrey Lewis and Aaron Stein observe that there has been renewed interest from policymakers and international relations scholars in the events described in chapter 3 – solely because of the Trump administration's withdrawal from the INF.[369] In the podcast, Lewis also describes the fear and anxiety that he also experienced as a child during 1983, which later drove him to work in arms control in order to reduce the danger of nuclear war.[370]

This body of work has therefore become unsettlingly timely, making it possibly one of the first bodies of academic research to look at the 1983 War Scare post-INF withdrawal. It is also unique in embodying the relationships between local experiences such as Dr Jeffrey Lewis and my own childhood experiences, and larger geopolitical assemblages. From chapter 1, I state that both my art practice and this body of research emerged from tacit and lived experience of running home from school during the build-up to the 1983 War Scare. Through adopting an embodied geopolitical approach, as outlined in chapter 1, I have sought to convey the social and cultural complexities of nuclear deterrence, demonstrating that the world-ending potential of nuclear deterrent assemblages also gives them biopolitical world-making capacities. This has been done through paying close attention to the materialities and actualisation of nuclear weapon assemblages by using creative practice to make visible the variety and innovations of their productions across social and cultural scales.

---

[369] 'Pulling Out of the INF', *Arms Control Wonk Podcast,* [podcast], 30th October 2018.

[370] Ibid.

This has involved developing a critique of representation modes of knowledge acquisition and meaning making. In chapter 3, I showed how drawing practice could form the basis of an embodied critical analysis. This was firstly enacted by looking at Sungook Hong's telling of the case of *Joey the Mechanical Boy* as a critique of Freudian and Lacanian psychoanalytical modes of abstracting reality. This led to superimposing new materialist philosopher Rosi Braidotti notions of becoming and relational ontologies over Jean Fisher's notions of drawing. Fisher describes drawing as an activity that does not take place on a flat page but as assemblages of experiences that are spatial and temporally dispersed. This picked up on Gilles Deleuze and Félix Guattari's notion of creative practices as an analytical method in itself, which operated by making visible the visceral and intensive forces that are invisible to established structures of knowledge.

As described in chapter 4, the intensive flows constitute productive assemblages of activities and social interactions that cross magnitudes of social scale. They span the subatomic, such as those in a detonating warhead, into the domestic, like my memories of drawing in my family's home, and up to the world-spanning assemblages of nuclear warfare. The practices, intensive flows and relationships become the focus of analysis and, as we have seen throughout, this resulted in an unsettling of the taken-for-granted epistemological stabilisation of reality by meaning making and representation. For example, in chapter 2 it was shown how the arts were actual constitutive components of MADs and practices of nuclear deterrence. Many examples of crossovers between the arts and nuclear deterrence were given: art historian Meyer Schapiro's notion of figure to ground that formed the basis of RAF Fylingdales' MIP threat discrimination program; the golf ball radomes that encapsulated the AN/FPS-49 radars were conceived by Buckminster Fuller at the Black Mountain College of Art; and the administration of RAF Fylingdales' supply chain shared office space with clerks managing the distribution of David Bowie records.

Elsewhere in chapter 4 it was shown how art practice has a historic relationship with the conduct of warfare, and by drawing upon Carl von Clausewitz's *Fascinating Trinity*, Deleuze and Guattari were able to deduct the concept of war machine. It was explained that Deleuze and Guattari did not conceive the war machine concept as negative but rather they conceive the war machine as an assemblage of creative flows and intensities, which both disrupt established structures of meaning and produce new possibilities. Therefore, this research was arranged around three questions: How and by what mechanism do nuclear weapons systems interact and produce socially and culturally? Why should creative arts practice be used to do this? And what new knowledge does creative practice produce about nuclear weapons?

Crucial to answering these questions was the unprecedented access to RAF Fylingdales' Cold War archives and SSPAR radar. As we saw in chapter 6, the creative engagement with RAF Fylingdales were made possible by Flight Lieutenant Richard Weeks who, through circumstances of being media and engagement officer at RAF Fylingdales, became the curator of the station's Cold War material culture, the RAF's first AIR, and a viva exhibition in the SSPAR radar building itself.

It was explained in chapter 2 that as a result of time spent at RAF Fylingdales I was able to conceive of the station as an assemblage, which arose from an interpretation of Manuel DeLanda's notion of "assemblages with knobs on". From this notion, I constructed the *Four-Minute Warning Drawing Machine* (FMWDM) assemblage. This assemblage spanned time and space and was built from artefacts in RAF Fylingdales' archive. As we saw, the FMWDM is composed of interconnections between my early drawing experience in my family's home and the operations of the MIP computer during the 1983 War Scare.

Through a constructed interview in chapter 5, I described how the FMWDM had manifested itself in my studio practice, and in making the artworks for the exhibition *Jenny, Reggie, Tony and Cleo.* Throughout the discussion, I describe how the artworks

emerge through tacit encounters with various aspects of the W76 nuclear warhead, described at the beginning of this epilogue. The discussion picked up on meeting [redacted], who had been responsible for protecting the weapons systems as HMNB Clyde as discussed in chapter 4. I also explain how this experience gave rise to artworks that produced assemblages from the administrative processes of the doctoral research, artmaking and weapons manufacture such as in the film *MM-AV76-RCA-PP00052018* (2016–2018) that stemmed from APR review, in *MM-w76-GRAPHITE-RT-30112017* (2017), which may have been manufactured for plutonium production, and in *MM-w76-INPROGRESS-xxxxxx* (2018), an assemblage made from a part of the public address system in RAF Fylingdales and informally commissioned by Flt Lt Richard Weeks. These artworks demonstrate that discrete delineation between domains of art, administration of higher education and military complexes are arbitrary because they are composed of the same processes and materials.

E.3 Non-human creativities

What has been implicit throughout this thesis is that creativity is not necessarily the sovereign domain of artists, nor is it constituted by institutional exhibitions that seek to code creative activity into structures of meaning. By adopting Deleuze and Guattari's concept of the war machine and creative flows, creative practice becomes a method of unsteadying meaning-making structures. Rosi Braidotti in *Nomadic Theory: The Portable Rosi Braidotti* suggests that metamorphic transformations, becomings and creative flows are the opposite of epistemological stabilisation through representation. We saw in chapter 2, with the sheep around the perimeter fence of RAF Fylingdales, that these coded structures become easily destabilised and decoded by spontaneous and arbitrary events. For me, at this point, it seems possible to not only uncouple creativity and creative flow from the domain of artists or artistic institutions, but also out of the sole domain of human agency. In doing so, creativity is seen as a spontaneous process produced by, and producing, things in relationship with each other to form

assemblages. At this point in time, more critical work is needed to be done in order to develop this notion, which includes a systematic survey of the existing literature.

E.4 The war machine and creative methodologies

The important implication of this research is the foregrounding of the making process as an analytical methodology for understanding the world. Emphasis is placed on the materialities and activities that not only constitute works of art, but also the processes of worlding, or social production. However, it is possible to extrapolate from this research a conception of making and creative process that is beyond human agency. In this conception, the artist is no longer a privileged producer of meaning, but rather is situated in a knowing position in order to analyse the flows and productions of complex assemblages.

The possibility of a non-anthropocentric creativity methodology has been demonstrated throughout this thesis, in particular the ongoing relationship with RAF Fylingdales and Flt Lt Richard Weeks. This relationship has led to an interdisciplinary AHRC research bid working in collaboration with human geographers Professor Rachel Woodward, Dr Neil Jenkins and curator Chloe Barker called *Turning Fylingdales Inside Out.* The central premise of the bid is the application of creativity as an analytical method based on ideas of assemblage to explore RAF Fylingdales in various social dimensions. This builds the upon central concept of this thesis of RAF Fylingdales being conceived of as a complex social assemblage by investigating: the relationship between practices of space surveillance and codifications of the surrounding landscapes; the affectivities produced by work patterns at the site; a deeper study of cultural interactions of RAF Fylingdales' technology, as well as using creative and cultural practices to make RAF Fylingdales visible to the public.

Furthermore, since September 2018, English Heritage have adapted the creative methods set out in this thesis in order to bring new understanding to their Cold War collection. This collection encompasses York Group 20 ROC HQ, mentioned at various points in this thesis. “DUMPY” are large regional government bunkers underneath Dover Castle, about 1,000 catalogued but uninterpreted items and another 1,000 uncatalogued artefacts. This has included investigating an assemblage of artefacts related to “HANDEL” – the codeword for the British Telecom system that included the speaking clock, which carried the four-minute warning from RAF Fylingdales to 1,500 Autowaler sirens across the country. For English Heritage, creative analysis of their archives has opened up a new way of understanding the Cold War collection as being composed of socially interactive assemblages, rather than static relics belonging to an inscribed historical era.

E.5 Nuclear weapons in the age of uncertainty

In the present, creative methodologies may contribute to understanding an age that arms control experts are calling the age of uncertainty. This is a time that is currently being heralded by the introduction of new nuclear weapons, such as the W76-2 and the US withdrawal from the INF treaty. It is a period distinct from the Cold War because there are many new nuclear state actors and no effective arms limitations treaties.[371] Some commentators such as Dr Jeffrey Lewis warn about the seemingly improbable role that technologies such as Twitter or Instagram may play in accidentally triggering a nuclear war.[372] But, as this thesis has shown, this kind of ostensibly strange interconnection should not come as a surprise, and has precedent in connections such as those between David Bowie records and ballistic missile early warning at RAF Fylingdales. This research has shown that assemblages of nuclear war are intricate social engines that operate from the scale of personal affectivities to that of global war.

[371] Ibid.

[372] Jeffrey Lewis, *The 2020 Commission.*

They are always in the process of production and exceed normative representation that renders them invisible. The FMWDM has sought to make visible the operations of nuclear deterrent assemblages and perhaps offer new ways of understanding this so-called age of uncertainty. It does so not by interpreting significance of signs but by making visible the creative flows emerging from activities, actions, events, weapons systems and embodied affects interacting at all social and cultural scales. In so doing, the FMWDM may provide a new way of casting a gaze into oblivion.[373]

[373] See chapter 3.

Bibliography

Abrahams, Brett S and Daniel H Geschwind, ‘Advances in autism genetics: on the threshold of a new neurobiology’, *Nature Reviews Genetics*, 9(5) (2008), 341–355.

Alexis-Martin, Becky. ‘Geographies of nuclear warfare: future spaces, zones and technologies’ in *A Research Agenda for Military Geography*, Ed. Rachel Woodward. London: Edward Elgar [in press]

Anderson, Ben, ‘The Promise of Non-Representational Theory’, in *Taking-Place: Non-representational Theories and Geography*, eds. Ben Anderson and Paul Harrison. Farnham: Ashgate, 2010.

Anderson, Ian, ‘Fylingdale Flyer’ in *Jethro Tull: A* [LP] UK:Chrysalis 1980

Arendt, Hannah. ‘Vita Activa and The Human Condition’, in *The Human Condition*. Chicago: Chicago University Press, 1998.

Artaud, Antonin ‘To Have Done with the Judgment of God’ in *Antonin Artaud: Selected Writings*. Ed, Susan Sontag. Berkeley, CA: University of California Press, 1976.

Atomic Archive, ‘Effects of Nuclear Weapons’ http://www.atomicarchive.com/Effects/effects7.shtml Accessed 18

Baker, Helen and Joe Woodhouse and Michael Mulvihill, eds. *GRAPHITE*. Newcastle: Northumbria University Press, 2011.

Ball, Andrew, ‘Manuel Delanda, Assemblage theory (Edinburgh University 2016)’, *Parrhesia* 29, (2018) 241-247

Bateson, G and D D Jackson, J Haley and J Weakland, ‘Towards a Theory of Schizophrenia’ *Behavioral Science*, 1 (1956), pp.251–264.

Bätschmann, Oskar ‘Landscape at one removed’, in *Gerhard Richter: Landscapes*. Ed. Dietmar Elger. Berlin: Cantz, 1998.

Bauma, Melissa, ‘Studying Soviets, not sex: Margaret Meads research at RAND’, *Rand Review*, 2011 https://www.rand.org/blog/rand-review/2018/03/studying-soviets-not-sex-margaret-meads-research-at.html. Accessed 17 November 2018.

Beck, John ‘Concrete Ambivalence: Inside the Bunker Complex’, *Cultural Politics*, (2011) 7(1), pp.79–102.

Becker, Howard S. *Art Worlds*. CA: University of California Press, 1982.

Bennett, Jane ‘The Agency of Assemblage and the North American Blackout’ *Public Culture* 17(3) (2005) 445-65

Biddle, Ian ‘Archives and Archivism’ Lecture, *Thinking Theories and Methods*, HaSS PGR faculty training, Newcastle University, February 2017.

Bishop, Clare ‘Participation and Spectacle: Where are we now?’, in *Living as Form* ed, Nato Thompson. New York: Creative Time, 2012.

Bois, Yves-Alain, ‘Painting: The Task of Mourning’, 1986, annotation by Harper Montgomery, The Department of Art History, Chicago University, 2004 <http://csmt.uchicago.edu/annotations/boispainting.htm. Accessed 19 February 2019.

Bond, Rosemary and Jim Coles, ‘TADS meeting report: July AWE Aldermaston, 1981-2000 and more by Kate Pyne’, 2002 <http://www.tadleyphotos.co.uk/tads/. Accessed February 2019.

Borger, Julian ‘US nuclear weapons: first low-yield warheads roll of the production line’, *The Guardian*, 28 January 2019 <https://www.theguardian.com/world/2019/jan/28/us-nuclear-weapons-first-low-yield-warheads-roll-off-the-production-line. Accessed 24 February 2019.

Boskamp, Ulrike, ‘Artist as Spy: Mobility and the power of the Image’ in *Mobility and Fantasy in Visual Culture,* Lewis Johnson ed. Oxon: Routledge, 2014.

Braidotti, Rosi ‘Affirming the Affirmative: On Nomadic Affectivity’,.http://www.rhizomes.net/issue11/braidotti.html. Accessed 14 July 2018.

Braidotti, Rosi. ‘Interview with Rosi Braidotti’, interviewed by Rick Dolphijn and Iris van der Tuin in *New Materialism: Interviews and Cartographies*, eds. Rick Dolphijn and Iris van der Tuin. Ann Arbor: Open Humanities Press, 2012.

Braseth, Timothy,‘Josef van der Kar: Building Architectural Bridges’, *Modernism*, Summer 2011 http://www.artcrafthomesla.com/Modernism_Magazine_-_Van_der_Kar.pdf. Accessed 6 March 2019.

Briggs, Raymond *When the Wind Blows*, London: Penguin, 1982.

Brown, Derek, ‘The US–China spy plane row’, *The Guardian* 4 April 2001, <https://www.theguardian.com/world/2001/apr/04/china.usa. Accessed 21 November 2018.

Carpenter, Ele, *Nuclear Culture Source Book*. London:Blackdog 2016

Centre for computing history, International Computers Limited, .http://www.computinghistory.org.uk/det/8271/International-Computers-Ltd/. Accessed February 2019.

Charlesworth, J J, *Documenta against Democracy?,* 2017 https://artreview.com/opinion/may_2017_opinion_jj_charlesworth_documenta/ Accessed 3 September 2019

Clausewitz, Carl von. *On War*, eds. Michael Howard, Peter Paret and Bernard Brodie New Jersey: Princeton University Press, 1989.

Clifford, Ellie *Two Minutes to Midnight* [radio] UK: BBC 2018

Cocroft ,Wayne D and Roger J C Thomas, *Cold War: Building for Nuclear Confrontation 1949–1989*, Swidon: English Heritage 2003.

Colebrook, Clare, *Gilles Deleuze*, London and New York: Routledge, 2002.

Collinson, Alan. *RAF Fylingdales: an historical perspective.* Porton Down: Defence Science and Technology Laboratory, Crown Copyright, 2002.

Damjanov, Katarina, ‘Of Defunct Satellites and Other Space Debris: Media Waste in the Orbital Commons, Science.’ *Technology and Human Values*, 42(1) (2016), pp.166–185.

DeLanda, Manuel, ‘Assemblage Theory, Society and Deleuze’, 2011 https://www.youtube.com/watch?v=J-I5e7ixw78. Accessed 11 February 2019.

DeLanda, Manuel, *Assemblage Theory* Edinburgh: Edinburgh University Press, 2016.

Deleuze, Gilles and Félix Guattari *Anti-Oedipus: Capitalism and Schizophrenia*, Trans. Robert Hurley, Mark Seem and Helen R Lane. Minneapolis: University of Minnesota Press, 2000.

Deleuze, Gilles and Félix Guattari, *A Thousand Plateaus*, Trans Brian Massumi, London: Bloomsbury 2013.

Deleuze, Gilles and Félix Guattari, *Nomadology: The War Machine*, Trans. Brian Massumi Seattle: Wormwood Distribution, 2010.

Dickerman, Leah and Achim Borchardt-Hume, eds. *Rausenberg*. London and New York: Tate Publishing, The Museum of Modern Art, 2016.

Dittmer, Jason, ‘Geopolitical Assemblages and Everyday Diplomacy’, chap1 in *Diplomatic Materials: Affect, Assemblage and Foreign Policy*, Durham: Duke University Press, 2017

Drawing North East, ‘Drawing North East’. <https://drawingne.org.uk/. Accessed 21 May 2018.

Dunlop, Gair, ‘Nuclear Art and Archives’, 201 <https://vimeo.com/216806746> Accessed 22 February 2019.

Dunlop, Gair, ‘Yellowcake: How we use to work’ [film screening], The Floating Cinema, Aldermaston Wharf, 17 June 2015.

Dunlop, Gair. ‘Relics of Acceleration’ in *Virilio and Visual Culture*, John Armitage and Ryan Bishop (eds), Edinburgh: Edinburgh University Press, 2013

Elisabeth Bumiller, ‘We have met the Enemy and he is PowerPoint’, New York Times, (2010) <https://www.nytimes.com/2010/04/27/world/27powerpoint.html > [accessed 21 February 2019].

Enwezor, Okwui and Willis E Hartshorn, *Archive Fever: Uses of documents in Contemporary Art*, Göttingen: Steidl, 2008.

Evans, Brad and Laura Guillaume, 'Deleuze and War: Introduction', *Theory & Event 13*, no. 3 (2010) <https://muse.jhu.edu/. 12 February 2019.

Fahrenkrog-Petersen, Uwe and Carlo Karges and Kevin McAlea, *Ninety-Nine Red Balloons.* Beverly Hills: Epic, 1984.

Fer, Briony 'Studio', in *The infinite line*. New Haven and London: Yale University Press, 2004.

Fisher, Jean 'On Drawing', in *The Stage of Drawing: Gesture and Act* eds. Catherine de Zegher and Avis Newman. London and New York: Tate Publishing and The Drawing Centre, New York, 2003

Flintham, Matthew. 'The Military–Pastoral Complex: Contemporary Representations of Militarism in the Landscape: Art & Environment', Spring 2012 in Tate Papers, no.17 https://www.tate.org.uk/research/publications/tate-papers/17/military-pastoral-complex-contemporary-representations-of-militarism-in-the-landscape.

Fukuyama, Francis 27 July 2014, https://twitter.com/FukuyamaFrancis/status/493451867922255872 Accessed 20 February 2019.

Gehring, Ulrike, 'Sketched Knowledge: Epistemic Procedures of Mapping Landscape around 1650', *Sketching Prohibited: Military Interdictions of Drawing*, Freie Universität Berlin 5 November 2015.

Gerhart, USAF General John K 'Ballistic Missile and Space Weapons Detection Systems' in *North American Air Defense Command and Continental Air Defense Command: Historical Summary* Colorado: NORAD HQ, 1962.

Gill-Peterson, Julian, 'Childhood blocks Deleuze and Guattari's infant affects', 2013 <https://juliangillpeterson.wordpress.com/2013/04/29/childhood-blocks-deleuze-and-guattaris-infant-affects/ Accessed August 2017.

Graham, Stephen. ‘Satellite: Enigmatic Presence’, in *Vertical: The City from Satellite to Bunker* London: Verso, 2016.

Gregory, Derek, ‘Project(ion)s’, *Geographical Imagination*, 2019 <https://geographicalimaginations.com/tag/space-of-exception. Accessed 19 February 2019.

Haraway, Donna J ‘A Cyborg Manifesto: Science Technology and Socialist Feminism in the late Twentieth Century’, in *Manifestly Haraway*, Minnesota: University of Minnesota Press, 2016

Harris, Dave, ‘Deleuze for the Desperate #8: becoming-animal’ https://www.youtube.com/watch?v=QjWKoLdVtt0> Accessed 19 February 2019.

Hart, john ‘Preface’, in Gilbert Simondon, *On the mode of existence of technical objects.* Trans. Ninian Mellamphy, Ontario: University of Western Ontario 1980

Hauskeller, Michael, *Gunther Anders on Promethean Shame, Philosophical Reflections*, 2015 <http://hauskeller.blogspot.com/2013/09/gunther-anders-on-promethean-shame-part.html> Accessed 21 November 2018.

Hennessy, Peter, interviewed by Eddie Mair, PM, [radio programme] BBC Radio 4, 2010.

Hines, Barry *Threads* [television] UK: BBC 1984

Holmes, ‘Early Synthesizers and Experiments’ in Analogue Synthesis and Instruments ([n.pl]: [n.pub.], [n.d.].

Hong, Sungook, ‘Joey the Mechanical Boy Revisited’, *e-flux Architecture*, 2018, https://www.e-flux.com/architecture/superhumanity/179228/joey-the-mechanical-boy-revisited/, Accessed 21 November 2018.

Ingold, Tim ‘Trace, Thread and Surface’, in *Lines: A brief history* Oxon and New York: Routledge, 2016.

Jones, Sam, ‘A wonk’s guide to the Trident nuclear deterrent’, *The Financial Times*, 18 July 2016

.https://www2.le.ac.uk/library/help/referencing/footnote/footnote#Online%20Resources. Accessed 18 February 2019.

Kaplan, Fred. *Wizards of Armageddon* New York: Simon and Schuster, 1983.

Kirkpatrick, L B, 'Book review of Pearl Harbor: Warning and Decision by Roberta Wohlstetter', 1993 <https://www.cia.gov/library/center-for-the-study-of-intelligence/kent-csi/vol7no3/html/v07i3a13p_0001.htm. Accessed 17 October 2018.

Kistiakowsky, George, 'The folly of the neutron bomb', *Bulletin of the Atomic Scientists*, (Sep 1978) 34(27).

Kristensen, Hans M, 'Video Shows Earth-Penetrating Capacities of the B61-12 Nuclear Bomb' *Federation of American Scientists*, 14 January 2016, https://fas.org/blogs/security/2016/01/b61-12_earth-penetration/. Accessed 23 November 2018.

Kubrick, Stanley, *Doctor Strangelove: Or how I stopped worrying and learnt to love the bomb*, [film], USA: Columbia Pictures, 1963.

Kwon, Miwon, *One place after another: site-specific art and locational identity*. Cambridge: MIT Press, 2002.

Lazzarato, Maurizio and Alliez, Eric. 'To Our Enemies' *e-flux Journal* 78 (2016) 1-10

Lee, Pamela M, 'Aesthetic Strategist: Albert Wohlstetter, the Cold War, and a Theory of Mid-Century Modernism', *October*, 138 Fall 2011, pp.15–36.

Leigh-Star, Susan, 'Power, Technology and the phenomenology of conventions: on being allergic to onions' in *A Sociology of Monsters: Essays on Power Technology and Domination* ed. John Laws. London: Routledge, 1991.

Levins, Hoag, 'A hundred years of Camden's RCA Building 17: Former Employees Pack Centennial Event in Famed "Nipper" Landmark', Historic Camden County, 2009. <http://historiccamdencounty.com/ccnews140.shtml. Accessed 21 February 2019.

Lewis, Jeffrey 'BMD 101', *Arms Control Wonk Podcast* [podcast], 24 March 2017.

Lewis, Jeffrey ‘FOGBANK’, *Arms Control Wonk*, 7 March 2008, <https://www.armscontrolwonk.com/archive/201814/fogbank/. Accessed 23 November 2018.

Lewis, Jeffrey ‘Italian Stallions and PLUTONIUM’, *Arms Control Wonk*, 31 May 2007, <https://www.armscontrolwonk.com/archive/201525/italian-stallions-plutonium/. Accessed 23 November 2018.

Lewis, Jeffrey ‘North Korea Tests an H-bomb’, *Arms Control Wonk Podcast* [podcast], 5 September 2017.

Lewis, Jeffrey ‘Pulling Out of the INF’, Arms Control Wonk Podcast, [podcast], 30th October 2018.

Lewis, Jeffrey ‘Russian Nuclear Doctrine’, *Arms Control Wonk*, [podcast], March 2018.

Lewis, Jeffrey. *2020 Commission Reports on the North Korean Nuclear Attacks Against the United States*. London: Penguin, 2018.

Livingstone, Jane and Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967–1971*. Los Angeles: LACMA, 1971.

Losoncz, Mark ‘Manuel Delanda, Graham Harman: The Rise of Realism’ *Phenomenological Reviews,* 2017. https://reviews.ophen.org/2017/11/22/manuel-delanda-graham-harman-the-rise-of-realism/ Accessed 13 September 2019

MacDonald, Fraser ‘Geopolitics and 'The Vision Thing': Regarding Britain and America's First Nuclear Missile’ *Transactions of the Institute of British Geographers* 31 (2006) 53-71

MacDonald, Fraser and Klaus Dodds and Rachel Hughes, ‘Introduction: Envisioning Geopolitics’ in *Observant States: Geopolitics and Visual Culture.* Eds Fraser MacDonald, Klaus Dodds and Rachel Hughes. London: I.B. Tauris and Co. 2010.

MacDonald, Fraser, ‘Anti-Astropolitik – outer space and the orbit of geography’, *Progress in Human Geography*, 31(5) (2007), pp.592–615.

MacDonald, Sharon, *Memorylands: Heritage and Identity in Europe Today*. Abingdon: Routledge, 2013.

MacKenzie, Donald 'Tacit Knowledge, Weapons Design and the Uninvention of Nuclear Weapons', in *Knowing Machines: Essays on Technical change*. Massachusetts: MIT Press, 1996.

Marquand, Richard, *Star Wars: Return of the Jedi* USA: Twentieth Century Fox, 1983.

McQueen, Steve *The Renaissance Society* interviewed by Hamza Walker,2007 https://vimeo.com/16536169 Accessed September 18th 2019

McSorley, Kevin 'Towards an Embodied Sociology of War', *The Sociological Review*, 2015, Accepted Author Manuscript, accepted for publication, (2014) pp.9–15.

Meritt, Emily 'The Washington Development Corporation: Remembering Washington New Town', Chronical Live, 2015. https://www.chroniclelive.co.uk/news/history/gallery/washington-development-corporation-remembering-washington-9088329 Accessed 21 November 2018.

Meyer, Nicolas, *The Day After* [film] USA: ABC (1983)

Moore, Richard, *The Real Meaning of the Words: a pedantic glossary of British nuclear weapons* Southampton: Mountbatten Centre for International Studies, 2004.

Morrissey and Johnny Marr, *Shoplifters of the World Unite* London: Rough Trade 1987.

Muller, Martin, 'Assemblage and Actor-networks: Rethinking Socio-material Power Politics and Space', *Geography Compass* 9(1) (2015) 27-41

Mulvihill, Michael interviewed by Jake Nussbaum and Richard Fleming Radyo Shak at *4th Ghetto Biennale*, Clock Tower Radio, December 2015.

Museum Battlefield, 'Is the museum a battlefield', (2013), Vimeo, <https://vimeo.com/76011774> Accessed February 2019.

Naka, F R and W W Ward, ‘Distant-Early-Warning Line Radar: The Quest for Automatic Signal Detection’, *Lincoln Laboratories Journal*, 12 no. 2 (200), pp.181–204 (p.200).

Narang, Vipin, ‘The discrimination problem: why putting low-yield nuclear weapons on submarines is so dangerous’, *War on the Rocks*, 8 February 2018, <https://warontherocks.com/2018/02/discrimination-problem-putting-low-yield-nuclear-weapons-submarines-dangerous/ Accessed 24 February 2019.

Narkevičius, Deimantas ‘The Dud Effect’ *LUX*, https://lux.org.uk/work/the-dud-effect, Accessed 23 November 2018.

National Cold War Exhibition, [permanent exhibition], RAF Cosford.

Newcastle University ‘Old photographs of the Newcastle University Computing Service’, http://moca.ncl.ac.uk/oldpics/people.htm. Accessed 23 November 2018.

Nuclear Awareness Group, ‘NAG Spring Meeting: The Untold Story Of Radioactive Discharges From The Atomic Weapons Establishment’, http://nuclearawarenessgroup.org.uk/content/nag-spring-meeting-untold-story-radioactive-discharges-atomic-weapons-establishment. Accessed 19 February 2019.

Nuclear Threat Initiative Project, ‘Senate Bill Cuts Warhead Funding’, 2013. http://www.nti.org/gsn/article/senate-bill-cuts-warhead-funding/ Accessed 12 July 2018.

Ogden, Jeff ‘NUMAC Northumbrian Universities Multiple Access Computer, UK’, *Michigan Terminal System Archive*, 2012 http://archive.michigan-terminal-system.org/discussions/how-did-sites-learn-about-and-make-the-decision-to-use-mts/3numac Accessed 23 November 2018.

Olsen, J W, ‘Safeguard data processing system: Architecture of Central Logic and Control’, *The Bell System Technical Journal: Safeguard Supplement*, (1975), pp.S41–S61 (p.S41).

Openshaw, Stan and Philip Steadman and Owen Greene, *Doomsday: Britain after Nuclear Attack* Oxford: Blackwell 1983.

Paglen, Trevor *Blank Spots on the Map: The Dark Geography of the Pentagon's Secret World*, London: Penguin, 2009.

Parr, Adrian. ed. *Deleuze Dictionary*, Edinburgh: Edinburgh University Press, 2010.

Pinto, Ana Teixeira, 'Hito Steyerl's "Left to our own devices"', *Art Agenda*, 2015, .https://www.art-agenda.com/reviews/hito-steyerl%E2%80%99s-%E2%80%9Cleft-to-our-own-devices%E2%80%9D/. Accessed 21 February 2019.

RAF Fylingdales @RAFFylingdales 18 March 2019 https://twitter.com/RAFFylingdales

Rainer, Rob, *This is Spinal Tap* [film] USA: Embassy Pictures, 1984.

Rech, Matthew 'Ephemera(l) Geopolitics: The Material Cultures of British Military Recruitment' *Geopolitcs* (2019) 1-24

Rech, Matthew et al., 'Geography, military geography, and critical military studies', *Critical Military Studies*, 1(1) (2014), 47–60.

Reid, J. 'Deleuze's War Machine: Nomadism against the State', *Millennium*, 32(1), (2003), 57–85.

Rentea, Simona, 'Introduction to The Routledge Handbook of Biopolitics' in *The Routledge Handbook of Biopolitics* Eds. Sergei Prozorov and Simona Rentea, London: Routledge, 2017.

Richard Pinhas/Gilles Deleuze, 'Le Voyageur', *CERCC*, [n.d.] <http://cercc.ens-lyon.fr/spip.php?article300. Accessed 11 February 2019.

Richter, Gerhard, 'Note 1985', in *The Daily Practice of Painting*. Ed. Hans-Ulrich Obrist. Cambridge Mass: MIT Press 1995.

Ritchie, Nick, *Replacing Trident: Background Briefing for Parliamentarians*, Bradford: Bradford Disarmament Research Centre, University of Bradford, 2011

Robinson, Tony, *Coast to Coast* [television] UK: Channel 5 2017

Rowell, Margit 'Images of Cruelty: The Drawings of Antonin Artaud', in *Antonin Artaud: Works of Paper*, ed, Margit Rowell.New York: MoMA, 1996.

Salamon, Gayle, ‘The Place Where Life Hides Away: Merleau-Ponty, Fanon and the Location of Bodily Being’ *Difference: A Journal of Feminist Cultural Studies*, 17 no. 2, (2006), pp.97–112.

Sauvagnargues, Anne, *Artmachines: Deleuze, Guattari, Simondon.* Trans Suzanne Verderber and Eugene W. Holland, Edinburgh: Edinburgh University Press, 2016

Schapiro, Meyer ‘On Some Problems in the Semiotics of Visual Art: Field and Vehicle in Image-Signs’, *Simiolus: Netherlands Quarterly for the History of Art*, 6, no. 1 (1972), pp.9–19.

Sebald, W.G *On the Natural History of Destruction*, Trans. Athena Bell, Munich: Carl Hanser Verlag, 1999.

Simondon, Gilbert Trans. Arne De Boever, ‘On Techno-Aesthetics’ *Parrhesia* 14 (2012) 1-8

Spinardi, Graham, ‘Golfballs on the Moor: Building the Fylingdales Ballistic Early Warning Radar’ *Contemporary British History* Vol 21 No. 1 (2007) 87-110

Steyerl, Hito. ‘A Tank on a pedestal: Museums in the Age of Planetary Civil War’ *e-flux Journal* 70 (2016)

Steyerl, Hito. ‘Freedom from Everything: Freelancers and Mercenaries’ e-flux Journal 41 (2013)

Sublette, Carey ‘4.4 Elements of Thermonuclear Weapons Design’, 20 February 1999, http://nuclearweaponarchive.org/Nwfaq/Nfaq4-4.html#Nfaq4.4.4 Accessed 23 November 2018.

Tate, ‘Art Term: Readymade’, [n.d.] <https://www.tate.org.uk/art/art-terms/r/readymade> Accessed 8 March 2019.

The National Academies of Science Engineering and Medicine, ‘Available data do not show health hazard to Cape Cod residents from Air Force PAVE PAWS radar’, 2005 <http://www8.nationalacademies.org/onpinews/newsitem.aspx?RecordID=11205. Accessed 22 February 2019.

The Yorkshire Post, ‘RAF Fylingdales opens its doors to dispel fears’, 2007 <https://www.yorkshirepost.co.uk/news/raf-fylingdales-opens-doors-to-dispel-fears-1-2465817> Accessed 22 February 2019.

Thomas, Roger J C. *Historic Building Report: RAF Fylingdales, Snod Hill, Lockton, North Yorkshire*. Swindon: National Monuments Record Centre, Crown Copyright, 1998

Thompson, Nato and Trevor Paglen, *Experimental Geography*. Brooklyn: Melville House, 2009.

Tucker, Nicola, ‘Turbulent dreams of a damaged saint’, 1995, https://www.independent.co.uk/arts-entertainment/books/turbulent-dreams-of-a-damaged-saint-1524787.html. Accessed 12 February 2019.

USAF, ‘Peterson Air Force Base, 21st Space Wing,’ 2017. http://www.peterson.af.mil/About/Fact-Sheets/Display/Article/326192/21st-space-wing/

Verzotti, Giorgio. ‘L’hiver de l’amour’, *Art Forum*, October 1994, 33 no.1, p.112.

Voss, Daniela, ‘The philosophical concepts of meat and flesh: Deleuze and Merleau-Ponty’, *Parrhesia*, no. 18, (2013), pp.113–124.

Vulliamy, Ed, ‘Bush plans space bomber’, *The Guardian*, 29 June 2001, <https://www.theguardian.com/world/2001/jul/29/usa.georgebush. Accessed 21 November 2018.

Watkin, Peter *The War Game* [television] UK: BBC 1963

Wellerstein, Alex. ‘Nukemap 2.6’, *The Nuclear Secrecy Blog*, https://nuclearsecrecy.com/nukemap/ Accessed 23 November 2018.

Wikimapia, ‘Durham House’, .http://wikimapia.org/1874279/Durham-House. Accessed 21 November 2018.

Wiksrtröm Josefine, *Art’s Economic Exceptionalism* (2015) Meta Mute http://www.metamute.org/editorial/articles/art%E2%80%99s-economic-exceptionalism Accessed 2nd September 2019

Wilcox, Sean, ‘Image-Making and Imperial Intervention in Nineteenth-Century South Asia’, *Sketching Prohibited: Military Interdictions of Drawing*, Freie Universität Berlin 5 November 2015

Wiley, John ‘Non-Representational Subjects?’ in *Taking-Place: Non-Representational Theory and Geography*, Eds. Ben Anderson and Paul Harrison, Farnham: Ashgate, 2010.

Williams, Allison, ‘Disrupting air power: Performativity and the unsettling of geopolitical frames through artworks’ *Political Geography* 42 (2014) 12-22

Williams, Allison, ‘Enabling persistent presence? Performing the embodied geopolitics of the Unmanned Aerial Vehicle assemblage’ *Political Geography* 30 (2011) 381-390

Williams, Allison, et al, eds. *Routledge Companion to Military Research Methods*. Abingdon: Routledge, 2016.

Wilson, B C F *Royal Air Force Fylingdales: A History* UK: Royal Air Force Fylingdales 1983

Wohlstetter, A J and F S Hoffman and H S Rowen, *Staff Report: Protecting US power to strike back in the 1950s and 1960s*. Santa Monica: RAND Corporation, 1956.

Wood, David ‘Territoriality and Identity at RAF Menwith Hill’ in *Architectures: Modernism and After,* Ed. Andrew Ballantyne. New Jersey: Wiley 2004.

Woodward, Rachel. *Military Geographies* New Jersey: Wiley-Blackwell, 2004.

Woodyer, Tanya ‘Ludic Geopolitics: children’s play, war toys and re-enchantment with the British military’ *Material Sensibilities,* 2015. https://materialsensibilities.wordpress.com. Accessed 19th March 2019

Archive Sources

40 Years of Computing at Newcastle University – IBM System 370 Model 168, ‘Terry Ratcliffe seated at the 370/168 Main Operators Console’

http://history.cs.ncl.ac.uk/anniversaries/40th/images/ibm370_1682/print02.html. Accessed 23 November 2018.

NATO Online Library, ‘Special Meeting of Foreign and Defence Ministers Brussels, 12 December 1979.’ Accessed 18 March 2019 https://www.nato.int/docu/comm/49-95/c791212a.htm

RAF Fylingdales Archive, [uncatalogued], [DVD], ‘The Unblinking Eye’.

RAF Fylingdales Archive, [uncatalogued], [DVD], ‘The Unblinking Eye’.

RAF Fylingdales Archive, [uncatalogued], ‘BMEWS training material sub-course L1000-2 RCA GB’ .

RAF Fylingdales Archive, [uncatalogued], ‘Scan: Autumn 1969’, p.3.

RAF Fylingdales Archive, [uncatalogued], ‘Scan: no. 14, November 1964’, p.18.

RAF Fylingdales Archive, [uncatalogued], ‘Scan: weapons contractors magazine for Site III RAF Fylingdales, edition 4’.

RAF Fylingdales Archive, [uncatalogued]. ‘BMEWS training material sub-course’.

RAF Fylingdales Archive: Pickering ‘RCA supply catalogues’.

RAF Fylingdales Archive: Pickering, ‘BMEWS Training Manual: sub-course L1000-2, system analysis handbook’.

RAF Fylingdales: Archive [photography room] pp 1-44 ‘RAF Form 540: RAF Fylingdales operations record book, September 2003’.

RAF Fylingdales: Archive, ‘RAF Form 540, September 2003’

The National Archives, AIR28/2473, ‘540 Form April 1–30th MIP Upgrade 1983’.

The National Archives, AIR28/2473, ‘RAF Fylingdales 540 reports 1983’

WGBH Media Library & Archives, ‘Randall Forsberg Interview 3:War and Peace in the Nuclear Age: Visions of War and Peace, March 1988’

http://openvault.wgbh.org/catalog/V_F4ABF4A779CE4613BDBF7A73CC019CAC
Accessed 20 November 2018.