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Drone Flight and Failure: the United States' Secret Trials, Experiments and Operations in Unmanning, 1936-1973

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Drone Flight and Failure: the United States' Secret Trials, Experiments and Operations in Unmanning, 1936-1973

By

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Committee in Charge:

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Professor Charis Thompson, Co-Chair
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Professor Jake Kosek

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Abstract

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I examine the precursors to contemporary unmanned combat air vehicles (UCAVs) to ask what is at stake in the designation "unmanned?" The apparent misnomer dissociates technologies and humans, occluding how international interventions, including surveillance, military support, signals intelligence, and targeted killing, are carried out through actions networked between humans and nonhumans. I use a genealogical approach to address how tensions and contradictions articulated by unmanning emerge, using the development, operation and failure of unmanned systems to complicate divisions between human and nonhuman; "us" and the enemy; immersion and distance; military and industry; and above and below.

I identify two phases in the development of remote controlled and unmanned aircraft in the United States: targeting and reconnaissance. Contemporary UCAVs loop together these practices, even as they separate socio-political relations from technical artifacts and their resultant role in geopolitics. In the first period between 1936 and 1944, drone technologies shape and were shaped by targeting. I begin in 1936, when a Navy program to produce remote controlled aircraft was given the code name drone. Drones from the interwar era were developed as targets to train anti-aircraft gunners, even while the technologies also became the first television guided weapons, described as "American Kamikazes," used briefly in World War II. In the second phase between 1956 and 1973, I explore so-called unmanning. This part turns to pilotless reconnaissance aircraft from the Cold War conceived as replacements for manned spy planes after the Francis Powers U-2 incident in 1960, also based on a target plane, the Firebee. These projects were used for over 3000 pilotless flights to collect surveillance over Southeast Asia.

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Figures

Abbreviations

AA	Anti-Aircraft
AAA	Anti-Aircraft Artillery
BuAer	Navy Bureau of Aeronautics, WWII
BuEng	Navy Bureau of Engineering, WWII
BuOrd	Navy Bureau of Ordinance, WWII
CHECO	Contemporary Historical Examination of Current Operations
CIA	Central Intelligence Agency
CinC	Commander-in-Chief, Navy
CNO	Chief of Naval Operations
DoD	Department of Defense
MIT	Massachusetts Institute of Technology
NAF	Naval Aircraft Factory
NARA II	National Archives, College Park
NASM	National Air and Space Museum
Nolo	No Live Operator
NRL	Navy Research Laboratory
R&D	Research and Development
RC	Radio Control
RCA	Radio Corporation of America
RG	Record Group
RKO	Radio-Keith-Orpheum
RPV(s)	Remotely Piloted Vehicle(s)
SAC	Strategic Air Command
SAM	Surface-to-Air Missile
SPA	Special Purpose Aircraft
STAG	Special Task Air Group
TRA	Teledyne-Ryan Aeronautical
UAV(s)	Unmanned Aerial Vehicle(s)
UCAV(s)	Unmanned Combat Air Vehicle(s)
USAF	United States Air Force
VJ-3	Target Drone Utility Wing, WWII

Drone, Aircraft and Missile Designations

124I	Ryan Aeronautical Reconnaissance Drone, Israel
A/BQM-34	Ryan Aeronautical Special Purpose Drone Aircraft, Cold War
DC130-A	Lockheed Launch Aircraft, Cold War
JH-1	Navy Drone Aircraft, WWII
MiG-21	Soviet Supersonic Jet Fighter, Cold War
MQ-1 / RQ-1	General Atomics Predator, present
MQ-9	General Atomics Reaper, present
N2C2-DRONE	Navy Plane, Drone Aircraft, WWII
NT-DRONE	Navy Training Plane, Drone Aircraft, WWII
Q-2	Ryan Aeronautical Firebee Target Drone, Cold War
TBM	Grumman / Navy Television Control Plane, WWII
TDN	Navy Television Guided Assault Drone, WWII
TDR	Interstate / Navy Television Guided Assault Drone, WWII
TG-2	Navy Torpedo Plane, Drone Control Plane, Assault Drone, WWII
U-2	Lockheed Reconnaissance Aircraft, Cold War and present
V-1	German Flying Bomb, WWII
V-2	German Rocket, WWII

Introduction

"A Different Lethality"

Between February 6 and 8, 2002 a series of television news reports announced Osama bin Laden may have been killed by a drone missile strike days earlier in southeastern Afghanistan, although confirmation of the report was delayed due to poor weather conditions and the inaccessibility of the region.[1] A week after the attack, on February 11, the *New York Times* reported "troops of the 101st Airborne Division spent today at the grisly task of gathering evidence at the campsite where a missile-carrying American Predator drone fired at a small band of suspected members of Al Qaeda."[2] Downplaying earlier speculation "that a tall bearded man seen through the Predator's camera" was bin Laden, [3] the article nonetheless emphasized how the drone weapon system had been conceived to target the terrorist leader after the bombing of two East African embassies in 1998. Pointing to the time lapse between capturing surveillance imagery and ordering a missile strike, military officials explained, "The idea of arming the Predator seemed to provide the answer: Mr. bin Laden and his lieutenants could be attacked by the same surveillance drone that spotted them."[4] The uncertainty of who was attacked by the unmanned aircraft, now apparent after the arrival of ground troops, did not unsettle the potency of the connection between targeting and surveillance. Testifying to Congress, Secretary of Defense Donald Rumsfeld used this logic to support new spending for the aircraft. "If you have an unarmed Predator that's out there gathering intelligence information and you replace it with an armed Predator, that not only can gather intelligence information, but then can actually fire a Hellfire … you've got different lethality."[5] The 2003 defense budget, submitted to Congress on the same day as the missile strike, provided over one billion dollars for unmanned aircraft.

On February 12, another official statement regarding the events appeared in the news, insisting the Hellfire missiles fired from the unmanned Predator drone on February 4, 2002 had hit their intended targets. "Those killed were 'not innocents,' said Rear Adm. John D. Stufflebeem, deputy director of operations for the Joint Chiefs of Staff in a press conference."[6] He explained, "I base that on the facts that [the 101st Airborne] … did some exploration in the surrounding area, to include some caves, a nearby village, and talking to locals. So I think that that sort of puts us in a comfort zone. These were not innocents."[7] This response came after press reports indicated individuals targeted by the drone strike were not Al Qaeda, rather the "victims might have been scrap metal dealers or smugglers searching for weapons abandoned by Al Qaeda and Taliban troops several weeks ago."[8] Reports that those targeted were local peasants first appeared on the front page of the *Washington Post* on February 10. The article explained:

> Villagers here in the remote mountains of eastern Afghanistan said Ahmad and two other local men, Daraz and Jahan Gir, were peasants gathering scrap metal from the war. ... They were killed last Monday when a U.S. Hellfire missile, fired from a CIA-run Predator drone, shrieked down in what was supposed to be an attack on terrorists.[9]

Questions were also raised as to why the Central Intelligence Agency (CIA), not the Air Force, made the decision to fire the missiles. Reports in the subsequent days indicated an Al Qaeda finance official had been killed. This claim was never confirmed. Victoria Clarke, Rumsfeld's press secretary, speaking on February 12, reiterated, “We're convinced it was an appropriate target, based on the observation, based on the information that it was an appropriate target.”[10] When journalists asked why villagers would say three innocent civilians were killed, government officials suggested locals, aware of the United States’ practice of paying compensation to survivors mistakenly killed by American missile strikes, were seeking to take advantage of this policy.[11]

In the February 4, 2002 attack in Afghanistan the interconnection between authority, power and evidence mobilized through unmanned aircraft was not yet secret.[12] Today, questions about CIA drone strikes produce no official response. The explanations from 2002 offer insight into the now hidden logic that underwrites the use of unmanned combat air vehicles. Crucially, it draws on the connection between intelligence and targeting that Rumsfeld explains as the system’s basis. Responses to questions about the strike were answered through the evidence provided by the same camera system used to carry out the attack, corroborated by forces on the ground. “Watching for hours” through the images transmitted to operators, as well as analysts based in the United States, justified the pronouncement that the men were “not innocent,” and the corresponding missile strike. Who is defined as an enemy target, the evidence for this designation, and the authority to make that decision are interconnected through the so-called unmanned system, a human and nonhuman network that surveys and monitors, as it strikes and kills.

Unlike most scholars and critics, I examine these concerns not through analysis of contemporary drone warfare but through antecedents to unmanned aircraft, which date to the earliest days of flight. While bin Laden and the War on Terror are often described as the origin of drone warfare, the development of unmanned aircraft in the United States reveals a patchwork of socio-technical systems, ranging from early aerial torpedoes, radio controlled aircraft, guided missile prototypes, television guided assault drones, jet propelled training targets, unmanned reconnaissance systems and cruise missiles. A government report from 1988 used to classify unmanned aerial vehicles (UAVs) includes more than a hundred models, produced in the United States and abroad, dating from as early as 1917.[13] My research draws on this history to identify two key periods in the development of drone aircraft that tie to the justification for the system today: Between 1936 and 1944, drones were used as targets and targeting systems. From 1953 to 1973, drones emerged as unmanned reconnaissance. Separately, targeting and reconnaissance drones were partially dismissed as failed technological innovations, even as their uses presaged contemporary unmanned combat air vehicles. My research makes three connected claims: First, I undo what drones and unmanned aircraft are by examining how terms and technologies referred to by this concept shape and are shaped by shifting technical, military, industrial, social and political contexts. A drone is a target and a targeting system; a prototype missile and reconnaissance vehicle; a domestic training tool and a system that tracks and surveys internationally. Second, I show how networked actions between human and nonhuman that comprise unmanned aircraft simultaneously operate through a series of disassociations – between human and technology; defense and attack; enemy and target; and here and over there. These connections and disjuncture were critical to the deployment of unmanned aircraft and transform the networked systems. Third, central to the development, experimental use, and deployment of drones are multiple accounts of failure at once technological, social and political. Looking at the ways drones crash, targets are missed, intelligence is wrong and projects fail, I complicate and fragment how targeting and reconnaissance are carried out. Failures disturb straightforward understandings what targets are or how territories are surveyed, showing instead ambiguities intertwined with these practices.

Lawrence Newcome, Michael Armitage, Steve Zaloga, Ian Palmer and Thomas Erhard[14] examine the development of unmanned aircraft in the twentieth century to provide accounts of the military and technical evolution of unmanned aircraft, noting the difficulties in sketching out a history of the systems. Authors of these works detail various experiments with teleautomation, aerial torpedoes, drones, cruise missiles and unmanned aircraft that have been proposed since the early days of flight. They establish a progression of technologies transformed through increasingly sophisticated communication and computational systems, leading to contemporary unmanned aircraft. To visualize this development, Newcome, for example, relies on a diagram of a tree, showing the multiple branches that emerge from radio control aircraft, ranging from target drones to cruise missiles to unmanned aircraft vehicles. Each author pieces together different versions from the patchwork of experimental unmanned aircraft, although similarly rely on a tree-like model, progressing to contemporary unmanned aircraft. Different from these accounts, I examine the history of drone aircraft not as a straightforward development, but as a series of ruptures and failures, emphasizing what does not come together in these histories and undoing the narrative of technological evolution.

A Genealogy of Drone Aircraft

My analysis of transformations to drone aircraft between 1936 and 1973 is informed by three scholarly frameworks: science and technology studies, media studies and genealogy. From genealogy, I take an approach that is an "unstable assemblage of faults, fissures and heterogeneous layers."[15] My focus on changing interdependencies between humans and nonhumans draws on science and technology studies, which shows how political and technical processes are entangled through unmanned aircraft. I use media studies to underscore the role of mediation in unmanned aircraft, asking how communications systems change the scope and scale of human and nonhuman interactions. I am guided by what are typically seen as problems in studying the history of unmanned aircraft: inconsistent terminology and a miscellany of systems. Language, practices and technologies do not just change over time. Rather, they are layered over one another, tied to changing configurations of human and nonhuman networks which shape and are shaped by political, military and industrial transformations.

The term "drone" is a case in point – describing both what an unmanned system is and what it is not. For the United States military, "drone" refers to an unmanned target plane used to train anti-aircraft gunners. It is a simulated aircraft to be shot at. The difference between these systems, especially for operators trained to use unmanned aircraft for combat, is critical. MQ-1 Predator pilots wear patches with the motto, "We're not drones … We shoot back,"[16] to distinguish the unmanned aircraft they operates in battlefields from those used for training air defense. Despite efforts by both the military and the trade association that represents unmanned aircraft however, "drone" is popularly used to describe *all* unmanned aircraft, interlayering the targets aircraft named in military parlance with reconnaissance systems and combat air vehicles.

The inconsistent terminology for the systems is tied to multiple, overlapping experiments that do not fit into a straightforward narrative of how unmanned aircraft emerge, transform and are used. As Michel Foucault remarks, "What is found at the historical beginning of things is not the inviolable identity of their origin; it is the dissension of other things. It is disparity."[17] I attend to the development, experimental missions and use of unmanned aircraft between 1936 and 1973 in the United States through just such disparity – the discontinuity, ambiguity and contradiction that constitutes what counts as "drone" or "unmanned," using these frameworks to mark two phases of development. With each phase, I analyze tensions found in the drone aircraft: it is a target aircraft and a targeting system in the first part, and in the second it is both a training target and reconnaissance system. These contradictions ground contemporary unmanned aircraft, poignantly formulated by Rumsfeld as a "different lethality," the justification for unmanned combat air vehicles marked by their capacity to survey and kill. This groundwork for contemporary drones is also formed by difference though, which leads to the second set of tensions in my research. Even as my analysis indicates how early unmanned aircraft presage contemporary weapons, how humans and nonhumans are networked, who is seen as the enemy, and how territory is pictured through a drone differ from today.

The ambiguities examined by my research can be thought as gray, a tone that troubles the fundamental oppositions, pointing instead to a series of contradictions. As Friedrich Nietzsche remarks, gray is the color of a genealogist. He explains the statement by adding, "which is to say, that which can be documented […] the whole, long, hard-to-decipher hieroglyphic script of man's moral past."[18] Michel Foucault seizes on this comment as a frame for his method, writing, "Genealogy is gray, meticulous and patiently documentary. It operates on a field of entangled and confused parchments, on documents that have been scratched over and recopied many times."[19] The development of drones in the twentieth century, as I indicated above, is a patchwork of projects and experiments – its history is gray, which adds to the challenge of examining how the human and nonhuman systems act politically and articulate values. Foucault explains, "The search for descent is not the erecting of foundations: on the contrary, it disturbs what was previously considered immobile; it fragments what was thought unified; it shows the heterogeneity of what was imagined consistent with itself."[20] Drones in the twentieth century were targets, targeting systems and surveillance aircraft. To examine their current use, I undo what is a "drone" or "unmanned" and instead point to tensions, contradictions and disjuncture.

Central to my analysis are contradictions between humans and nonhumans, articulated through networked actions distributed between humans and technologies. Bruno Latour writes, "To conceive of humanity and technology as polar opposites is, in effect, to wish away humanity: we are socio-technical animals, and each human interaction is sociotechnical. We are never limited to social ties. We are never faced only with objects."[21] Science and technology studies in this way challenges both social construction and technological determinism, as humans and nonhumans together fabricate collectives that shape lived experiences. Sheila Jasanoff elaborates on these interactions to examine the co-production of discursive and material practices. She writes "co-production is shorthand for the proposition that the ways we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it."[22] Jasanoff argues science and technology "[embed and are] embedded in social practices, identities, norms, conventions, discourses, instruments and institutions."[23] These theories capture how unmanned aircraft frame the actions of the engineers, operators and military decision makers, who simultaneously constitute the system co-produced through social and technical parts, layered into changing practices of warfare and politics.

The integration between humans and nonhumans, as well as the disjuncture, which I explore more below, is achieved through media. I use media studies to explore *how* humans and nonhumans are linked. Early configurations of the drone employed radio, telephone, radar and television technologies to network together human and nonhuman, while Cold War systems relied on Doppler radar, altimeter controls and pre-programmed navigation to take photographs. Writing during this period, Marshall McLuhan (most likely, unaware of early efforts to build drones) explained media extended and transformed human actions:

> Long accustomed to splitting and dividing all things as a means of control, it is sometimes a bit of a shock to be reminded that, in operational and practical fact, the medium is the message. This is merely to say that the personal and social consequences of any medium – that is, of any extension of ourselves – result from the new scale that is introduced into our affairs by each extension of ourselves, or by any new technology.[24]

McLuhan explores how media are tied to changing scales. It is not just that humans and nonhumans co-produce unmanned aircraft, radio signals, real-time visual transmissions, tracking systems and reconnaissance photography change interactions through space and time. Lisa Parks' analysis of satellite technologies foregrounds these transformations. She writes "satellite television is a part of an ongoing dialectic of distance and proximity. By this I am referring to television's capacity to produce a structure of feeling that enables an experience of simultaneous connection and separation."[25] Media intertwine engineers, operators and military decision makers with machines, changing ways of seeing and ordering, which impacts how connection and separation are articulated, as well as how proximity and distance are mobilized in domestic and international politics.

The contradictory formations of "simultaneous connection and separation" tie broadly to a series of ambiguities enacted through practices, terminology and media that constitute unmanned systems. I use tension, rather than resolution between these oppositions to organize my research, which explores practices, technologies and media variously connected and disjoined by "drone," in the first part, and "unmanned," in the second. Each part draws on a collection of archival materials, which detail the development, experimental use and operation of two unmanned aircraft: the Navy drone and the Ryan Aeronautical Firebee. In so doing, my account sidelines countless other experimental efforts to develop unmanned aircraft in the United States. I select these two projects because both were used as training targets, experimentally tested for multiple uses and deployed in war, even as they foreground ruptures between the two phases, as well as connections and tensions with current systems.

"Drone" was the code name for a Navy project in 1936 to develop radio-controlled planes to train anti-aircraft gunners and its naming, development and transformation into an assault weapon guides the first part of my analysis. While the target plane was used to simulate air defense, it drew on earlier efforts to develop an aerial torpedo. An article published in *The New York Times* by Nikola Tesla in 1915, "Tesla's New Device Like Bolts of Thor," promoted a remotely operated bomber. Through wireless control, Tesla explained, it would be possible "to direct an ordinary aeroplane, manless, to any point over a ship or an army, and to discharge explosives of great strength from the base of operations."[26] During World War I, both the United States Army and Navy tested prototypes of these early guided weapons, although none were deployed. The Navy effort in 1936, which first made use of the name "drone," also noted ambivalence between the target plane and its possible use as a weapon. Four years later, the same core group of engineers that led efforts to build the target drone would develop a television guided assaulted drone, used in September and October of 1944 in Europe and the South Pacific. Funding for these weapons was cancelled before the end of the war, although drone persisted as a designation for target aircraft and remotely piloted air vehicles.

The second part of my research explores how "unmanned" becomes associated with remotely flown aircraft, even as the term "drone" continues to be used to name the unmanned training systems that simulated jet planes for training air-to-air and surface-to-air defense. This part of my research focuses on the Firebee, a jet powered drone produced by Ryan Aeronautical, still used today as a target aircraft. The term "unmanned" gains currency as early efforts to build drone reconnaissance are positioned against manned U-2 flights, which became an international flashpoint following the capture of Francis Gary Powers as a prisoner while flying a secret reconnaissance mission over the Soviet Union in 1960. 6Overlaying "unmanned" and "drone," I explore how the use of unmanned aircraft shifts in the context of the Cold War, even as the systems are overshadowed and enshadowed by the development of nuclear weapons, intercontinental ballistic missile delivery systems, as well as computing and satellite technologies. Modified versions of the Firebee, developed for intelligence collection, flew over 3,000 missions in Southeast Asia, capturing photographs and electronic signals during the Vietnam War. In 1973, the same systems were used in the 1973 Arab-Israeli War. Examining these two uses, I explore how the Cold War division between East and West also operates in a vertical plane, separating above from below. Drone crashes, navigational error and other failures complicate these divisions and I consider how "unexpected landings" disturb an emerging aerial view of the world, as does the project's cancellation.

Contemporary Unmanning

While little attention has been given to the antecedents to unmanned aircraft, a gap noted by Derek Gregory in his recent writing on drones, there has been a proliferation of research addressing unmanned aircraft in the past ten years. [27] Below, I sketch out three main currents to indicate how I am in dialogue with these works. Each relies on a particular model of interaction between humans and technologies. I outline how drones are studied by the engineers who design and use unmanned systems, researchers who interrogate their use geopolitically, and legal critics of drone warfare. These areas of research indicate how so-called "unmanning" is undone through the humans and nonhumans that comprise the aircraft system, which operates instead through a constellation of elements across the planet. My genealogy uses the fissures and gaps between earlier drones and contemporary systems to examine what is at stake in their multiple configurations and how changing human and nonhuman relations that are formed and broken in the two phases analyzed by my research.

Missy Cummings and Vijay Kumar lead research to engineer human-machine interfaces for unmanned aircraft. Cummings highlights a cognitive approach, focusing on human responses to the technical design,[28] while Kumar examines the possibility for networked actions, engineering the coordination of robots.[29] Their work underscores the interconnected and networked qualities of unmanned aircraft, although these designs leave out how these networks have transformed over time, as well as social and political contexts interwoven into the systems. Timothy Cullen, an Air Force fighter pilot, ethnographer and engineer, addresses this gap through his study of RQ-9 Reaper pilots, sensor operators and image analysts. He examines the day-to-day use of remotely piloted aircraft in Air Force trainings.[30] Drawing on Edwin Hutchins' studies of situated cognition, Bruno Latour's analyses of science in action, and Thomas Sheridan's taxonomy of human-machine control,[31] Cullen shows how people, practices and machines associated with unmanned aircraft are formed by communities of practice and organizational structures. He details how operators "become the camera," learning to act with and through a matrix of communications, onscreen images and sensor information to remotely fly the MQ-9 Reaper. Situating these changes in the development of the system since 1995, Cullen ties remotely piloted aircraft to the military and industrial contexts that shaped them: the expedited Air Force funding program, Big Safari, and earlier contracts through the Defense Advanced Research Projects Agency.[32] Big Safari emphasizes rapid development, transforming an unmanned reconnaissance system into weapons platform in less than sixteen months. At the beginning of the invasion in Afghanistan, there were only two working models and the system maintained its experimental status until 2005. Cullen notes, for example, how the aircraft's history as an endurance reconnaissance system is reflected in the ground control unit, which was never intended for use as a weapon.[33] He concludes by observing, "Like many of the people, tools, and procedures incorporated into Predator and Reaper, many of the conditions contributing to the successful performance of [remotely piloted aircraft] are inseparable from the environment of military conflict."[34]

While Cullen details the complexities of drone operations from the perspective of pilots and operators in the United States, what is largely absent (at least in the public version) is how the "environment of military conflict" fits into this account. These questions, on the other hand, have been the main focus of approaches taken by Derek Gregory, Keith Feldman and Gregoire Chamayou.[35] These authors study how drones interact with and tie to global power relations. Situating their work in relation to post-colonial critiques and bio-politics,[36] the authors examine how unmanned aerial vehicles are deployed through multiple layers of air power against a targeted enemy on the ground. They show how drones tie to changing framework for territorial boundaries and the ethics of who can live and who is killed, interconnected with global politics,. Feldman writes of the use of drones along the Afghanistan and Pakistan border to argue "racialization from above arrays visual technologies along a vertical vector in order to supplement imperial sovereignty's practices of ubiquitous bordering on the ground."[37] He ties the American use of drone to a new framework of empire, where bio-political differences are also mapped out along a vertical axis. Gregory makes a correlated argument by attending to the techno-cultural system of the drone, showing how the networked actions between humans and technologies cross borders while reinforcing them. Gregory writes "the time-space compression of the kill-chain ensures that, whatever cultural divide has been crossed in 'precision and information,' another has been signally reinforced: the techno-cultural distinction between 'their' space and 'our' space, between the eye and the target."[38] For Chamayou, the question of violence from a distance sets out what he calls the necro-ethics of the drone, premised on the protection of the military pilot, distinct from the target. These analyses foreground global politics enacted by drone aircraft. I use these insights though, to attend to the complex of practices, disrupting the seamlessness of their accounts. I examine not just the global divisions enacted by drones, but mediated ambiguities between humans and nonhumans that comprise unmanned systems as they have developed throughout the twentieth century, troubling the boundaries that are formed by drones, even as they are co-produced.

Distinct from the two previous frameworks, most ethical and legal approaches to contemporary drone warfare draw on existing models of ethics or law. "Living under Drones,"[39] a report by New York University and Stanford Law Schools, for example, aims to document recent target killings in Pakistan and Yemen. Focusing on civilian deaths, the report challenges the use of unmanned aircraft through international law. The report argues drones violate human rights and critiques their deployment on this basis. This work raises important questions about unmanned aircraft, although it does not ask what is a central concern for me: how are unmanned aircraft already shaped by and shaping the political, ethical and legal frameworks that evaluate drones? While drones may be fit into ethical and legal frameworks, the socio-technical system is also shaping and transforming these bases. I examine how drones and unmanned aircraft intervene in, transform and disturb what is human and what is not, who is an enemy and who isn't, and what is close and what is far to ask how unmanning exceeds and transforms the very categories that are at the groundwork of contemporary debates.

Chapter Outlines

The first part, "Targets and Targeting," is organized through connections and ambivalences between drones as targets and their use as targeting systems. The account is drawn from archival documents, known as the "Collected Records of Delmar Fahrney,"[40] which include over one-hundred boxes of materials gathered by Navy Rear Admiral Fahrney for his unpublished 1957 manuscript, *The History of Pilotless Aircraft and Guided Missiles*. I use the archive to examine the Navy projects Fahrney led, beginning in 1936. From the earliest days of his command, Fahrney highlighted the potential of the drone not just as a training target but also as an assault weapon. In his manuscript, Fahrney emphasized the latter, although the collected materials from the period indicate interconnections between the target and targeting system. Fahrney, along with a co-worker at the Navy Research Laboratory coined the term "drone" in 1936, which serves as a starting point for Chapter 1, "The Queen Bee and the Drone." This chapter maps out how humans and nonhumans were networked together through pilotless planes, following the connections and disjuncture set out through the media, technologies and people that produce the first radio controlled targets. I analyze the development of the "Laboratory Drone," an experimental aircraft tested by human safety pilots, and the use of drones to train anti-aircraft gunners beginning in 1937. Crashes figure prominently in the early experiments, which disturb the ideal of remote control named by the drone, as well as the changing strategies of airpower simulated by the radio controlled planes. Humans and nonhumans are linked and disjoined by drone aircraft, setting up a network of relations that proposes both interconnections that tie to changing practices of warfare, yet are also marked by enmity and difference between humans and technology.

While most remotely piloted aircraft used during World War II were targets to train anti-aircraft gunners, the U.S. Navy researchers who engineered the drone also proposed the system could be modified for use as a weapon. Chapter 2, "*American Kamikaze*," examines these projects, emphasizing the significance of television. Reversing the perspective of the target drone in the previous chapter, I ask how targets were sighted by incorporating image transmission into assault drone aircraft. Forty-six television guided weapons were used in the Solomon Islands in the South Pacific and a modified version of the television guided aircraft flew thirteen flights over Europe. Technical discussions and military reports indicate how the assault drone was likened to suicide bombings, as does the title of James Hall's memoir about the top-secret assault drone unit, *American Kamikaze*. While television guided drones were correlated with enemy tactics, they were also promoted as exemplary of American ingenuity, using technology to replace human risk, though the program was ended in 1944. This chapter analyzes how operators interacted with enemy targets onscreen and the distinctions made between "us" and the enemy through distance and immersion.

In the second part, "Unmanning" I analyze connections and oppositions between manned and unmanned flight that emerged during the Cold War through the use of drone reconnaissance. This part draws on documents from the "Ryan Aeronautical Special Collection."[41] Originally, the collection was the Ryan library, established and maintained by William Wagner, corporate historian and public relations manager of Ryan Aeronautical. A portion of the collection is devoted to drone aircraft and draws on materials gathered for two books about the Ryan Aeronautical reconnaissance drone written by Wagner, *Lightning Bugs and other Reconnaissance Drones* and *Fireflies and other UAVs*. The materials in the archive include lengthy transcribed interviews from the personnel involved in the projects, mostly made in 1971 when Wagner began the book. Due to security restrictions, *Lightning Bugs* was not cleared for publication until 1982 and *Fireflies* was published in 1992. Additional documents include technical reports, company briefings and promotional materials, as well as photographs and film footage. I also rely on declassified Air Force documents, including the "Buffalo Hunter" report, a history of the use of drones in Vietnam between 1970 and 1972.

Chapter 3, "No-Body," considers how "unmanned" aircraft emerged. I examine how drone technologies tie into shifting relations between military and industry, as well as global divisions between the United States and the Soviet Union. I compare the design of the Firebee jet target with previous target drones. Described as "a bee with an electronic brain," the drone is correlated with a cybernetic system to suggest it operates on its own. Following how inputs and outputs are organized through Firebee, I complicate this account to show how the model moves between human and machine actions, displacing one and the other. After Francis Gary Powers' U-2 reconnaissance flight was shot down over the Soviet Union in 1960, unmanned surveillance was positioned as minimizing political risk. Disconnecting the human pilot and the remote aircraft, there is "nobody" that can be taken prisoner through unmanned reconnaissance. I complicate these displacements of the human through *Nobody's Perfect*. A humorous film about Ryan Aeronautical's failed attempts to build manned and unmanned aircraft alike, the film counters the opposition between human and nonhuman setting up instead a series of alliances and disparities between technologies and operators.

Chapter 4, "Drones from Above and Below," examines reconnaissance drones developed between 1960 and 1973, which were tested in the United States and flew top secret missions in Southeast Asia. It concludes with sale of a Ryan Aeronautical drone system to Israel in 1971, used during the Arab-Israeli War in 1973. The chapter explores how national security is tied to reconnaissance, both as a response to nuclear threats to the United States and the basis for international interventions in Vietnam. Even as these distinctions divide between domestic and international territory, they are reformulated by aerial views, which reconfigure territory from above. Drone crashes, unexpected landings and tensions between what is known and unknown intervene in these separations. Examining the practices that produce what is seen and what is not, I explore how ambiguity is interlayered with the geopolitical uses of these drone, arguing contradictions are the systems' secret.

Part One

Targets and Targeting

Chapter 1

The Queen Bee and the Drone: Remote Controlled Aerial Targets in the Interwar

"An urgent need in the fleet exists for radio-controlled aircraft for use as aerial targets,"[1] wrote the United States' Chief of Naval Operations (CNO) William Standley in a memorandum from March 23, 1936, circulated to the Navy Bureaus of Aeronautics, Ordinance, and Engineering. This call came after Standley returned from the Second Naval Conference in London, where the world's five major naval powers negotiated armament limits, beginning in December 1935. There, he witnessed anti-aircraft practices held by British Royal Navy with a remote controlled aircraft, known as the *Queen Bee*.[2] The "urgent need" Standley expressed tied to changing strategies of attack and defense in the interwar: airpower would change what was a target and how militaries targeted. The radio controlled targets, already in use by the British Royal Navy, replicated the mobility of aerial attack for navy gunners, training them to defend against the largely untried strategies of airpower, also being developed at the time. The drones would become the first widely used pilotless aircraft. A memorandum in support of the radio-controlled targets by the Bureau of Aeronautics, made the following observations:

> (1) Definite data must be obtained as to the effectiveness of present and projected anti-aircraft equipment before any further marked improvement can be reasonably expected.
> (2) Training of personnel assigned to anti-aircraft activities must be carried out under conditions more closely simulating action conditions than exist at present if maximum proficiency is to be obtained.[3]

The memorandum emphasized two factors in support of the project. The radio-controlled aircraft would "simulate" the conditions of aerial warfare, while also enabling the collection of data, so the Navy could study how to defend against aerial attacks. These explanations show how the early development of a radio-controlled target worked with and against emerging strategies of airpower.

In the twentieth century, targeting is conceived as a scope of vision, a point in space and mark to be hit. My analysis frays the singularity of these ideas. The Navy's investigations into and subsequent developments with radio controlled aircraft relied on interconnections between targets and targeting. Pilotless planes were engineered as training targets, even as in 1944 they became the first remote-controlled aerial targeting systems used in warfare by the United States. Simulating an air attack, radio controlled aircraft were not just a point of aim, they were a meeting point between offensive and defensive positions, each respectively coordinated through different, although related, practices of control, communication and calculation. These shifts relied on tension and disjuncture between actions networked between humans and nonhumans. For the engineers, operators and commanders involved in the development and use of drone aircraft, the radio controlled system was not merely utilitarian or a technical inevitability. Instead, drones were defined through the ways they separated and connected the operator and the aircraft, conceived as a simulated enemy and a measure of defense. They were formed by and operated through these tensions, which simultaneously produced radio controlled targets and changed practices of targeting.

"Without Further Ado:" Naming the Drone

The concerns informing the memorandums for radio control aircraft that circulated within the Navy in 1936 stemmed from the relatively new problem posed by anti-aircraft defenses, particularly for ships. During World War I, the majority of air battles were tactical fights and aircraft primarily flew in support of ground forces. Anti-aircraft defenses on the ground were relatively minimal and largely unused by naval forces, which were more concerned with defending against attacks by submarines and other ships. Kenneth Werrel, in his history of anti-aircraft systems, notes that by the 1930s, greater aircraft speeds and altitudes had rendered the largely improvised anti-aircraft defenses from World War I obsolete.[4] Proponents of airpower in the interwar period, as I will discuss later, advocated for the wartime use of aircraft to carry out strategic bombing, promoting the ability to strike targets from the sky, including ships. As highlighted by efforts to develop radio controlled aircraft targets by the United States Navy, however, aircraft in turn were studied as targets. Allan Millet observes, "Military innovation in the interwar period proceeded within an international geopolitical environment of great uncertainty and strategic ambiguity."[5]

No mention was made in the initial memorandums that circulated between the Navy's Bureaus that radio controlled planes might also be used for attack. The use of drones as target planes to train anti-aircraft gunners reverses current notions of military drones, which are figured by surveying and killing targeted individuals, even as drone aircraft continue to be used by the military to simulate aircraft for air defense training. In the discussions that led to the project in 1936, the memorandums discussing the proposed target plane referred to a radio controlled guided bomber tested after World War I by the Navy Research Laboratory (NRL).[6] Both the Bureau of Engineering and the Bureau of Ordinance noted difficulties with experiments conducted between 1923 and 1924 using remote control. The prior attempts were used to counter the Standley's newfound enthusiasm for radio controlled target aircraft. On a test flight in September 1924, the aircraft "was taken off without pilot, flown for about twelve minutes, and landed. The plane sank after landing."[7] A puncture in the sea plane's pontoon was deemed the cause of its sinking and the radio control gear was retrieved from the submerged plane and tested again in October. When the researchers attempted another test in December, the plane crashed on take-off and the project was eventually "allowed to die a natural death." [8] Although the previous efforts raised doubts about the technical feasibility of radio controlled target planes, Standley pointed to recent shifts in radio and airplane technologies, as well as urgency of anti-aircraft training, providing the rationale to go ahead with the project.

My account of the development of drone aircraft draws from the collected archives and unpublished history of pilotless planes and guided missiles written by Delmar Fahrney, who was given charge of the project by Standley in 1936 and would chronicle the systems he developed in the 1950s. In his manuscript, completed in 1957, Fahrney attempts to stake out a place in history for the project he oversaw. Written in the third person, it reads not as an autobiography, but as an effort to claim his status as "the father of guided missiles" in technological history.[9] This narrative at times is far-flung and the assertions of innovation made by Fahrney have only recently been recognized, legitimated by the current use of cruise missiles and unmanned aircraft systems. In the era when the manuscript was authored, Fahrney's use of radio controlled airplanes seemed to be a mistaken technological strategy and the period's missile innovations were tied to the V-1 and V-2 rockets first built in Germany. What I attend to in the documents, photographs, films and manuscript devoted to drones though, is how Fahrney's insistence that the project is the first of its kind is underwritten by an account of technical development that troubles a teleological conception of innovation, as well as a utilitarian idea of technology.

The drone target developed under Fahrney's command indicates a threefold transformation: First, the technical developments carried out by the Navy in the interwar period offer an example of how networked warfare was presaged by connecting humans and machines through communications technologies. Efforts to build the drone rely on a conception of a target that no longer is merely a point of aim, but rather, is indeterminate, mobile and unpredictable. Second, the target as network functions through an exchange of attributions between what is human and what is technical, highlighting how targeting works as a simulation and ensemble. Third, while the drone target relies on nonhumans for its functioning, this connection is not symmetrical. Instead, it is marked by disjuncture, separation and, sometimes, hostility. Above, I highlighted how drone targets were proposed for defensive trainings, even while they were modeled after remotely controlled torpedoes. These shifting alliances play out on multiple levels and drone aircraft operate by networking elements in tension.

Among the factors that had influenced the Navy's decision to return to its investigations with remotely piloted aircraft was a demonstration by the British Royal Navy of its radio controlled target plane, the Queen Bee, used for anti-aircraft training until 1947. Three months after the project began, Fahrney used association between the two projects to give the drone its name. He explained,

> Along in November 1936, Fahrney discussed with Dr. Taylor, Technical Director of the NRL, the selection of a code name which would best describe the project. It was brought out that the English had dubbed their project the 'Queen Bee' and following this phraseology, a number of insect names were reviewed.[10]

Reports by the military attaché and navy attaché from the United States indicated the interest of both military branches in the Queen Bee. The Naval attaché report observed, "It has not been possible to obtain details of the 'Queen Bee' radio-controlled target plane … Royal Air Force personnel have been specifically notified by the Air Ministry that no information is to be released than that which has already appeared."[11] Of significant interest was how the radio control system worked. The report noted, "This apparatus is all inclosed [sic] in a box so that it is impossible to see what the apparatus looks like."[12] Beginning the project in the summer of 1936, the team led by Fahrney at the Navy Research Laboratory was charged with the task of developing a remote control target plane based on the Queen Bee, knowing little about its specifications.

In his "Monthly Report of Progress" from September 1936, Fahrney observed, "The initial phases of the investigation of the subject project have been completed and it is now possible to select the material to accomplish the solution to this problem."[13] The report outlined the approach that would be taken by the team of five engineers at the Navy Research Laboratory tasked with developing a radio control system to operate an aircraft. They drew on previous military experiments with radio operated aircraft, as well as innovations in radio and telephone technologies made during the 1920s. Fahrney described the control system as follows: "The signals sent by the transmitter are to be carried on one frequency band and the eleven modulated frequencies will travel over this carrier wave and be separated out by the filters."[14] Explaining that the control of the aircraft would require nine frequencies, the two additional tones would provide "spares for any eventual usage." These developments filtering radio signals used a tuned vibrating disk to filter transmitted sound waves based on the telephone dial. Having laid the groundwork for this system by the time he and Dr. Taylor discussed the system's name in November 1936, the second half of Fahrney's explanation suggested the communications used to control the aircraft were drone-like.

> It was decided that the word DRONE best fitted the situation in which a released target plane found itself engaged;[15] and the terminology was easy to handle. Without further ado the name was used in all discussions oral and written and the term persists to this day.[16]

Naming the Navy's project, Fahrney and Taylor chose a name that highlighted the system's filiation with the Queen Bee. Yet, they reviewed a number of insect names for the project. Why was the analogy with of a drone bee considered most apt? What resonates is the idea of control, particularly the naturalized hierarchy ascribed to beehives. Earlier, I noted that the Navy engineers had described previous projects to build radio controlled planes as "dying a natural death." What is shown in this statement is how technologies multiplied alignments between humans and nonhumans, analogizing these relations with those of insects. The British name highlighted a queen bee, assumedly, the controller in the network, while the American project put emphasis on the controlled, subservient members of the hive. The drone bee has a singular function within the hive, to mate with the queen bee, after which it dies. One might think of the drone as a target as driven to a similarly singular and also lethal fate – that of being shot at. Drones are also distinct from worker bees and this term, applied to humans, indicated a lazy worker.[17] In this way, drone attributes a docile quality to the new radio controlled aircraft.

Yet, while the name imagined a hive-like control guiding the functioning of the drone, the team's engineers reckoned with precisely the opposite problem - what would happen if the drone lost its connection to the human operator. The first monthly report devoted considerable attention to developing safety mechanisms in the radio controlled plane's communications. Fahrney proposed a system of back-ups in case link between the radio and the aircraft was lost: "If, for example, the receiver gets no signal after an elapsed period of two minutes, the plane is placed in a turn by the time relay. If no signal is received after twenty minutes, the controls are neutralized and set for the landing condition and the throttle cut."[18] The name drone set up an idealized version of what natural control in flight might look like, even as the radio and aeronautical engineers building the drone were acutely aware this kind of control might not be actuated.

The final sentence of Fahrney's account of naming the drone is striking: the terminology was easy to handle and "without further ado" the name was used in "all discussions." The claim resonates with the contemporary moment, as drone remains the most common term to refer to pilotless aircraft, in spite of efforts by the United States military and industry to change the terminology. Why does the insect-like notion persist? I suggest that the term speaks to the networked control set up through radio, intertwining humans and technologies. As I indicated above, insect control is associated with a naturalized hierarchy, ostensibly organized around the singularity of the queen. The name acts to order the network that will produce unmanned flight, setting the human controller as the center of the system, while the pilotless target plane is the locus for action. Linking remote control to an insect hive overlays the technical mediation necessary for, as well as the fallibility of, a radio operated plane. Drone becomes a term that glosses the network of humans and nonhumans interconnected through remote control and speaks to an ideal where the technology responds to the signals sent by its human operators, even when this is not always the case.

The Laboratory Drone and the Safety Pilot

Bruno Latour examines relations between humans and nonhumans as a "*modus operandi*, a chain of gestures and know-how bringing about some anticipated result,"[19] which I have likened to a hive in the previous section. Outlining his method, Latour writes, "Students of technology are never faced with people on the one hand and things on the other, they are faced with programs of action, sections of which are endowed to *parts* of humans, while other sections are entrusted to parts of nonhumans."[20] In this vein, I ask of drones, what were their programs of action? The answers to this question – drones are experiments, simulations, and ordinance; they are targets and targeting systems; and they are framed both as defensive measures and top-secret weaponry – point to the ways programs of action and the network of humans and nonhumans incorporated by drones are contradictory, as much as they are associative. Latour's definition of program suggests these complications, noting that "each device anticipates what other actors, humans or nonhumans, may do (programs of action), but these anticipated actions may not occur because other actors have other programs … anti-programs."[21] However, drone targets take shape as a network of elements that not only come together in a chain of action, but also come apart and fail – what is unanticipated – leading to tensions and rupture, not just connections, between humans and nonhumans.

By December 1936, the Navy Research Laboratory had produced a complete set of radio equipment, which modeled how the aircraft would be controlled in flight. The team planned to use signals sent by radio to move the hydraulics of the plane. Fahrney explained in his semi-annual report: "In order to adapt the conventional plane control system to the radio control system, it was necessary to develop a hydraulic contact mechanism which would transmit any motion of the operator's controls to the controls of the 'DRONE.'"[22] Having finished these controls, the engineers set up a model at the Navy Research Laboratory: "The Laboratory 'DRONE' [23] was located in the field house, several hundred yards from the main building … signals were sent out to the field house, picked up, and filtered out and caused to operate the solenoids in the elevators."[24] After these tests were deemed satisfactory, the radio system's controls were installed in a TG-2 airplane and tested from the air. The TG-2 was an obsolete torpedo aircraft that the aeronautical engineers at the Naval Aircraft Factory converted to an airborne control plane. Describing the modifications made by the team in his September 1936 monthly report, Fahrney wrote,

> After a study of the TG-2 plane, it has been decided to disconnect the control wheel and column and throttle lever in the front cockpit from the controls in [the] second or pilot's cockpit. This will leave the control wheel and column of the throttle lever in the front cockpit to the functioning of operating the radio transmitter.[25]

Following the construction of the laboratory drone (figure 1), the TG-2 airplane operated the hydraulic controls from the air. The networked system was shown to be functional at a distance of twenty-five miles.[26]

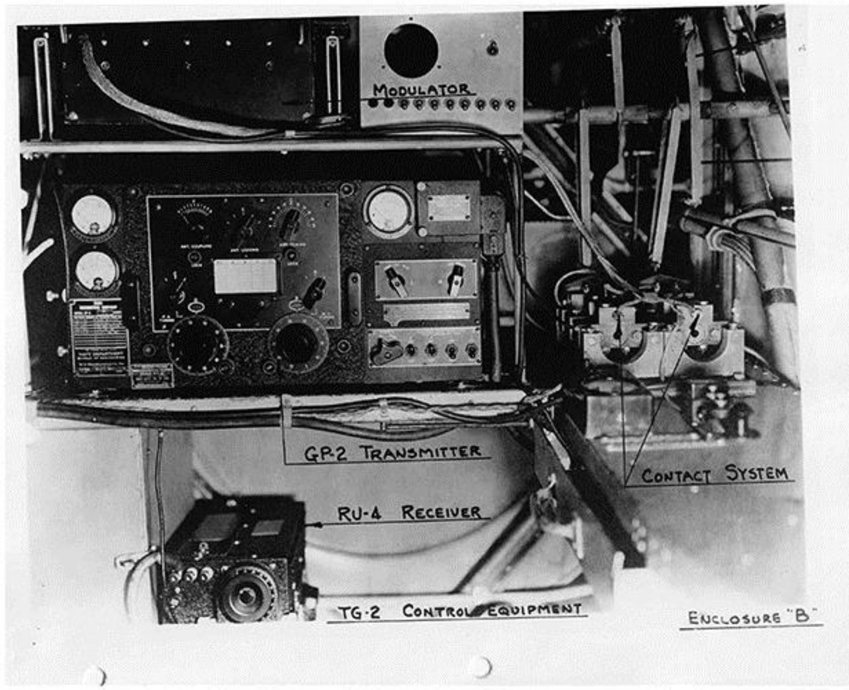

Figure 1. Laboratory Drone. Collected Records of Delmar Fahrney. RG 72, NARA II, College Park, MD.

The laboratory tests were also an opportunity to witness the drone in action, an "exchange in competencies between humans and nonhumans,"[27] as Latour might put it. Fahrney's semi-annual report from December 1936 noted, "the first actual operation of the laboratory 'DRONE' by radio was carried out without the slightest difficulty on the 16th of December in the presence of Commander-in-Chief of the U.S. Fleet."[28] Previously, I outlined a networked account of the drone's functioning that moved between objects. The radio signal activated the solenoid in the drone from the control system and the networked system was then tested between the TG-2 and the laboratory model. Yet, the radio controls are also being operated, watched and directed by humans. While Fahrney's manuscript is ostensibly a technical history of drones, he lingered on the people who made the project possible. He wrote, "Much development work was done by Navy personnel assigned to the project which is the normal course of events when a small group eat, sleep, and live with an interesting problem."[29] At the time of the first experiments, Fahrney's monthly report from December 1936 indicated, "All personnel at the Navy Research Laboratory assigned or otherwise participating in the project, from the Director down, are intensely interested in the problem and have contributed to an early and complete solution."[30] What Fahrney describes in his account of the project networks between what is technical and social, giving shape to the drone through a connected set of functions that at times seemed hive-like.

Following exchanges between humans and nonhumans though, the first drone flights also suggest redundancies and tensions between human and mechanical control of flight. As radio control opened new connections and distances between the operator and the technology, the network also came apart. By March of 1937, the three pieces of the remote control – the modulator, demodulator and the hydraulic control – had been fabricated and tested by the Navy Research Laboratories. Anxious to move to a model that could be tested in flight, the team of engineers procured a training plane, designated NT DRONE (figure 2). Like other drone aircraft developed between 1936 and 1946, the NT DRONE could still be operated by a human pilot. Many test flights used a "safety pilot," a person onboard to take over controls of the plane in case the system malfunctioned. As I indicated earlier, safety measures associated with radio control were among the main concerns of the project. Achieving the drone-like control the engineers hoped for necessitated they account for the numerous malfunctions that might cause connections between the plane and controller to be lost.

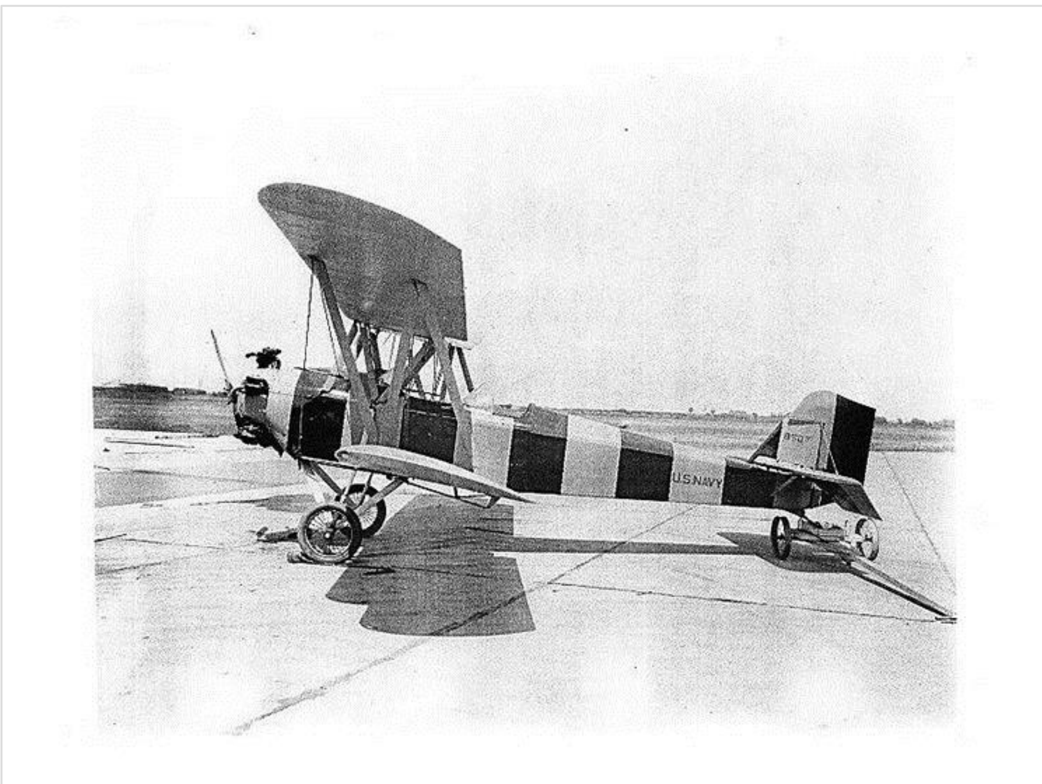

Figure 2. NT Drone. Lt. Commander Fred Wallace. Early Navy Radio-Controlled Target Airplanes. San Diego Air and Space Museum, San Diego, CA.

In a report submitted after the first test flight using the new equipment, Fahrney explained in detail how the team double-checked the functioning of the radio control between the TG-2 control plane and the NT DRONE before its first flight. Fahrney was the radio controller, while Fred Wallace, borrowed from his assignment at the Naval Aircraft Factory, was the safety pilot:

> Finally after a number of shifts the planes took to the air at about 1300 with Wallace … in the NT DRONE as a safety pilot and Fahrney as controlling pilot in the front cockpit of the TG-2. At 3000 feet the circuits were tested and found O.K. and then the DRONE pilot was ordered to throw in the gear – shortly thereafter, there ensued the most astonishing evolutions which could only be ascribed to a drunken pilot: the DRONE went into wild gyrations to the right and to the left with plenty of climbs and dives mixed in to give Wallace a most harrying ride. [31]

Throwing into gear the radio control on the NT DRONE resulted in "astonishing evolutions," differing from the straightforward functioning that up to this point had been ascribed with the laboratory model. And while, as I noted above, equivalence is suggested between the radio control and safety pilot, in this case the role of the safety pilot was just the opposite for him, a position of risk. It took several minutes before the team realized what the matter was. Fahrney's report continues,

> After a few moments of anxious concern it developed that the controls governing climb and dive were satisfactory, but that the aileron controls were decidedly 'hay wire.' The DRONE pilot was requested to throw out the gear, level off and then throw in the gear – when the right run control operated, the plane went immediately into a left turn and the more the right turn signal was given by radio, the more tight the left turn became. The obvious fact that the controls were crossed was not at first apparent because the safety pilot threw out the gear and brought the plane back to level flight after each unusual maneuver.[32]

A simple crossing of the wires, mixing up right and left, resulted in a harrying first flight for the safety pilot, while his ability to straighten out the plane actually made it more difficult to see this was the case. After the plane goes "hay wire," it signals how actions carried out through remote control move from the control plane through the radio signal to the drone. When these connections function, the drone seems as if it were piloted. When the signal is crossed, as it was in the first test flight, missed communications make it seem as if it were operated by a "drunken pilot." The safety pilot functions to level out the aircraft and try to return it to its normal functioning, offering a response that would have been impossible for the mixed up radio controls.

Fahrney goes on to conclude, "After the aileron control was properly hooked up, following this first awkward flight, the next test hop proved that the radio control was adequate for all normal flight maneuvers."[33] While he is quick to highlight the eventual success of the radio guided plane, what the report also indicates are tensions implicit in the networked action of the drone target. When Fahrney's team was able to move the radio control aircraft that had been built for the project in November 1937, he noted in his report, "No further testing is scheduled for the ever faithful little NT 'DRONE' which suffered through many hours of radio controlled mistreatment. While all safety pilots reverently view its passing into the discard, they nevertheless feel relieved that its testing days are over."[34] The passage seems to reverse the suffering of the NT DRONE and the safety pilots, as well as their respective faithfulness to the project. Fahrney, as commander of the project, peculiarly emphasizes the obedience of the technology, even as the passage shows the risks that would have been associated with the early radio control plane for the safety pilot. Two different senses of the drone are being parsed out, relying both on the faithfulness of what is mechanical, on the one hand, and its unpredictability on the other, as well as how these same characteristics would be applied to personnel.

Misalignments between humans and technologies frame Gilbert Simondon's writing, even as he notes, much like Latour, "the opposition drawn between culture and technology, between man and machine, is false and without ground." Rather, Simondon claims, "the world of technical objects mediates between nature and man."[35] In the next paragraph though, Simondon complicates these claims, writing "culture behaves toward the technical object much in the same way as a man caught up in primitive xenophobia behaves towards a stranger."[36] Resistances between people and machines, as much as their connections, characterize relations between humans and technologies. Simondon writes "the machine is a stranger to us; it is a stranger in which what is human is locked in, unrecognized, materialized and enslaved, but human nonetheless."[37] The networked actions that produced drone technologies are also marked by the xenophobia Simondon describes. Simulating the operations of a piloted, enemy aircraft, the drone is also strange and unpredictable, even though its production as a technology is apparent to all involved in its operation, who are also part of its functioning.

Simondon considers how humans might be rethought as part of a technical ensemble, i.e. both an element of and director within the ensemble, consequently re-thinking how humans and technologies interact. This model suggests how alignment and disjuncture between humans and technologies might be explored in tandem. In the development of radio controlled target planes, what I observe is how the engineers become at once intertwined with the technologies they create, even as what is designated as the machine remains strange and sometimes at odds with what is human. These shifting contexts set up the drone as a target – a transformative network of humans and nonhumans – marked both by relation and contradiction.

I take a closer look at the control mechanism, keeping in mind the tensions between human and nonhuman noted by Simondon, to explore the transmission of commands to the aircraft and the relationships implied between the operators and technology in these processes. Initial plans for the drone radio controls, used during the laboratory tests and the first flights, relied on a simulated version of the pilot's yoke and wheel, which was adapted from the second controls of the TG-2 aircraft. In early drafts of the project, Fahrney drew out the steering system in his plans, showing how it would serve as the remote control link to maneuver the hydraulics of the drone plane through radio. After a number of test flights though, the difference between piloted control and radio control came to the foreground. Fahrney explained in his manuscript,

> It was found that a simple electrical contact system mounted on a rigid control column was sufficient as only a momentary signal was required to get a response from the DRONE … In time it was found that a simple stick which could be operated with the forefinger and thumb was sufficient to handle all the radio control requirements. [38]

Here, we see the joystick used in contemporary, remote control, which ties to computer controllers, model planes, as well as to the control units of unmanned aircraft. Fahrney commented, "Because the action of the control was so short, the control became known as the 'Beep Control' and remains known as such to this day."[39] Unlike the name "drone" though, "beep control" has become an anachronism. The example nonetheless shows the back and forth movement between developers and the system that they produce. "Beep control" was a point of contact between the radio operators and the technical system. It did not replicate aircraft controls because only a momentary signal was required to link the radio pilot and the drone. With this innovation, remote flying changed; the simple gestures of a “stick” guide the drone’s flight, networking the pilot and aircraft through radio.

The simplifications made possible by linking humans and nonhumans by beep control, were countered by greater complications for the drone’s take-off and landing. In Fahrney’s report about the first test flight of the NT DRONE, the safety pilot did not put the radio control into gear until the plane was in the air. Through further experimentation, Fahrney explained the team ultimately found a way for the drone to take off by radio control, although the safety pilot still landed the NT DRONE. Fahrney noted,

> The NT DRONE was taken off by the field cart control pilot under radio control, flown in the air and lined up for a landing by the control pilot in the TG-2 plane, and brought down the landing glide by the field control pilot until within 50 feet of the ground when the safety pilot took over manual control.[40]

During the summer of 1937, personnel at the Navy Aircraft Factory converted a Curtiss-Fledgling training plane, which was designated N2C-2 DRONE. In contrast with the NT DRONE, “The first N2C-2 DRONE was completed on 4 October 1937 and on the 7th of October it was given a flight test under radio. Before the end of the day the plane had been taken off and landed under radio control with no assistance from the safety pilot riding in the plane.”[41] Equipped with tricycle landing gear, it was deemed possible for the N2C2 to land without the aid of the safety pilot. Fahrney explained that the plane bounced a couple of feet, as the landing was made on a rough portion of the field, although the radio pilot “completed the landing on all three wheels without damage to the DRONE or to the nerves of the safety pilot (F. Wallace), or of the control pilot (Fahrney).”[42]

That these early drones could take off and land is noteworthy, given that the Cold War versions of pilotless aircraft usually were launched by catapult and landed by parachute. Even during the First Gulf War in 1991, drones used by American forces catapulted for take-off. Fahrney flags a problem with this innovation, however, indicating how a successful take-off and landing required that the pilot align himself with the aircraft:

> The landing presented more of a problem, mainly because [of] the required orientation; that is the control pilot at the field control station faced the descending plane opposite to the direction of flight. It was necessary to reorientate [sic] himself mentally in order to give the proper signals for levelling the wings or changing the course. At this stage of the development there was no automatic pilot, only a turn and bank instrument connected to a neutralizing gear. It was necessary therefore to fly the DRONE at all times as though the remote controlling pilot were in the DRONE.[43]

How does the remote pilot “reorientate himself mentally” to land the plane by remote control? How does this differ from the safety pilot’s seizing of the controls to land the aircraft, as in the case of the NT DRONE? The radio field controller needed to act as though he were controlling the aircraft – as if he were in a plane. This required him to re-position himself in the opposite direction from where he stood on the landing field. This reversal of orientation is significant to the networked operation, altering the spatial arrangement between its nodes. Previously, I indicated how distance between the operator and the aircraft separated human action from the technology. These passages complicate this claim, as they point out how simultaneously the pilot must "fly the DRONE at all times as if the remote controlling pilot were in the DRONE."[44]

By November 1937, the successful test flights with the safety pilot onboard led the team of engineers to set up a pilotless flight without a human onboard. Remarking on this decision in his manuscript, Fahrney recalled how this resulted in new terminology. Describing the preparations for the drone's first flight without a safety pilot, he wrote,

> When a human pilot climbs into his plane to fly alone without an instructor for the first time, the flight is called a 'Solo.' In this case where a plane flies without a safety pilot for the first time under radio control it is obvious that the term to describe the flight is 'Nolo.' This term was coined by Cdr. Ralph Barnaby (Asst. Chief Engineer at NAF) and used in all future terminology to describe this flight condition.[45]

Like with the previous instances of naming, Fahrney commemorated the efforts of the engineers by naming them. "Nolo" is a clever word play, which as Fahrney explained came out of the idea of a solo flight, but in this case, marks a plane flown remotely. Later, the term also became an acronym "no live operator," foregrounding the mechanical operation of the drone. The term suggests an equivalence being made between drone flight and human flight, even as it emphasized the absence of a "live" human pilot. Like "unmanned," a name that comes later, the concept is ambiguous, as the "Nolo" drone remains under the operation of a human pilot, guiding the plane through the radio controller.

Describing the first "Nolo" flight, the report submitted by Fahrney notes four "perfect" take-offs and landings were made under radio control with the safety pilot onboard. About rigging the drone for "Nolo" flying Fahrney wrote, "In the safety pilot's seat a special 14 volt aircraft battery was secured which was to supply current for a duplicate receiver and selector which doubled the chances of loyal and faithful operation of the electronic equipment."[46] Using the terms "loyal" and "faithful," which echoed his comments on the NT DRONE's retirement, the battery replaced the safety pilot, although the battery back-up for the communications system, would prevent the loss of control if the aircraft lost power, suggesting a new role for the battery, not a replacement for the safety pilot. In his monthly report, Fahrney noted, "the Officer in Charge opened the DRONE'S throttle by radio and the plane made a normal takeoff. Very little difference was noted in the behavior of the DRONE without a Safety Pilot."[47] Continuing with the operation, Wallace took the controls; no longer onboard as a safety pilot, he operated the pilotless plane from the TG-2 aircraft as the radio controller. Fahrney writes that Wallace "controlled the DRONE through simple maneuvers for about ten minutes and then lined up the plane for a well executed landing approach."[48]

As I indicated earlier, the landings and take-offs of the drone were of considerable difficulty for the radio control pilots. At landing, the control shifted from the radio controller in the aircraft to an operator on the ground and the pilots used the same changeover as in flights with a safety pilot onboard. Fahrney described the first instance of this transition from remote control to operator control in detail:

> The plane passed the control cart at about 50 feet of altitude, flying level and under complete control. At a point about 75 yards away the throttle was cut back for a 'fly on' landing. … As soon as the throttle was cut the DRONE's nose went down abruptly and the front wheel struck the ground before an elevator correction could be applied – the front wheel carried away and the plane slid along for forty feet on its nose as the rear wheels folded slowly.[49]

Despite an otherwise successful mission, the crash landing of the first "Nolo" flight indicates the difficulty of achieving naturalized control through the newly networked system. Had the safety pilot been onboard, he would have immediately corrected for the plane's nose dive. Yet, with the loss of the throttle power, the plane immediately dipped into a crash landing. With the action of the plane moving from the operator to the technology, flight was transformed. In subsequent "Nolo" flights, the remote operator stalled the aircraft before guiding it in for a landing rather than easing up on the throttle to prevent the drop in the aircraft's nose.

Describing the mixed reactions to the project in his manuscript, Fahrney wrote,

> Even though this test produced good results for the most part, yet it came at a time when a hassle was going on in the Bureau about maintenance funds for the project, so route slip comments were not very favorable, as, "we should … disband the 'Unit' … as soon as possible." Cdr. Stevens was quick to defend the project with, "If this Unit is disbanded, what is to happen to further development of radio control? I firmly believe that R.C. has enough possibilities - - - to warrant keeping it alive."[50]

Interlayered in this early crash, one sees not just the function and failure of the drone as a network of human and nonhuman parts, but also the various reactions the system provoked within the Navy. In the Bureau of Aeronautics there was widespread suspicion about the usefulness of the project and the innovations proposed by radio controlled aircraft were unclear. At the same time, the experiments set out how the drone functioned, intertwining, repeating and separating human and nonhuman actions through communications technologies that will simulate an airborne target. The next section turns to this use, and I analyze how the system becomes a point of aim, even as it relies on mobility, indeterminacy and unpredictability. Action, as I have suggested, moves between the operators and the technical system but also in the back and forth between the naval commanders and gunners. These interactions, like the production of the drone, set up alliances between humans and technologies, even as tensions emerge. Targets are missed, the drones crash and the usefulness of the pilotless aircraft was debated.

Targeting Target Drones: Simulating Warfare 1938-1941

On May 21, 1938, three months prior to the first trials with drone targets to train gunners on Navy ships, Rear Admiral H. R. Stark, senior member of the U.S. Fleet Permanent Anti-Aircraft Board, wrote to Delmar Fahrney, Officer-in-Charge of radio controlled aircraft: "the most important use to which DRONES may be put is to determine the effectiveness of our present anti-aircraft armament – the use of DRONES will give us a test that is nearer to wartime conditions than any we have had to date."[51] Anticipating the move of the unit to San Diego over the summer of 1938, Stark's comments point to the next phase of the project's development, which would test how drone targets simulated wartime conditions. As Fahrney noted in a letter to Commander Albert G. Noble, the Fleet Gunnery Officer, “Fleet Training and the Bureau of Aeronautics are withholding any decision as to future work on this project, pending the outcome of these experimental firings and dependent on the reaction of the Fleet Gunnery Officers as to the value of this type of training.”[52] While previous tests had shown drones could be flown remotely, doubt remained as to their effectiveness for anti-aircraft training. The first experimental trials held in San Diego were just as much a test of the drone’s capacity as they were a test of anti-aircraft gunnery on the ships.

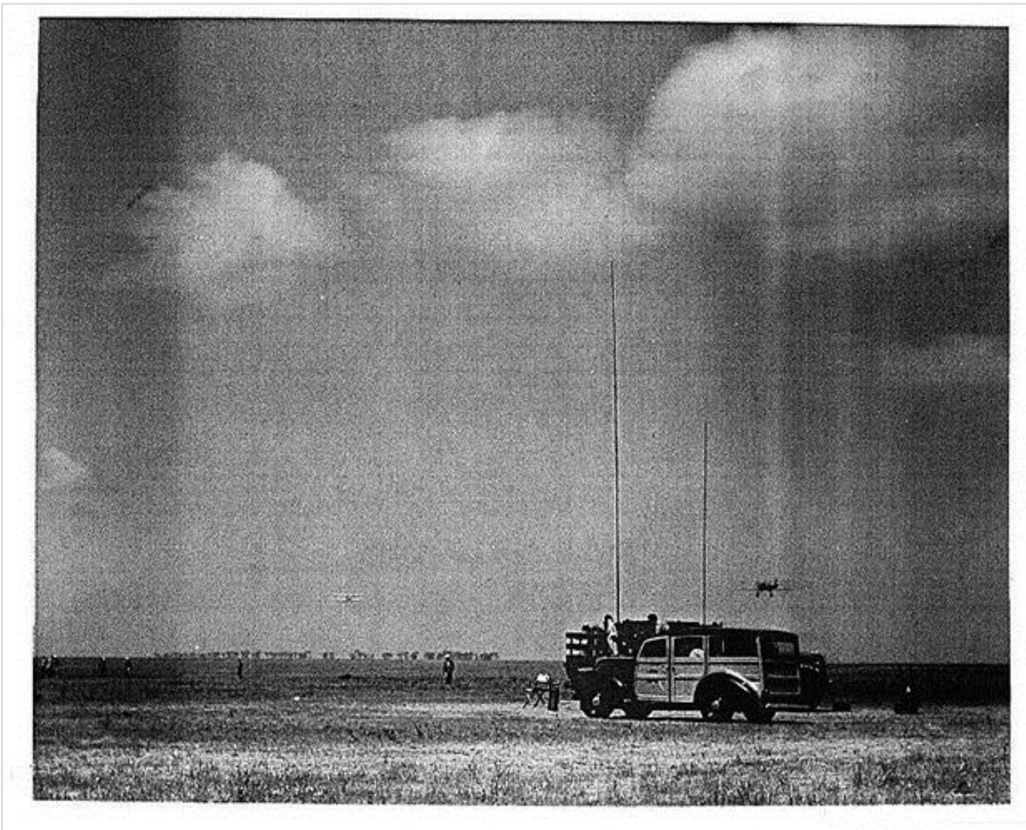

Figure 3. Radio Control Set-Up for Drone Practice at Otay Mesa. Lt. Commander Fred Wallace. Early Navy Radio-Controlled Target Airplanes. San Diego Air and Space Museum, San Diego, CA.

The remotely controlled aircraft that had been developed at the Navy Research Laboratories and the Naval Aircraft Factory were transported to the West coast. These included four drone targets, two JH-1 planes and two T2C-2 planes, as well as two TG-2 control aircraft. The radio controlled planes were taken off from the ground by a radio pilot based out of a Chevrolet truck used as a field station (figure 3). The target drone was operated via beep control, sending nine commands to the aircraft through oscillations in the radio frequency. Once airborne, control of the target drone shifted another radio operator onboard the TG-2, a control plane. This operator guided and maneuvered the drone, approximately one mile away from the TG-2 (figure 4). Distance between the aircraft and the drone was limited not by the radio signal, but by the pilot’s sight. The drone pilot could change the direction and pitch of the radio plane, operate the throttle, as well as a wing stabilization system. At landing, the control would be again shift to the radio pilot at the field unit.[53] Differing from piloted flight, drone control moved between multiple points, on the ground and in the air, networking between the parts. As I explained earlier, the "Nolo" operation of the drone removed the human pilot from the cockpit. What emerges though is not pilotless flight, but a tension between the drone as a target and the network of operators, communications and technology that make its flight possible.

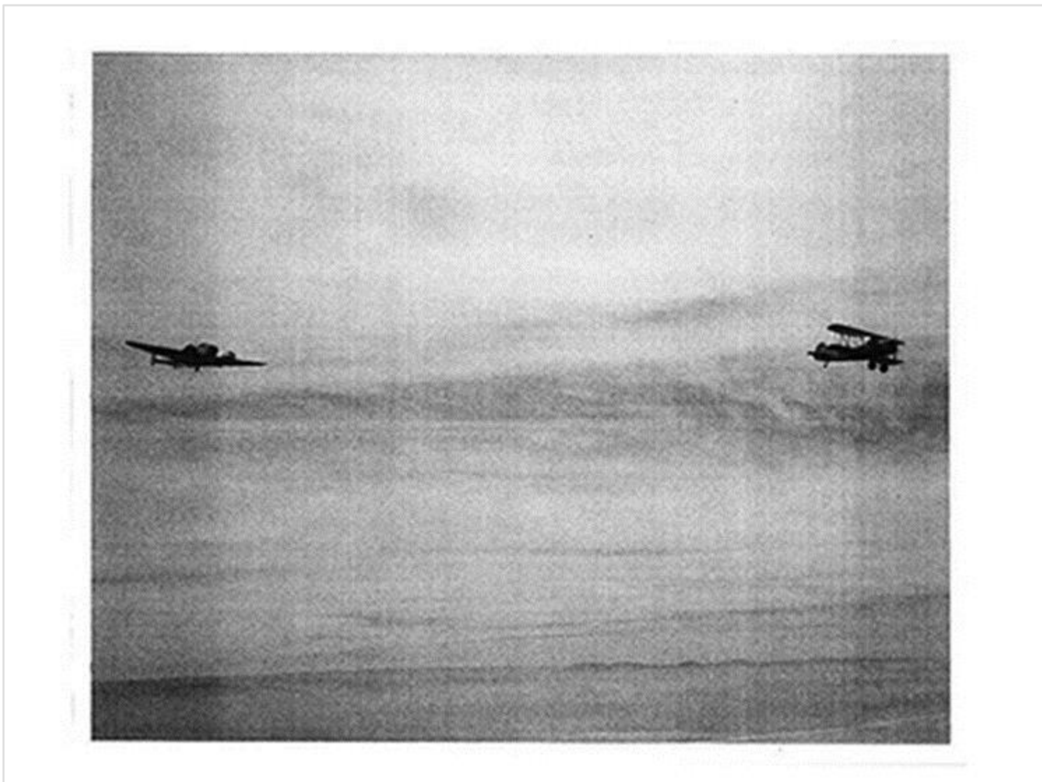

Figure 4. [Control Plane] in Flight with Drone. Lt. Commander Fred Wallace. Early Navy Radio-Controlled Target Airplanes. San Diego Air and Space Museum, San Diego, CA.

Prior to target drones, anti-aircraft gunners trained by targeting towed sleeves attached to piloted aircraft. Towed sleeves could only be used to model certain aerial maneuvers. These limitations were where the drone was supposed to fill-in. Discussing the planned trials in San Diego in his semi-annual report, Fahrney wrote,

> The Gunnery Board has suggested a total of six practices for which it is believed that R.C. targets can be used – the main consideration seems to favor dive bombing attacks (by DRONES), rather than the horizontal bombing [which seems] to be well taken care of by … airplanes towing sleeves at 12,000 feet at speeds up to 122 knots. However, it may be found that a horizontal approach by a maneuvering target plane at 11,000 feet may be of value. [54]

While the changes Fahrney proposes seem minor, they fit with broader shifts to aerial warfare and anti-aircraft defenses in the interwar period, anticipated by the drone's proponents within the Navy, mostly in the Bureau of Aeronautics. Remotely controlled target planes were being developed to defend against aerial attacks that had yet to happen on a broad scale and were largely without precedent for naval forces. Although World War I saw the first use of airplanes, "senior officers viewed bombers as extensions of field artillery rather than independent bombing platforms."[55] During World War I, airplanes primarily engaged in reconnaissance and tactical missions, tying them to the movement of the troops on the ground. Williamson Murray writes that after World War I, "whatever the initial attempts at strategic bombing, both the extent of such attacks and their results left room for considerable debate as to its potential effects on future warfare."[56] In 1921, William "Billy" Mitchell, a well-known promoter of air power, famously demonstrated the vulnerability of ships to aerial attack using manned bombers to sink an ex-German battleship in the Chesapeake Bay. In his report following the demonstrations, recounted by official Air Force histories of the project, Mitchell wrote "sea craft of all kinds, up to and including the most modern battleships, can be destroyed easily by bombs dropped from aircraft."[57] As such, he proposed that surface ships were irrelevant, antagonizing naval commanders and, ultimately, doing little to advance the strategies he promoted. By the 1930s though, "Navy reformers … found Mitchell as [a] useful foil for pushing the navy's leadership towards serious investment in naval air power."[58] The trials with drones were part of these changing attitudes and were aimed at testing the Navy's response to airpower. As drones modelled new strategies, the network of operators and technologies connected land, sea and air, giving shape to targets as a spatio-temporal medium moving through radio, marking out the targets' mobility, indeterminacy and unpredictability.

The first targeting practice using radio controlled drones was held August 24, 1938. For the trial, a JH-1 drone was flown in a horizontal maneuver to test the gunnery of the *U.S.S. Ranger*. Outlining plans in a memorandum to the Chief of the Bureau of Aeronautics and Division of Fleet Training before the trial, Fahrney wrote, "The first practice will simulate an attack directed by a bomber on the Fleet center and the U.S.S. Ranger will take station as a protective vessel. … Firing will be opened after the drone passes overhead."[59] Taking off at 1140 hours, the JH-1 drone ran a rehearsal pass, was fired at by the starboard battery and then the port battery on the second pass. Fahrney observed of the first run:

> After fire was opened the target turned right and, as seen from the above ranges, maintained a nearly constant range from the firing ship. From the firing ship, bursts appeared to be to the left of the target. … The bursts followed the changes of course of the target but lagged so far behind that it is not believed any hits were obtained.[60]

The lag between the drone's maneuvers and the bursts of fire is critical. Comparing Fahrney's account to Commander of the U.S.S. Ranger, John S. McCain, illustrates how this gap marks the inability of the gunnery to hit the overhead plane. McCain notes that during previous practices with target sleeves, gunners had shot at them with a high level of success. "An examination of the sleeves indicated that the starboard battery had three hits … and the port battery made four hits … RANGER's fire control party was well trained."[61] McCain's comments suggested how anti-aircraft training had favored the ability to shoot at a target run in a set pattern, visualized by the streaming target. The reliance on patterned, rather than unpredictable, targets is further indicated in McCain's account of the first pass: "On the approach the Drone was noted to be maneuvering and the steady course had not been maintained as planned."[62] He insisted in his report that had there been a squadron of bombers, there would not have been such variation and the battery "would undoubtedly have had planes hit and the formation broken up thus preventing an effective bombing attack."[63] Yet, none of the firings came close to the drone and, to McCain's surprise, the anti-aircraft gunners on the *U.S.S. Ranger* failed at what had been considered the simplest maneuver to counter. This first trial exemplifies how the mobility of the drone complicates targeting for the anti-aircraft gunnery. While Navy gunners would have been familiar with the unpredictability of targets at sea, the drone trials show how a similar indeterminacy shifts to the sky.

I also note how simultaneously the targeting of the gunners is being transformed, even if they lag behind the drone. Fahrney notes in his report that onboard the *U.S.S. Ranger* were 5"/25 calibers gunnery and a Mark 19 Anti-Aircraft defense system. McCain's report described that

> From the firing ship, bursts appeared to be to the left of the target and were out of the field of the Range-Finder Operator's glass thus preventing him from supplying information to the Range-Keeper Operators as to the position of the bursts. During this run changes of target angle were given to the Range-Keeper Operators who adjusted the range-keeper set-up accordingly.[64]

This account set out the networked operation of the gunnery as well. Aiming was more than searching out the target in the sky. Teams operating the gunnery would have included a number of personnel, with at least five to seven men being assigned to each gun. The Range-Finder would figure the target speed and altitude, while the Range-Keeper was responsible for a mechanical computer that would predict future target positions. Together, they would establish a firing sequence for the gun. In the first drone trials, this information would have been pre-set, as the speed of the drone and the altitude at which the aircraft was flying were determined by the commanders beforehand, although unexpected deviations still occurred. Like the system they were shooting at, the anti-aircraft defenses would become more mobile as the gunners aimed to calculate for the unpredictability of incoming aircraft.

McCain's report defends the performance of his personnel though his analysis of the drone trials is unequivocal. He wrote "anti-aircraft training received from firing on a target similar to a Drone is the most valuable and instructive firing that any ship equipped with an anti-aircraft battery can have."[65] This approval takes on further weight given the outcome of the second firing run. After the first pass, it was agreed to open more distance between the control plane and the JH-1 drone. As in the previous trial, the bursts of fire were distant from the target, the closest coming within 300 feet. At the end of the run, Fahrney observed,

> The DRONE flew a divergent course of 10 to 15 degrees from the control plane thereby opening the distance between them still more. Before the control plane could close in on the DRONE at 'cease fire,' the smoke from the bursts obscured the DRONE and the distance was so great that it was impossible to ascertain the flying altitude of the DRONE.[66]

In the ensuing moments, the target plane would lose altitude and, shifting control between the ground operator and the radio pilot in the control plane, the team lost control of the aircraft.

McCain reported "shortly after the last shot was fired the target plane was seen to make a sharp turn to right finally going into a spin and crashing into the water."[67] The drone sunk in five hundred fathoms of water. Only a gasoline tank and some small debris were recovered from the wreckage. The crash highlights how time and distance were critical in the operation of the drone aircraft. When the drone mimicked an incoming aircraft assault, it was through a careful choreography of the human and nonhuman elements. If this did not happen, the system crashed.

The experimental doubt set up by the drone's first flight, which showed the difficulties of hitting aerial targets for the anti-aircraft defenses, suggested aircraft targets might not take a form that was pre-planned or fixed. Targeting against a plane moving in multiple dimensions, as opposed to the marked course of a towed sleeve necessitated different responses. Fahrney quoted from a review of the project by Commander-in-Chief, Claude Bloch,

> This maneuvering of the target throughout the approach and the firing presented a problem never before experienced when firing on an antiaircraft target sleeve, or when training on planes. … personnel were unprepared for the problem as presented, and were unable to accommodate their procedure to effectively handle it.[68]

Later in the report, he concluded

> it is feared that the fixed conditions of speed, course, and altitude of antiaircraft sleeve targets in formal gunnery firings have resulted in control methods which may not prove sufficiently elastic for firing effectively on hostile aircraft free to maneuver. Future firings on radio controlled target airplanes should prove invaluable in determining this.[69]

Pointing out the need for elasticity, Bloch calls attention to the transforming relations between targets and targeting, which work not as a fixed point but through multiple, changing elements. Elasticity maps onto the networked movements that I have charted previously, showing how these changes fit into the military operations forming around airpower.

The first trial with drones set up an ongoing experimental practice that would be used to further test and develop the United States Navy's anti-aircraft defenses, and drones are still used to train military personnel. As Murray notes in his analysis of airpower, "friction, ambiguity and uncertainty all affect air operations."[70] Aiming at a target moving through space in three dimensions is more complex than targeting a fixed or moving point on the ground, as one must calculate the range, azimuth, and altitude. After the first test runs, the naval command ordered that twelve more drones be built over the course of the winter and plans were made to transfer the team to Guantanamo, Cuba, for further training during the next year. Yet, Fahrney's program, initially, remained relatively small, and, the usefulness of the remotely controlled plane was controversial, as suggested by the next trial. Like the first, it ends with a crash, as a result of the ways the flight control was shared between operators and technologies, moving between ground and air control.

A few weeks after the trials held by the U.S.S. Ranger, a T2C-2 drone was used to mimic a dive-bombing run against the *U.S.S. Utah*. Bombers would attack ships diving in at an angle, optimizing the potential for the bombs to hit the ship, while making it difficult for anti-aircraft gunners to hit the incoming plane. Using drone targets to simulate dive-bombing attacks was a high priority for the Navy, seeking counter-measures to such missions. Towed targets would have been unable to simulate these attacks. Two field controls were used to control the T2C-2 in its simulation of a dive bomber, one at the airfield and another on the ship. It was planned that the control of the drone would move from the airfield to the control plane, while the radio pilot on deck of the *U.S.S. Utah* would guide the target drone on the final part of its forty-five degree dive toward the ship. After it had been fired upon, the flight angle would be straightened out and the aircraft would return to the airfield for landing.[71] Summing up the pass, Commander Walter E. Brown of the *U.S.S. Utah* wrote, "On the first run, while firing target ammunition the plane was hit causing it to go out of control and it later crashed 1000 yards port beam. It was not salvaged."[72] His overall assessment of the trials was less than positive. "Due to the cost of the plane and the danger to personnel if plane goes out of control, it is doubtful this is an altogether feasible program."[73] Moreover, in hitting the drone, he expressed confidence in the Navy's current anti-aircraft measures, describing doubts by Fahrney and others about their effectiveness as "mistaken."[74]

While Brown's views were not enough to cancel the project, they point to overall confidence in the interwar Navy's measures to defend against air attack, as well as to the challenges faced by proponents of the drone program. Recalling the first trials in his manuscript, Fahrney wrote, "There were mixed feelings of pessimism and optimism, lament for the failure to hit the DRONE on a high altitude bombing run in the RANGER practice and joy over the crushing defeat handed a diving DRONE in the UTAH practice."[75] Here, his investments in the "success" of the drone target espoused earlier are replaced by characterizations aligned with the success of the Navy. Paradoxically, it was the success of the drone against the *U.S.S. Ranger* that resulted in the continuation of the project. More important though, are the singularities being set up to stand-in for the complexities of targeting and pilotless flight. In such a way, the drone can be seen as the gunner's enemy, even though by simulating an airstrike the practices may later save the gunners.

Target as Network

Samuel Weber observes a long-standing connection between targeting and thinking. He claims, "Thinking is hitting the mark, making the point: targeting."[76] Yet, while pointing to historic links between the two concepts, he also indicates "a certain inflation [that] seems to have marked the use of the word *target-targeting* in the past decades, at least in English."[77] Weber sets out to examine what might be at stake in this change, asking "What, if anything, does this inflation in the use of the words *target* and *targeting* tell us about the world we are living in and the direction which it is going?"[78] His argument maps onto recent work by other scholars, including Rey Chow and Ryan Bishop. Chow considers knowledge production and worldwide targeting in the aftermath of World War II, linking the development of area studies to an array of Cold War projects aiming for systematic world control, most notably American nuclear missile programs.[79] In a similar vein, Bishop interrogates the ways targeting, in forms ranging from military uses to planning practices, links to conceptions of urban space.[80] All three of these works point simultaneously to the ubiquity of targeting in the past century, as well as the relative lack of attention devoted to the concept by scholars. My research comes at these questions through the technical, material and social changes that are interconnected with the transformations these authors describe. Drone technologies call for a reconsideration of the dyad, target-targeting through the network of elements that produce and transform how the two processes are enacted, at the intersection of the material and conceptual.

Returning to the question what links targeting and thinking, Weber offers Walter Benjamin's thought as an example of thought not aimed at a singular mark, but as a spatial-temporal disposition, "a pattern, although exemplary [that] is not representational but 'arbitrary,' hence determined not through content but through its context, … its layout."[81] Weber applies this analysis to the current Global War on Terror. Close-reading a *Washington Post* article describing the capture of Saddam Hussein and his advisers, "'Target of Opportunity' Seized," Weber observes two sides of targeting. On the one hand, he notes, "The enemy would have to be *identified* and *localized*, *named* and *depicted*, in order to be made into an accessible target, susceptible to destruction."[82] This aspect of targeting, he suggests, did not differ substantially from previous practices of targeting. He goes on to claim "what *was* [new], however, was the mobility, indeterminate structure, and unpredictability of the spatio-temporal *medium* in which such targets had to be sited."[83] What Weber claims as new however can be seen in the projects set out by the United States Navy in 1936. As I show, mobility, indeterminacy and unpredictability of targets are precisely what radio controlled target planes were designed to simulate. Their effectiveness for training gunners during World War II points out these conceptions of warfare were widespread, at play in both the strategies of the United States, its allies, and its enemies. In my analysis, I explore Weber's conception of a target within a temporal-spatial medium to point out how this idea imbricates technologies, strategies and politics that mark not just the most recent decades, but much of the twentieth century.

Up to now, I have focused on Fahrney's efforts within the United States Navy to build remote controlled target planes. Parallel to these projects, the United States Army also explored possibilities of using radio controlled target planes based on model airplane technologies. Early correspondence between the Army and Navy, at the inception of the Navy project in 1936 explained that the Army considered "a radio controlled target … desirable to them for … artillery training but of low priority at this time."[84] By 1938 though, after two years of informal conversations with the Army, Reginald Denny Industries, a model airplane company run by the Hollywood actor and a team of three aeronautical and radio engineers, was given a special weapons contract to develop three prototypes for the Army. Denny explained in a letter to Delmar Fahrney in 1958, "My embarking on the Radio Controlled Target Plane project was in a sense accidental."[85] Through Denny's account of how he came to build radio controlled target planes, I consider how the contingency he emphasizes complicates the teleology implied in Fahrney's manuscript.

Denny explains he began Reginald Denny Industries in 1934, "manufacturing model airplane kits, both rubber band and gas powered and also a miniature gas engine called the 'Dennymite.'"[86] The project grew out of his experiences as an aviator, trained by the Royal Air Force during World War I, and as a civilian pilot in the 1920s. Yet, the publicity garnered for his model plane projects was tied to his fame as a Hollywood actor. Working for RKO Studios in 1936, he brought one his model planes to the film set. Denny writes, "One of the RKO publicity men came on to the set and took some pictures of the Company with the model, and of course wanted a story from me."[87] Describing how the model plane operated, Denny speculated about the possibility of producing a radio controlled plane after "one of the sound technicians told me about a revolutionary new tube that had just come out that would be very helpful in this regard."[88] Agreeing to work with the sound engineer, "a few days later the story broke in the papers that I was coming out with a radio controlled miniature airplane."[89] Following the publicity for his new project, Denny was contacted by Colonel Thiele at Fort MacArthur in Los Angeles. While Thiele proposed that the plane be used for tracking, setting distances for anti-aircraft range finders, Denny suggested the radio-controlled plane could be "an actual target to be shot at."[90] Over the next couple of years, three engineers working with Denny built early prototypes.

Almost concurrent with the tests by the Navy in San Diego, the Army Air Corps Materials Division sent three of its personnel to witness a trial of Denny's radio controlled aircraft at Lake Muroc, California on October 18, 1938. The two test flights, less than five minutes each, both resulted in crashes. Reporting on the second flight, the memorandum from the trial remarked,

> The catapult take-off … was excellent. At 1500 feet, the airplane's controls were neutralized. The airplane then began to fly straight and level. In order to bring it more directly overhead, the operator applied a slight right rudder. Immediately, the craft turned to the right and started descending in a rapidly tightening spiral and spit at 200 feet. An attempt to release the parachute failed. Damage to the airplane amounted to about 80% complete destruction.[91]

The planes built by Reginald Denny Industries were significantly smaller than the full-size aircraft produced by the Naval Aircraft Factory, with a twelve foot wingspan. They were operated through a system of radio control, dialed through a telephone. As the report noted, the Dennyplanes were catapult launched and parachute landed. Denny explained in his letter to Fahrney, "Landing the model seemed absolutely impossible."[92] Although the Army Air Corps review of the 1938 tests concluded, "The radio controlled target plane failed to pass acceptance tests,"[93] by the next year Denny had built a working model. On June 21, 1939, Fahrney was among the personnel invited to witness the Dennyplanes' test flight. Reporting on the project to his superiors, he wrote, "The precision with which the Denny target can be operated and its probably low cost in production suggest such a plane for a number of uses by the Navy."[94]

Earlier, I suggested that in simulating aircraft, the drone transformed how operations might be carried out from the sky, working not just from an aerial perspective, but between land, sea and sky through communications networks that connected humans and nonhumans by mediating how they acted across distance through real-time transmissions. Training for attack in the air, the early drones shifted how time and space was negotiated between controllers and technology through radio operation. The Dennyplane further emphasized how the function of the drone responded to the mobility, unpredictability and indeterminacy of aerial warfare. It did not matter that the drone target could not take-off or land, or that it was significantly smaller than actual aircraft. What the target plane needed to simulate for the anti-aircraft gunner was the elasticity of an attack from the air, which conditioned the drone's early development. That Denny explains his involvement in developing the target drone as "accidental," calls attention to transformation within the networked relations. The intertwining of technical, social and political developments is not pre-set and here we see how they rather unfolded through a series of changing encounters.

Lieutenant Robert F. Jones joined the Navy's project to produce a radio controlled target in Philadelphia in 1936 and was assigned command of the newly created radio controlled aircraft utility wing, VJ-3, after the trials in San Diego. He would later command the unit that tested the Navy's assault drones in the Pacific in 1944. Fahrney continued to oversee the development of drone aircraft at the Naval Aircraft Factory. Between 1938 and 1940, VJ-3 kept records for the ninety-nine drone trials they carried out. In the trials, nineteen drones were lost to mechanical failure, weather conditions, or unknown causes, while seventeen were hit by gunfire.[95] Jones made special note of the longevity of Drone #9310, which "survived 28 runs as a target."[96] As more information was gathered about anti-aircraft targeting, target practices also became less stereotyped. In a newly conceived training against the U.S.S. Nashville on March 10, 1941, "The ship [was] warned that a DRONE attack will be made in a two hour period designated on a certain date, ship must fire if DRONE is sighted."[97] Many times the drones passed overhead without being engaged.[98]

In 1940, a report of the year's firings was circulated by the VJ-3 unit, "A Survey of Firings of Radio Controlled Target Aircraft."[99] Reviewing practices against target drones between 1939 and 1940, the report emphasized lacunas in the Navy's anti-aircraft measures. For example, although the *U.S.S. Utah* had effectively countered a dive bomb attack by the T2C-2 drone in San Diego, successive trials were less successful. A memorandum from April 3, 1939 observed,

> The 1.1 inch battery of the U.S.S. Utah was exercised in experimental firing runs on a diving DRONE on Wednesday, 29 March and on Thursday, 30 March 1939. Three practices were carried out on Wednesday and six practices on Thursday using the N2C-2 DRONE. A total of 1500 rounds of service ammunition and 50 rounds of target practice ammunition were expended. Careful examination of the two DRONES used, after the practices, gave no evidence of hits.[100]

In an analysis from July 6, 1939, Admiral W. D. Leahy, then Chief of Naval Operations claimed, "Firings against DRONE targets during the past year have demonstrated the ineffectiveness of present control methods and procedures, and possibly, equipment, to combat realistic bombing attacks … the early solution of the AA Defense problem is considered urgent."[101] A special committee reviewed the records of anti-aircraft firings against drones in 1940 and made a series of recommendations to the Navy. They wrote, "It is considered the unanimous opinion of the Board that aircraft progress has rendered our AA batteries ineffective against determined attack by modern aircraft."[102] The report went on to observe that confidence in the Navy's defenses against aerial strikes were a "dangerous misconception."[103]

The attack by the Imperial Japanese Navy on Pearl Harbor on December 7, 1941 used 353 fighters, bombers and torpedo planes launched from two aircraft carriers to attack the American Base.[104] The Japanese Naval Forces sunk or severely damaged nineteen ships, destroyed 188 aircraft, and killed 2,402 personnel. The Pearl Harbor attack proved the drone trials prescient; only 29 of the 353 aircraft were shot down by Navy anti-aircraft gunners. The wreckage of the *U.S.S. Utah* remains in the harbor as a memorial to the lives lost by its crewmembers. In this chapter, I have taken a reverse view of strategic bombing, exploring its development in the interwar period through the defensive measures tested by the United States Navy, rather than the aerial perspective that marks its use during World War II. Looking back at the sky to the remote controlled target, I show how the mobility associated with airpower also changed military tactics on the ground and at sea.

Drone aircraft had already demonstrated the vulnerability of the Navy's anti-aircraft defenses and these gaps had been debated within the naval hierarchy prior to Pearl Harbor. Still, expectations of warfare that ran counter to the elastic conditions tested by drones underscored the surprise associated with the Japanese attack. Declassified messages decoded by United States intelligence show President Roosevelt had knowledge of the movements of the Japanese fleet in the Pacific, while Navy radar picked up signals of incoming aircraft on December 7, 1941. I point out these details not to question what happened at Pearl Harbor, but to ask what constituted its surprise. What I have indicated is how targets and targeting are networks, operating as a spatio-temporal medium. The attacks on Pearl Harbor emphasized not only the interconnectedness of the various parts, but also the significance of their disjuncture and rupture. The signals the Navy received of a possible attack, through intelligence intercepts and technologies, did not connect with the network in place at the time. Pearl Harbor shows that in spite of the efforts made to simulate and prepare for aerial bombings, prevailing attitudes about warfare nonetheless continued to function. A planned attack by a mobile force from the sky, no longer tied to military counterparts on the ground and at sea, had not yet been configured by the Navy forces.

Fahrney's manuscript is silent about Pearl Harbor, even while the event marks a point of transformation for the program, leading not just to the widespread implementation of anti-aircraft target training with drones, but also a large-scale attempt to build remotely piloted assault drones. The chapter on target drones in the manuscript points to the ways the target aircraft indicated the deficiencies of anti-aircraft defenses, as well as the challenges to innovation within the Navy. By the end of the war, the United States Navy's "Anti-Aircraft Action Summary" would be used to counter their defeat at Pearl Harbor, making the claim, "surface vessels during World War II fought and won two major defensive battles--one against submarines and the other against aircraft."[105] The report indicated that 2, 256 planes were shot down over the four years of the war, amounting to thirty-six percent of the total planes launched against the United States. Anti-aircraft defenses, the Navy argued, were improved both by increased emphasis on training, as well as technical measures, including larger gun size, fuzed projectiles, improved scope, and radar, of which, the first three were tested during drone trials between 1942 and 1943. Anti-aircraft successes in battle overwrite the earlier trials against drone aircraft, even though the remotely controlled target planes would have prepared personnel for their assignments. An indication of the significance of drones are the 102 squadrons of Dennyplanes within the Navy and the over 10,000 targets built by the company by 1945.[106]

Target practices against drones mimicked aerial attacks, yet were developed in response to airpower, simulating the elastic conditions of targets and targeting prior to World War II. The drone was part of changes to anti-aircraft defenses made by the Navy, even though the most significant transformations were carried out after the start of the war. Drones, as such, were part of the United States' protective defenses, networked into strategies used to counter airpower, even as they replicated aerial attack. Intertwining communications and aeronautical developments, what I point out is how drones also networked between the air, ground and sea, setting out a spatio-temporal medium for targets-targeting. Different from aircraft, drones were controlled through a communications system, linking radio pilots to aerial technologies through multiple points. Within this network, I have shown not only connections, but also tensions and disruption. Drones set up a system of humans and nonhumans that both succeed and crash, showing how control transforms and is configured by it various, networked parts.

Chapter 2

American Kamikaze: Television Assault Drones in World War II

In 1940, Delmar Fahrney formally began a Navy program to develop an assault drone that would be guided by television. The project grew out of radio controlled target planes and responded to the outbreak of war worldwide. A squadron of television guided drones, the Navy's Special Task Air Group 1 (STAG-1), was deployed to the South Pacific 1944. In the midst of these experiments, the United States military would change its approach, turning to guided missiles modelled on the German V-2. The television guided drone was cancelled shortly after its deployment and described as "dead, buried, and dismembered."[1] The tensions that resulted from the project's failure are still present in Fahrney's manuscript, written a decade later. Human and nonhuman networks linked and disjoined through drone aircraft are marked by these conflicts, as they shift from a training target to television guided weapon. Interlayered with their success and failure are shifting alliances between "us," technology and the enemy, emphasized by the television assault drones' status as a technological alternative to Japanese suicide bombers.

American Kamikaze,[2] a memoir by World War II television drone operator James J. Hall offers no explanation for the title, which recounts STAG-1 training in Oklahoma, Michigan and California and missions using the assault drones from the Russell Islands in 1944. The assault drones were guided through images transmitted to an onboard television receiver and maneuvered through radio control. Several miles away, the drone was directed to a target and the 2000 pound bomb onboard detonated on impact. In the memoir, Hall reprints the official diary for forty six missions flown against the Japanese in 1944, sent by STAG-1 commanders to the Navy Commander-in-Chief. He is surprisingly silent about the attacks and he details only one mission in his own voice in the over three hundred page book. Between multiple rumors that circulated about the program's function and the news that after one month in the South Pacific they were inexplicably being sent home, Hall fleetingly mentions misgivings. Television failure was noted as the official cause of an unsuccessful mission on October 15, 1944. At the television controls for the flight however, Hall explained the failure was actually due to "a partial windup which caused the drone to veer at the last minute and crash almost exactly in the middle of the red cross on the white roof of the hospital."[3] In the military records, the crash is recorded "at the south end of Hospital Ridge"[4] and makes no mention of a building. The images transmitted through the television loom in Hall's memory. He writes "he couldn't blot out the picture he saw on the [television] screen of the cross looming ever larger and no matter what he did with the stick or rudder controls the drone wouldn't turn, until the screen went blank at the moment of impact."[5] He remembered thinking "what if it really was a hospital, what about all those guys in there, even if they were Japs, what must the survivors, if there were any … think of the Americans now after all the atrocities the Americans were accusing the Japs of perpetrating."[6] The image on the television screen is one he can't "blot out," while also enacting distance, allowing him to ask "what if" it was a hospital he struck.

American Kamikaze is a striking formulation for the television guided drone, today described by the United States Navy as the first unmanned combat air vehicles. Their operation was likened to suicide bombers, a technological analog for the ferocity of *kamikaze* flights, which resulted in significant losses for the United States Navy, as well as the inhumanity ascribed to enemy tactics. These associations are tied to the television camera. Seeing through the television onboard the drone, the camera and controller are both aligned and separated, networking together the human operator, pilotless aircraft and enemy target through transmitted imagery. At once close and far, the contradictions of this way of seeing also frame how the drone aircraft is articulated. The onscreen target made visible the enemy, a view that was both tied to and dissociated from the camera that zoomed in to attack. Immersed in the drone's nose dive, the operator saw and participated in the strike, even as the technology, aligned with enemy tactics, was posited as separate.

"A Flying Torpedo with an Electric Eye"

In 1934, Dr. Vladimir K. Zworykin, RCA engineer and "pioneer" of television, [7] sent a memorandum to David Sarnoff, the President of Radio Corporation of America (RCA), "A Flying Torpedo with an Electric Eye." He proposed a remotely controlled weapon using the recently developed kinescope camera and iconoscope receiver, an early version of television. Zworykin explained the camera would transmit images from an airborne torpedo to an operator who could remotely control the flying bomb through the image receiver. As a graduate student in electrical engineering in 1911, Zworykin has assisted with the development of one of the first electronic image transmissions, carried out by Boris Rosing in St. Petersburg, Russia. After he immigrated to the United States in 1919, Zworykin worked for Westinghouse and received his doctorate from the University of Pittsburgh. He met David Sarnoff at a television conference in 1929. There, Sarnoff asked Zworykin what he needed to make a workable television:

> Zworykin told him that he needed a few additional engineers and facilities, but that he hoped to complete the development in two years, at an estimated cost of about a hundred thousand dollars. Sarnoff replied, 'All right, it's worth it.' … This proved to be one of the classic cost underestimates of technological history – by about $50 million.[8]

At RCA, Zworykin was in charge of television development at their laboratories in Camden, New Jersey, and in 1930 he began work on the kinescope camera and iconoscope receiver described in the 1934 memorandum.

In "A Flying Torpedo with an Electric Eye," Zworykin proposed, "Television information furnished would be of two kinds, and would be given simultaneously: (1) an actual view of the target which could be sighted by means of crosshairs; (2) accurate information on the readings of instruments in the piloted weapon."[9] Delmar Fahrney included a re-print of the paper in the archival materials he collected for his unpublished manuscript, *The History of Pilotless Aircraft and Guided Missiles*. His interest in television though, was expressed in his first monthly report as Commander-in-Charge of radio controlled aircraft in 1936. He advocated that the Navy, "Investigate possibilities of using television as a sighting directive for guiding an aerial torpedo to its target,"[10] perhaps aware of the proposed project at RCA, which circulated to the Navy in 1935. During World War I, Radio Corporation of America had formed as a branch of General Electric to manufacture radio parts for the Army and Navy, later becoming a leader in commercial radio during the 1920s. The military applications for television proposed by

Zworykin drew on these connections and resulted in military contracts for the company in 1939. During World War II, RCA would produce five thousand television cameras and receivers for the military. The refinements to the television tube that was used to guide the drone aircraft relied on the image orthicon, which would be used in the production of television sets until 1965.

Image transmissions used by American forces in assault drones during World War II predated widespread commercial broadcast television. In *American Kamikaze*, Hall's memoir of being a television drone operator for the Navy between 1942 and 1944, he recalls being told about the top-secret mission for which they had been selected. The Lieutenant told the men, "We are going to mount radio-controlled pilotless drones against the enemy,"[11] and explained how the pilotless planes would be operated by four different divisions. He was interrupted when mentioning the television unit. Hall writes, "'Television?' the buzzing went through the crowd. 'Men! Men! Yes, television, both transmitting and receiving.'"[12] The buzz from the crowd reacting to television, as well as the explanatory response it called for from the Lieutenant is indicative of television at the time. While television had been anticipated worldwide since the 1920s, there were fewer than seven thousand television sets in the United States before 1941. The brief comment that television would both transmit and receive explains how television operated and foregrounded differences with other image technologies. Photographs and motion pictures had to be chemically developed and fixed, whereas the electronic view produced through television would be transmitted in real time.

The ability of television to transmit and receive tied to how, as a medium, television was immersive and participatory. Marshall McLuhan proposed media "shapes and scales the form of human action and association."[13] Interactions through televisions transmissions and the consequences resulting from these relations are starting points for McLuhan's analysis, which I read in relation to the television guided torpedo. Explaining how television might be used strategically in "A Flying Torpedo with an Electric Eye," Zworykin emphasized the instantaneous transmission of the image, giving the operator the ability to both target and accurately gauge the controls of the weapon, extending his ability to operate across space and time. The "actual view" of the target tied to a live view of the battlefield. The real-time image sent through the camera on the pilotless aircraft would follow the trajectory of the bomb to the target, allowing the operator to visualize the path of the weapon. Unlike the gunners who aimed in anticipation of aerial targets, a strike coordinated through image transmission would move as the action happened. The television transmissions sent to the drone were low fidelity, a grainy electronic transmission. The pictures would have been shown on a screen with 325 lines, which compared to film footage of the period or aerial photographs would have been noticeably different. McLuhan uses hot and cold to account for this difference. A cool medium, like television, "leaves much more for the listener or user to do than a hot medium. If the medium is of high definition, participation is low. If the medium is of low intensity, the participation is high."[14] Through the television camera, operators reacted to the aircraft, adjusting the instruments and the course of flight as necessary. Rather than picturing the battlefield, television would have called for the ongoing involvement of the operator in the process of guiding the missile to its strike. What Zworykin promotes as the "actual view" of the iconoscope camera is not a high-fidelity image, but a transmission that necessitates engagement. McLuhan explains further, "the most effective [television] programs are those that present situations which consist of some process to be completed."[15] In the case of the assault drone, the torpedo exemplified how television was a medium to complete a process, as the simultaneous interaction between the operator and television system would make an attack possible.

The version of “A Flying Torpedo with an Electric Eye” in the archival materials collected by Fahrney was a re-print of the 1934 memorandum, from a 1946 article in the *RCA Review*, one of many reports found in various folders about television guidance, dating from as early as 1935. While the actual views provided by television were emphasized in the first two paragraphs, the article primarily focuses on another aspect of television – the ability to see at a distance. McLuhan’s insights point out how real-time image transmission called for the participation of the operator through the medium. Yet, what Zworykin promoted as the usefulness of drones opposes this reading. His analysis indicated distance, rather than interactivity, as the key strategic feature of television. This connects with William Uricchio’s claim, “Television, at least as it was originally imagined and for most of its first seventy-five years, was about the ephemeral act of seeing, of extension and instantaneity, of visually connecting disparate locations in real time.”[16] Uricchio links television to its etymological counterpart, the telescope, to conceive of television as tied not only to radio and image transmission, but also to the telegraph and telephone, both of which emphasize operation over distance.

In the extended discussion found in the re-print of “A Flying Torpedo with an Electric Eye,” Zworykin describes how eye-like qualities of the iconoscope camera distinguish the weapon from other military technologies. Explaining how the camera saw, the article effaced the interactivity between operator and television. Similarly, in *American Kamikaze*, the Lieutenant who introduced television as transmitting and receiving later described the system “in the nose of the aircraft as near to the centerline as possible … so that it can look dead ahead at the target.”[17] Here, “it,” the television guided drone looks “dead ahead.” “Seeing” the target left out the transmission and reception and associates looking with the camera itself. “A Flying Torpedo with an Electric Eye” used the eye-like qualities of television to highlight the innovation of the weaponry Zworykin proposed, which he explained within a progression of technologies. He noted, “There have been quite a number of attempts to devise an efficient flying weapon. The aerial bomb is the simplest form, and the recent improvements in aerial ballistics make these bombs a formidable modern weapon.”[18] Their effectiveness was lessened by the improvements of anti-aircraft defenses. Probing the problem further he observed, “Considerable work has been done also on the development of radio-controlled and automatic program-controlled airplanes having in mind their use as flying torpedoes.”[19] Radio control however, relied on the operator’s sight to direct the missile to its target, limiting the range of the weapon to how far the operator could see.

Having set up limitations of the human operator as a problem to be overcome, Zworykin continued, “The solution of the problem evidently was found by the Japanese who, according to newspaper reports, organized a Suicide Corps to control surface and aerial torpedoes.”[20] The Suicide Corps exceeded the limitations of the body, including the range of sight, which would have restricted radio control pilots. Responding in the next sentence, Zworykin wrote, “We hardly can expect to introduce such methods in this country, and therefore have to rely on our technical superiority to meet the problem. One possible means of *obtaining practically the same results as the suicide pilot is to provide a radio-controlled torpedo with an electric eye* [emphasis added].”[21] While the first part of “A Flying Torpedo with an Electric Eye” proposed the television guided torpedo would relay targeting and control information simultaneously, providing the operator with "an actual view," the second set of justifications described television as a technology of distance, promoting the electric eye as a technology to overcome human limitations. More than just showing how television control would enable separation between the controllers and the weapon systems, the television guided system was analogized to a suicide pilot. Television does not replace or stand in relation to the American pilot. Rather, Zworykin argues "our" technical superiority engineers an aircraft that could obtain the same results as the Japanese Suicide Corp through "an electric eye." [22]

Effacing the role of the operator through the television technology continued in the next part, as well. In describing how the television torpedo would operate, Zworykin used the passive voice. The interactions I described above as occurring between media and operator are attributed the camera and aircraft. "The carrier airplane receives the picture viewed by the torpedo while remaining at an altitude beyond artillery range. It is not even necessary to have direct visibility of the target from this plane, as the information is supplied by the torpedo from much closer range."[23] In this explanation, no mention was made of the human viewers who would have controlled the weapon, though their distance was emphasized. Rather, the *carrier plane* not the human pilots onboard received the imagery, while "information" provided by the television camera guided the torpedo. The only moment when Zworykin directly referred to an operator was at the end of the paragraph, observing that television control "introduces an entirely new principle in ballistics, since in all existing methods the operator has no way of controlling the projectile once it has been released."[24]

In 1946, when the re-print of the memorandum was published, missile guidance was in its nascent stages. I read Zworykin's claim that the "electric eye" of television introduces an "entirely new principle in ballistics" as a way to analyze how the television interface functions between the operator and the battlefield – one that changes the framework of distance and proximity, as well as what it means to target. While the television camera ostensibly just adds onto the radio control drone, Zworykin's memorandum points out how the addition of television mediates new relations between the operator, drone and target. By incorporating image transmission into the pilotless drone, the system becomes an attack weapon tied to enemy tactics, even as it transformed how the remote pilot strikes a target, seeing through the television camera. In this way, Zworykin claimed the technology as superior to even as he makes it analogous with the Japanese Suicide Corps. The dissociation between the operator and the drone was also a connection, both immersing and distancing the remote pilots from the television-guided drone aircraft. The drone confused in this way who was the operator and how the technology related to the enemy, an ambiguity also found in the camera, at once tied to and detached from the operator's sight. Both contradictions troubled what it meant to see an enemy target.

Interpretative flexibility is a counterpoint to technological determinism, emphasizing how innovation and change never happen through conditions intrinsic to technologies. Instead, the framework shows how an array of factors, e.g. social, economic, political and scientific, shapes what a technology becomes. Moving from the target drone to the assault drone, the transformation is not a change intrinsic to the technology but tied to the intersection of military and industry explored above. In a classic study, Donald Mackenzie posits interpretative flexibility to examine nuclear guidance technologies built for missiles from the 1950s onward. He shows how missile guidance did "not simply [mean] different things to the different ‘inventors,’ but also [were] seen by different groups as a solution to quite different problems.”[25] Mackenzie does more than enter into debates about whether nuclear missile guidance was accurate, a concern of the early 1980s. Instead, he argues that the very concept of accuracy emerged through particular networks of knowledge that shape and were shaped by guidance technologies. He writes, “Take away the institutional structures that support technological change of a particular sort, and it ceases to seem ‘natural’ – indeed it ceases altogether.”[26] Accuracy, as such, is not a teleology measured by ever greater progress in hitting a target, but a social and political claim, mobilized by a range of actors in multiple and, at times, incompatible contexts.

William Uricchio echoes this analysis in describing the ongoing, interpretative flexibility of television as a medium. He writes,

> Television, a medium, even before its institutional consolidation around 1950, … was related to telephone, radio, and film technologies; … drew upon journalistic, theatrical, and (documentary) filmmaking practices; … was variously understood as domestic like radio, public like film, or person-to-person like the telephone. … Indeed, the medium’s undulations today … are not so much new as reminders of the medium’s long-term flexibility.[27]

Marked by a series of changing social and technical relations, television is not a given. Rather, it is a flexible medium, entangled with other forms of media and changing contexts. The analyses of both authors are suggestive of the transformations that change the target drone into a television-guided weapon, undoing a single sense of the drone. Interpretative flexibility highlights how drones are multiple: they are targets, even as they become a targeting system; they are both a plane and a missile; they are a robot and a kamikaze. These ambivalences persist throughout their innovation and remain in current debates, which I argue are marked by discord between the drone’s multiple meanings.

Pointing to the multiple different formulations of what comes to be taken as a given, interpretative flexibility instead posits a process of socio-technical development entangled with failures and successes. Eventually, methods drawing from the social construction of technology claim closure results, “the irreversible end point of a discordant process in which several artefacts existed next to each other.”[28] As I will explore in more detail later, Delmar Fahrney offers a reading of drone development that is not unlike analyses made by the social construction of technology. His account emphasized the social factors within the Navy hierarchy he argues led to the failure of television guided assault drones. The closure described in his 1957 manuscript however, is troubled by newfound significance of unmanned combat air vehicles in the post-Cold War, as well as contradictions that continue to inform their development. My account of television guided drones during World War II draws on the entanglements between humans and nonhumans to trouble the irreversibility of closure and rather, points to the ongoing open-endedness of innovation and failure. Uncertainty, as MacKenzie argues, remains even in highly developed technological systems.[29] Drawing from this cue, I show how, in spite of the apparent failure of television assault drones during World War II (or the success ascribed to current unmanned combat air vehicles), abstruseness is intertwined with how the drone operates, as a social and political technology that both immerses and distances.

Project Option

As early as 1935, Radio Corporation of America met with representatives from the Navy about the possibility of using television to control aerial weapons. The Navy invited Zworykin to report on his ideas in 1937. Following his presentation, the review board concluded they "appreciated the thorough study … of television and radio controlled aerial torpedoes, and were satisfied that, at least for the present, the situation does not justify any expenditures of funds for experimental purposes in this field of endeavor."[30] Attitudes toward remotely controlled technologies shifted as trials with drone targets expanded and Navy personnel increasingly agreed on their usefulness for training anti-aircraft defense. By 1939, Commander-in-Chief of the Navy Claude Bloch would offer the following commentary supporting the possible development of radio controlled weapons:

> The extension of the role of the radio controlled airplane from the passive one of a target to the active one as an offensive weapon should be recognized as a reasonable development, and experimentation to determine the most useful field for this weapon is considered fully justified.[31]

RCA received a contract from the Navy to produce an experimental prototype of its television control system for remotely guided aircraft in 1939, the same year it demonstrated the technology at the World's Fair in New York. Meanwhile, the Navy officially began its assault drone program on March 22, 1940, when the then Chief of the Bureau of Aeronautics, Ernest King approved the conversion of a TG-2 aircraft to radio control. The television controlled weapon relied on the personnel and technologies that had developed drone targets for anti-aircraft defenses. Fahrney was given command of the assault drone program and subsequently recruited key personnel involved in the target drone program to produce the new weapon, which reconfigured drone. The TG-2, for example, which became the first television guided aircraft, was previously a drone target control plane. Using technologies that had already been developed for target drones, the Navy engineers transformed radio controlled system to simulate enemy aircraft into a prototype of an offensive weapon.

Television was the feature that distinguished the top-secret attack weapon from the drone target. Writing to the Naval Aircraft Factory on January 17, 1941, King noted he was "particularly desirous that the technique of operating offensive torpedo carrying radio controlled aircraft in quantity be pushed to a conclusion, and that sufficient flight tests of aircraft television be carried out to permit recommendation of useful application for Naval work."[32] In 1941, a number of tests were made guiding the converted TG-2 plane and using an RCA television set. Exemplary of these trials were practices on August 7, 1941. Walter Webster, manager of the Naval Aircraft Factory, who oversaw the production of the experimental assault drone, wrote:

> Approximately fifty simulated torpedo attack runs were made with the DRONE under radio control, using the television equipment to sight and effect a collision track on the target. All runs except three were satisfactory. In addition, the DRONE was maintained under continuous radio control, television guided, for a period of forty minutes (during which time the control pilot was not able to see the DRONE), made runs on a target,

> returned the DRONE to the initial point and repeated the runs. The maximum distance that a clear picture was obtained (television) was six miles.[33]

Television enabled a greater distance between the control aircraft and the drone than radio control alone. At a distance of six miles, the drone was no longer in the vision of the controllers and instead was operated through a television screen onboard the control plane. Two additional TG-2 planes were assigned to the project in September 1941 for conversion to assault drones. By November, the Bureau of Aeronautics began to explore production possibilities on a larger scale, looking to obsolete airplanes as possible frames for the remotely guided weapons, as well as cheaply produced plywood airplanes.[34]

The attack on Pearl Harbor on December 7, 1941 shifted responses to the experimental program though. With a large part of its fleet and aircraft destroyed, many within the Navy emphasized the importance of rebuilding and mobilizing already tried methods of warfare, as the United States formally entered World War II. Positioned against Japan in the Pacific, the Navy was challenged by the unexpected defeat. Internal discussions within the Navy characterized the threat of the Japanese as inhuman. To counter this, experimental weapons were promoted as providing a technological advantage. Captain Oscar Smith, of the Naval Bureau of Ordinance, unaware of the top-secret developments with radio and television control already underway, wrote to the Chief of Naval Operations on December 15, 1941. He proposed:

> We need no suicide squad to dive torpedo laden airplanes into the sides of the enemy ships. Let a simple type of radio control be placed on a plane, and we have a suicide pilot who will not falter, but will obey all orders of the controlling plane, and will not hesitate to fly within 100 yards (of the enemy ship) before dropping his torpedo.[35]

Smith would become the most prominent advocate for the assault drone program and, after visiting the project in February 1942, suggested its development be expedited. Like Zworykin, who may have drawn on Smith's ideas for his article, Smith conceived of remote control as having the capacity to produce the tactics of a suicide pilot, fitting his description of the radio control aircraft with American stereotypes of a kamikaze, unflinching and obedient. While there was no organized Suicide Corps at the outset of the war, the American military had already characterized Japanese forces as engaging in suicide tactics. This may have been due to Japan's no-surrender policy.[36] Smith accordingly frames the radio control technology as more-than-human, unfaltering in its approach to death, even as he points to a specifically American, "we," who stands counter to the enemy.

By May of 1942, the United States Navy's first attempt to mass produce a remotely controlled weapon was approved, in part through the lobbying of Smith. Admiral King, Chief of the Navy Bureau of Aeronautics who had subsequently assumed the rank of Chief of Naval Operations (CNO) outlined two requirements: "(1) to develop a service weapon from the experimental guided missile, the … assault DRONE and (2) to ready the weapon for combat employment at the earliest practicable date."[37] The proposal called for between one thousand and five thousand television guided weapons, arguing that smaller quantities would "lose the advantage of surprise inherent in these weapons."[38] As CNO, King fostered the project that he had been overseen since 1936. Yet, the assault drone required a large investment of personnel and budget. The new Chief of Bureau of Aeronautics, John Towers, a Navy pilot and proponent of Naval aviation since World War I, was more hesitant. He requested that the project develop five hundred units and be named "Option." Towers noted "this bureau is considerably concerned over premature commitments of funds, materials and personnel to this project which otherwise would be available for current needs."[39]

The controversies suggested by this initial exchange continued between 1942 and 1944. The CNO laid plans for a top-secret Fleet Special Air Task Force, which began training in 1942 in Clinton, Oklahoma. Smith was given the new rank of Commodore and charged with overseeing the program. Plans called for over three thousand personnel, 99 control planes and 891 drones divided into three Special Task Air Groups (STAG). Despite this, in early 1943 only twelve TDN assault drones had been built and although the pilotless aircraft incorporated television and radio control, they were low performance air vehicles, built of plywood. This meant that they were slow and could only be maneuvered simply. Further, the cost far exceeded the available budget.[40] American Interstate Company was contracted to build the next model, the TDR, which was ready to be flown in late 1943. Towers, now Commander of the Pacific Fleet, resisted efforts to include the television guided drone in his battle plans. The TDR were declared "untried," and the current efforts of United States Navy's in the South Pacific effective.

Reviewing the project ten years later, Fahrney would offer the following analysis of the tensions that underwrote the different objectives of Smith, who came from the Bureau of Ordinance and Towers, a pioneering aviator within the Navy, who had been thwarted in his attempts to use aircraft in World War I. Smith, who was never trained as an aviator, was viewed with some skepticism within the Bureau of Aeronautics, which funded the television guided assault drones. Describing how the dispute between the two escalated, Fahrney wrote,

> Considerable light can be thrown on the attitude of Towers toward the assault DRONE program if we analyze the personalities involved in this issue concerning its combat employment. Towers was well disposed toward the idea of radio controlled and guided air traversing vehicle for assault usage and gave it his strong support during the development phase. … He had misgivings, however, based on his experiences with [previous unsuccessful aerial torpedo experiments] and the general conviction that it took a human pilot to fly an air machine. Having been one of the first naval pilots, he was reluctant to concede that an aviator would be displaced by a robot.[41]

Fahrney's analysis points to the interpretative flexibility of the drone. He claimed tensions between the two commanders were not the result of the technology and rather, stemmed from their different approaches to pilotless aircraft, which were informed by their institutional background. The controversy between Smith and Towers figured two sets of relations between drones and their human operators. Smith argued for the potential of radio and television control to take up what he called the enemy's suicide tactics. Towers saw the aviator being replaced by a pilotless plane. In the former, the technology acts like the enemy for targeted attack, while in the latter, the drone displaced the naval aviator.

In 1944, the conflict between Smith and Towers came to a fore. Fahrney was re-assigned as Head of the Logistics Section of the Aircraft Command between 1944 and 1945, the only position he would hold not related to drones or guided missile development between 1936 and his retirement in 1950. This came after he had been directed by Towers in 1943 to "have no further unofficial or official personal contacts with the … CNO,"[42] regarding the assault drone program. An ally of Tower's, Captain H. B. Temple was placed in charge of the Navy's guided missile program on February 15, 1944.[43] According to Fahrney's manuscript, Temple was instrumental in changing Navy plans. He reduced the scale assault drone program significantly, and much of the personnel that had been trained for the television guided assault drone program were re-assigned. Other experimental guided missiles were cut.[44] Commodore Smith continued to exercise some influence within the CNO's office though and argued the television guided assault drone should be tested in combat. This held sway with King and resulted in the deployment of the one remaining STAG unit to the Russell Islands in June of 1944.[45] By the end of the summer, King would terminate the program. He proposed to transfer the remaining radio and television technologies to the Army, in an effort to reduce costs and refocus the efforts of the Navy. The Navy would turn instead to "the latest advances in the science of propulsion, aerodynamics, and electronics"[46] and future developments would emphasize the strategic advantages of the sea fleet. The television guided systems were failed, even before they had been used in war.

Earlier I suggested Fahrney's account of television guided assault drones provided an explanation for the failure of television guided drones that foregrounded social factors. In his telling, tensions between Smith and Tower highlight how the development of the aircraft system linked to conflicts internal to the Navy hierarchy and show why, even before the weapon had been tried out in war, it was cancelled. Quoting those involved in the project, Fahrney makes the case that social conditions that led to the termination of the television assault drone, not technical failures, as officially claimed. Fahrney's manuscript undoes the conventions expected of a history of technology, even as he insists the developments initially spearheaded under his command would shift how war was waged. The television assault drone program does not end with its cancellation though. When King terminated the program, the Special Task Air Group-1 (STAG-1) was already deployed in the South Pacific. The assault drones were used for one month in the Pacific, while a joint Army-Navy effort tested television controlled bombers in Europe. Turning to these missions, I examine interconnections between the operators, television and the enemy. What interaction was set up through the television guided drone, seen as an analog for enemy tactics?

Testing Television against the Enemy

The inability of the United States Navy at the beginning of World War II to defend against aerial attacks by the Japanese forces was part of a turn to strategic aerial bombardment by the world's major military forces, at the time.[47] In the interwar period, ideas about aerial bombing in the United States were exemplified by training given to pilots the Air Corps Tactical School, even as the effectiveness of the proposed strategies remained largely untested. In "The Evolution of Air Force Targeting," John Glock indicates how the Air Corp proposed to use airpower strategically, separating air attacks from those of ground forces:

> Proper selection of vital targets in the industrial/economic/social structure of a modern industrialized nation, and their subsequent destruction by air attack, can lead to fatal weakening of an industrialized enemy nation and to victory through airpower.[48]

Airpower proponents planned to wage war from the air against specific targets to weaken military, communication, and industrial infrastructure, transforming the use of aircraft from tactical support – the primary role of planes during World War I – to a strategic use that could operate without ground and sea forces. A number of recent histories have devoted considerable attention to this transformation, highlighting how the strategy had enormous impact on civilians and was far less effective than proponents of air power had claimed.[49] These practices nonetheless changed how war was waged. The increased reliance on aerial bombings as a military strategy also called for better reconnaissance, much of it done by aerial photography.[50] Further outlining the doctrine of the Air Corp Tactical School in the interwar, Glock notes how airpower proponents recognized their strategy depended on reconnaissance. They noted, "Much of the value of the bombing offensive, should there be one, would of necessity rest on intelligence data and the conclusions planners gleaned from it."[51] Yet, relatively little targeting information was available to the United States after its entry into World War II:

> While there was an Air Intelligence Section, there was still no organization capable of doing the systematic analysis required for proper targeting. There were no trained target intelligence officers. Just as important, we still had not developed the data base of potential targets.[52]

This changed over the course of the war and by 1944, American flights by the Army and Navy were producing as many as 3 million photographs a month.[53] The intelligence was collected in what became known as the *Bombing Encyclopedia*, a compilation of installations and physical areas of potential significance as objectives of attack.[54] The transformation marked the increased significance of visual information and interconnections between airpower and reconnaissance.

I point to these broader changes as I analyze how the assault drone was intended for real-time strikes against strategic targets during three missions in 1944. While the Navy officially cancelled the operations, television guided planes were used both in a joint Army-Navy effort in Europe and by the Navy in the Solomon Islands in the South Pacific. As an interactive and connective medium, the television guided drone transformed the processes of information gathering, targeting and strategic bombing described above. Though strategic targets were, likely, based on materials previously collected through aerial reconnaissance, the "electric eye" of television choreographed an operation that changed the relation between how the target was pictured and hit, linking these two practices together in an immersive, onscreen image.

A film made in a final effort to secure support for the Navy's television guided drones, "Service Test of Assault Drone,"[55] offers a record of how the TDR aircraft operated, staging both an experimental test and an idealization of the human and nonhuman system. Using the conventions of silent film, Commodore Smith's commands to the STAG-1 unit are relayed through title cards. He directed the test-strike of four assault drones, which was also witnessed by two commanders of the South Pacific Fleet in Guadalcanal on July 30, 1944. The trial shows how the television controlled systems could attack a ship and targeted a beached Japanese freighter, *Yamazuki Maru*, the wreckage of which remained in the area from a previous battle. Choosing to attack a beached ship with the assault drone, Smith set up a demonstration not unlike those conducted after World War I by Billy Mitchell to promote airpower. The real-time strike of the target both connected different points spread out over a distance of seven miles, while immersing the operator in the strike.

Time organizes the narrative of the film, as an intertitle early on indicates the drone strike will occur at fourteen-hundred hours. The goal of hitting the target on time functions as a marker for the success of the experiment, as well as a cinematic climax organizing the sequences leading up to the strike. Time also indicates how the television guided drone uniquely sights and tracks its target instantaneously, distinct from other imaging technologies, like photography and film. The footage from the test begins with a title card, indicating there is no onboard pilot, "the drone in NOLO [no live operator][56] condition ready for take-off." The TDR drone is then pictured in the center of the frame on an empty runway, palm trees in the distance. The shot is framed so that none of the personnel involved in the TDR's take-off are in the picture. The next intertitle states each TDR holds a 2,000 pound bomb and is radio controlled from a TBM plane, as the image pans across the runway showing the other assault drones and island landscape in the background. The television guided drones contrast with the tropical vegetation in the background. Yet, the film also points to an analogy with nature, presenting the drones as if they functioned without human intervention. In the next shot, a sleek, aircraft without a cockpit launches from the runway and takes off into the sky, apparently operated by a radio controller off screen.

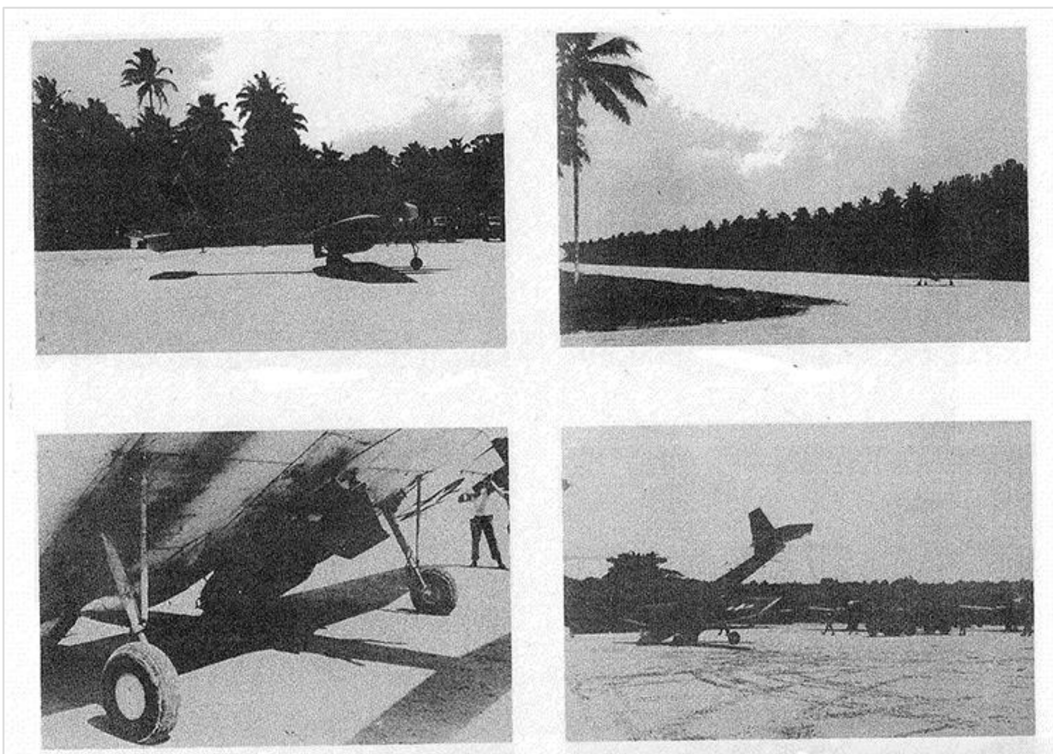

Figure 5. Drone Nose-Over (Stills). *Service Test of an Assault Drone*. July 30, 1944. Adapted from James Hall, *American Kamikaze*, 1984.

The next sequence though, interrupts the naturalized association between the tropical landscape and the technical system's "NOLO" operation (figure 5). Before the second plane takes-off, the viewer is alerted by an intertitle, "the number 880 starts take off, noses over."[57] The plane nose-dives just as it is released on the runway. As opposed to the long shot shown of the first drone's take-off, coasting for several seconds before launching into the sky, the nose over takes only a few seconds. In these moments, personnel move into the picture to fix the aircraft as the film cuts to the next take-off. A title card has already explained the failure, due to a malfunction with the nose wheel pin retaining clip. In the first minutes of the film, the TDR test is staged through flight and failure. The connections that link the human operators to the drone are hidden from view, while the technical system is presented as if its actions were its own – with no live operator. Even the drone malfunction is explained in technical terms, although failure makes the personnel who operate the drones visible, emerging into the screen as the aircraft malfunctioned. Three more drones take-off without incident, including a replacement for the drone that failed to take-off, and the film shifts from the view of the tropical runway to the air.

Once airborne, a title card states, "During attacks, control planes remain seven miles from the target." The next image shows the TBM control plane against the open sky with no sign of the television controller who is onboard.[58] This shot is the same image of the "carrier plane" that Zworykin described in his proposal, setting up the networked operations of the drone as if they moved between technological components. After showing the control aircraft, the next title card sets out the orders: "To crash the side of the breached Jap freighter, *Yamazuki Maru*, Cape Esperance, Gaudalcanal, in succession, commencing at 14:00." The following image provides a close up of the beached freighter deck, slowly pans across the "point of aim"[59] in the previous intertitle. More than half of the film is devoted to showing the drones, control plane and target, in succession, organizing how the drone operates and how it will target. Each element – drone, controller and target – is framed separately, setting up their separation, even as they are linked together. This set of relations parallels the networked target I described before. However, the assault drone is now a targeting system. The change is emphasized in second part of the film, which focuses on the television transmission. Looking through the screen on the control plane, the operator would see the view from the nose of the drone, diving toward the beached freighter. What the drone is has changed. Despite the separations marked in the first half of the film, the medium of television extends human action and links these separations onscreen. The image relates the operator, drone and target.

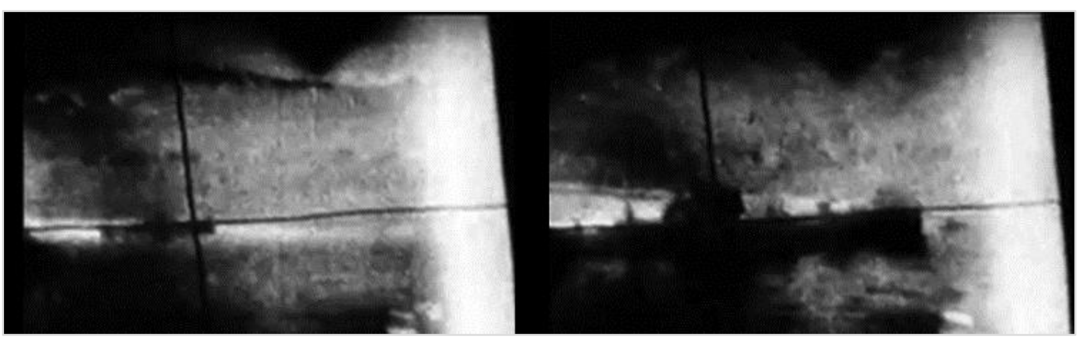

Figure 6. Television Control (Stills). *Service Test of an Assault Drone*. July 30, 1944. National Air and Space Museum Motion Picture Archive, Chantilly, VA.

The next title card states, "At 13:58 control pilot sights target on television screen."[60] This is followed by images from a grainy television transmission, an almost unintelligible island landscape with the freighter in the foreground (figure 6). The target might not be recognizable if a prior sequence hadn't shown a close-up of the deck line. The ship stands out against the sea, as the light reflecting off the water contrasts with the shape of the sea craft. Onscreen, for both the pilot watching the television screen and the viewer watching the film, crosshairs indicate the target. Just two minutes before fourteen hundred hours, the title card reminds the viewer that the strike will be carried out against a specific target at a specific time. Watching the television screen with this parameter underscores how the transmitted images follow the course of the strike in real-time. The trajectory of the shot moves to the target, relaying the image from the drone's camera to the 325-line television set. Shown on film, the low fidelity of television is apparent through the contrast between the two mediums. As the drone approaches its target, the freighter becomes more prominent in the operator's screen. The water in front of the *Yamazuki Maru* glares white with the midday light and the ship comes to occupy more and more of the frame. Visual noise interrupts the transmission, and the display flickers, reminders of the simultaneity of the television image. The picture returns and *Yamazuki Maru* fills more of the screen, turning black as the drone crashes into the deck. The intertitle draws the viewer's attention to the connection between the black screen and the completion of the mission indicating, "First drone TDR #860 strikes at scheduled time."[61] The next shot is then shown from the point-of-view of another camera, filming the freighter. The TDR nose-dives into the *Yamazuki Maru,* followed by a large explosion. Watching the two shots relays the impact of the assault drone as the camera is destroyed when it hits the deck of the ship. The destruction consumes the technical system and the image disappears with the explosion. The second view however, shows what has happened through the distance of a landscape shot: billowing clouds of smoke against the tropical island in the background, a film image that relays this record only after it has been processed (figure 7).

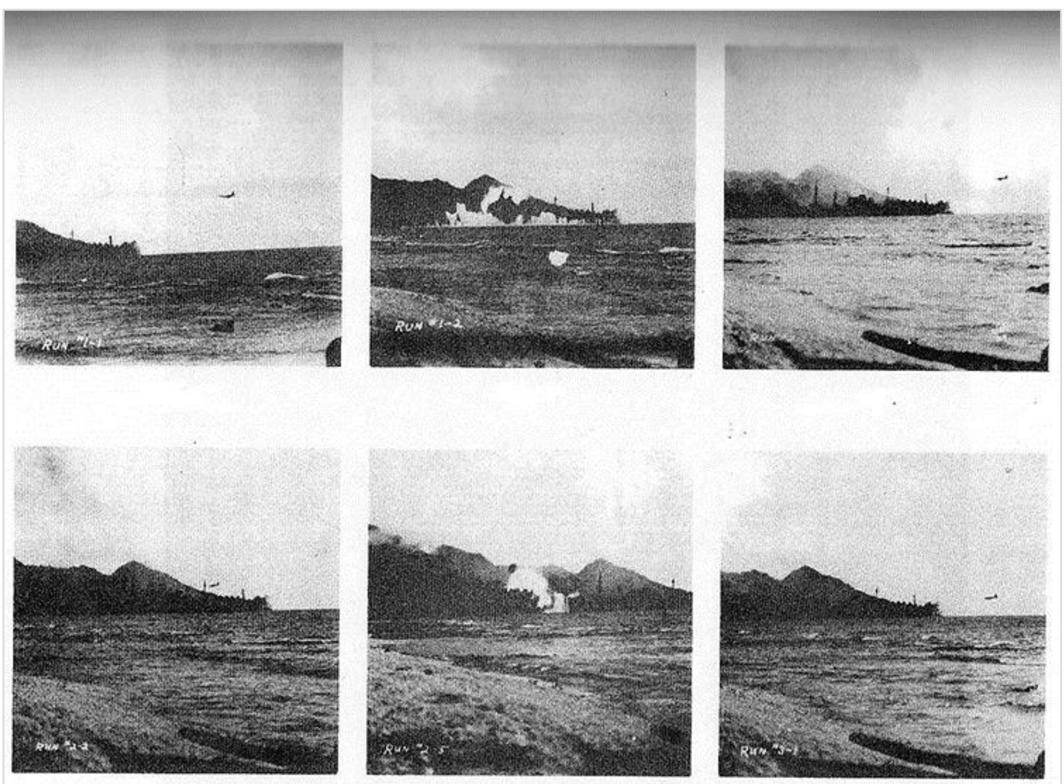

Figure 7. *Kamikaze* Drone Attack (Stills). *Service Test of an Assault Drone*. July 30, 1944. Adapted from James Hall, *American Kamikaze*, 1984.

Two of the four planes hit the ship and the final bomb strike closes the film with "The End."[62] This piece of mixed media, a filmed account of a television guided missile strike, guides the viewer to watch both the strikes and the bombings in a particular way. The viewer sees through the television lens and watches the bombing from a "neutral" camera documenting the strike, while the real-time transmission relayed from the drone's camera zooms in on the target in the crosshairs. The television assault drone targeting the freighter onscreen becomes ever closer before turning black, immersing the viewer in the trajectory to the target and its impact. Yet, these images also point to the safety of the operator's position, particularly the second shot of the strike, which distances the operator from the view of the television camera, showing the drone diving into ship from the perspective of an onlooker. Both scenes visualize strikes by Japanese *kamikaze* pilots carried out a few months later in the Pacific, although mediated by television, their impact is transformed, replacing the pilot with the television camera. The onscreen images also suggest how they are out of sync with the film and photography of the time period. Distinct from the aerial view of reconnaissance photographs or the calculated reckoning of strategic bombing, the television zooming into its target brings together both intimacy and distance in its real-time flight. As Zworykin suggested in the text that opens this chapter, the "electric eye" transforms the logic of targeting.

The constellation of elements I describe above point out recall how drone aircraft were formed through dynamic human and nonhuman networks. Ontological choreography refers to the ongoing, mutable, coordination of humans and nonhumans that marks shifts enacted through the television guided assault drone. Charis Thompson develops this framework to provide an analysis of the changing interrelationships between people and things coordinated through technologies, which I articulate through the change of drones as targets to drones as targeting systems. Yet this transformation is not progressive and rather, is halted by the failure of the remotely piloted assault weapons and the success of the drone target. As Thompson explains, coordination refers not only to connection, but also reductions and separations. She writes,

> Attempting to elucidate some of the specific choreography that enables ontologically different kinds of things to come together has inevitably led me to explore the ontological separations between things … and to examine the reductions of one kind of thing to another. … These kinds of things occur at specific times, do specific ontological work, and are highly instructive.[63]

Ontological choreography highlights movements, re-organization and re-arrangement of things that seem apparently different, yet are aligned. The choreographies between television, remote controlled aircraft, Navy engineers, RCA inventors, military decision-makers and the politics of war transform drone target planes into television controlled assault weapons. At the same time, these dynamic relations are imbricated in the almost immediate failure of the system. And though the television guided assault drones come apart in 1944, they also speak to contemporary unmanned combat air vehicles, as the choreographies indicate how operator, onscreen image and enemy are linked through immersion and distance.

Navy RCA television technologies transferred by Admiral King to the Army during the summer of 1944 guided "War Weary" B-17 bombers, Army Air Corp planes that were no longer usable by pilots and were converted into remotely piloted weapons. Two top-secret missions, "Project Aphrodite" and "Project Castor," were trialed in the fall of 1944 in Europe. The "War

Weary" B-17s differed from the TDR drones developed by the Navy. An onboard pilot would take-off in the plane from an airfield in England and parachute from the aircraft once the B-17 was airborne, and operation would then shift to the radio and television controllers. The pilotless B-17s, laden with twelve thousand pounds of explosives, were flown to strategic targets in the North Sea and in continental Europe, crashing into the site and detonating the explosives onboard. A television controlled flight, aiming for an airfield in Helgoland on September 3, 1944, was described as follows:

> Almost immediately, we could see bursts of flak in the television camera's field of view. In my television screen several miles away at about 5,000 feet altitude, I could see trees, streetcars, automobiles, windows in barracks, an airfield complete with airplanes and the enemy running by the hundred to take cover. … The control pilot in the … mother plane guided the DRONE, as if he were in it, straight toward the airfield.[64]

Using two control planes, the television transmission and radio communication interfaced between the drone and control planes to guide the pilotless B-17 to its target – the German airfield. The drone allowed the pilot both to act "as if he were in it" and to watch as the plane crashed and exploded, while the viewer remained distant and unharmed. Anti-aircraft gunfire onscreen signaled the enemy, but its flickering attacked the pilotless plane being flown several miles from the operators' planes. As the image transmission came into focus over the airfield, the screen enabled the operator to guide the plane on its trajectory, passed on the way by trees, automobiles, and barracks. The simultaneous experience of immersion and distance, gave form to a target that is not only seen from distance, but projected onto the operator through the television screen, unlike other pictures of targeting produced during the war.

What did the remote operators see onscreen, though? The Army summary of this mission highlights how the remote pilots failed to locate and hit their target:

> The take-off, set-up route, and bail-out were accomplished without mishap and the two PV-1 control planes guided the robot[65] over the North Sea for the sub pens at Helgoland. The [television] operator, with a poor picture picked up the breakwater on Dune Island, mistaking it for Helgoland. Eight seconds prior to impact, the [television] picture was lost, indicating a hit by flak on the transmitter. The robot also started into a right turn and the controller dove it into Dune Island. The photos show a large crater near the barracks area and extensive damage to the barracks and other buildings.[66]

While the pilot's account described the mission as if it the B-17 was being guided to the target, what is onscreen is not the airfield in Helgoland, but the military barracks on nearby Dune Island. What I indicate here is how the immersive qualities of the television did not ensure what the remote pilot saw as the target. To the contrary, what would be seen through the television screen relied on the involvement of the operator and the target he expected to strike through the drone's camera relay.

The Army report also suggests the significance that has been given to a particular conception of targeting. Success of the "robot" flight was evaluated according to whether the weapon struck the Helgoland submarine pen, asking whether the pilotless B-17 hit its aim. No indication was given of the number of lives taken by the mission. Given the damage to the barracks, it is likely a number of people were killed. Of the twelve “War Weary” missions that flew B-17s by television control in 1944, only one hit its proposed target, a German oil refinery. The Army concluded:

> The results … were not satisfactory as far as damage to enemy installations is concerned. However, these missions were in the nature of experimental missions, and have proved the value and serviceability of the weapon and equipment. The failures [though] can be chiefly attributed to weather, with some personnel failure, and in two instances, the possibility of equipment failure.[67]

Targeting, in the Army’s evaluation, took two different forms. The “War Weary” B-17s were not successful strategically. As the report indicates, the results were unsatisfactory. Yet, the Army concluded the missions did prove “the value and serviceability”[68] of the television control system. As an experiment, the television system was functional, even if this form of targeting would not be used in warfare as such for several decades. Failures associated with the project are variously ascribed to the weather, personnel and equipment, which variously intervene in the missions. Unmentioned in this report, although discussed in others and still analyzed today, are the deaths that corresponded with the “possibility of equipment failure.” Two volunteer Navy pilots, Joseph Kennedy and Wilford Willy, were killed during earlier tests, after the bombs onboard the aircraft detonated before they were able to parachute out of the plane. As discussed previously, the role of the “safety pilot” onboard remotely controlled planes carried with it high risks and these deaths were among those of many pilots who died in testing experimental aircraft. These factors complicate straightforward distinctions between hitting or missing the target, whether the equipment succeeded or failed, or if the drone changed how warfare was waged. Like the disjuncture between the two reports of the attack on Helgoland, the drone aircraft can be seen as both hitting or missing the target, while the overall evaluation indicates both the drones failure and potential.

While the Army Air Corp tested the television guidance system with B-17s in Europe, the STAG-1 based in the Russell Islands campaigned for the chance to use the television assault drones in the Pacific. Instrumental in setting up the combat test for the TDR was Robert F. Jones. After commanding a target drone utility wing, VJ-3 beginning in 1937, he was eventually chosen by Commodore Smith as his second-in-charge. Fahrney takes up the story in his manuscript, explaining how Jones used the “Service Test of Assault Drone” to convince commanders to deploy the weapon.

> Jones made a flight to the headquarters of Commander Aircraft in the Northern Somomons on Bougainville and conferred with Brig. Gen. Clauss Larkin … regarding the employment of the guided missiles in strikes against the enemy. After Larkin viewed the films of the [tests] he was convinced suitable targets could be found. Dispatch authority was given by … for a thirty day trial. [69]

STAG-1 carried out bombing missions between September 27, 1944 and October 26, 1944 in the Japanese held Bougainville and Rabaul Islands. The group was split into two teams and the drones were flown in configurations of four. Forty-six TDR-1 drones were launched during this month. Of these, twenty-nine were detonated, while the others failed due to mechanical or weather conditions, as well as anti-aircraft fire. Jones and Larkin construed the project as an overall success; at the time hitting almost fifty-percent of the targets was seen as a strong record. Two TDR struck a lighthouse and six hit a beached ship, used by the Japanese as an anti-aircraft emplacement. Of the remaining drone strikes, "the attacks were difficult to evaluate as in most cases the targets were either barely distinguishable or could not be seen at all from the television screen."[70] As the recollections by Hall in *American Kamikaze* quoted at the beginning indicated, the barely distinguishable details nevertheless were significant.

For the personnel, the unmentioned failed missions were just as memorable as their successes. While the explanation that drones saved pilots' lives was absent in the official discussions of the drone, it was salient for the squadron. Billy Joe Thomas, a control pilot, recalled decades later,

> Yeah, I got shot down once or twice … anti-aircraft fire just brought it down. I didn't have control but the picture was still on the screen, and all of the sudden I was looking straight down and couldn't do anything about it. … If it had been a piloted plane and [I'd have] been shot down, it would have been a funeral.[71]

As the operator of the aircraft, Thomas remembers being shot down, even while in the next part of the sentence, he distances himself from his possible death, recalling how anti-aircraft fire brought *it* down. An alternative movement happens in the next sentence through the image on the television screen. Thomas explains that the picture was out of his control, "he couldn't do anything about it." Yet, he also sees himself at the origin of its perspective, looking straight down. In being hit by anti-aircraft fire, Thomas identified with the drone flight, while distanced from it.

The final sentence of Thomas's recollections is important: he views what would have been his death if he had been onboard the aircraft. Jones's final report similarly highlights how drones could "attack with minimal risk to the pilot and crew." This statement comes back to the ambivalence between drone targets that were framed defensively when they were first developed in the interwar, even though they were premised on early remote-controlled bombs. Jones's report loops these ideas back around, pointing out how the television guided assault drone protected the operators. Yet, these arguments were not enough to continue the project. At the end of the month new assignments were issued for all the remaining personnel and, "all 30 Avenger control planes were placed aboard a barge, taken out to Reynard Sound, and dumped into the lagoon."[72]

Writing to Jones shortly thereafter, Commodore Smith articulates bitterness following the termination of the project. The failure of the project is explained in terms that emphasize the challenges internal to the Navy:

> In time of course, the weapon or its counterpart will arise again … It is not an ending for the idea, that will progress in time – to fruition – the making of accurate robot planes and bombs will be solved in 10 or 15 years following the war; instead of being used in this war, as we strived to do. What a source of gratification for those who stopped us.[73]

The exchange articulates a determinism that Smith thought guided the technology he spearheaded, undermined by opposition, not from war, but internal "enemies" against the project.

The dismissal of the project is exemplified through comments made by Vannevar Bush, former director of the Office of Scientific Research and Development in World War II. In a 1947 letter he wrote, “We do not need to go into this fiasco in detail. It is an illustration of what can happen when military requirements are written by enthusiasts of little grasp.” In my rendering though, destinism and divisiveness are both produced by the drone, staging multiple, changing iterations of us versus them, flight and failure. Target drones simulate enemy aircraft, demonstrate the failure of anti-aircraft defenses in experiments, are targeted by new tactics and ordinance, become guided missile for strategic targets, stand in for suicide bombing missions, attack enemies and defend lives of naval aviators, even while the programs allowing for these incongruities were cancelled.

Peter Galison’s proposes that the circuit between humans and machines, articulated by Norbert Weiner’s attempts to build an anti-aircraft predictor during World War II, established a “cold-blooded machinelike opponent”[74] and shaped “an image of human relations thoroughly grounded in the design and manufacture of wartime servomechanisms and extended, in the ultimate generalization, to a universe of black-box monads.”[75] He explains this relation as a new ontology of the enemy, which he ties to a critique of cybernetics. In the same period, drones take a position similar to Weiner’s anti-aircraft predictor. They are a simulated mechanical enemy, on the one hand, and also designed as guided weapons that will strike enemy targets. The drone in this way sets out a socio-technical process parallel to Weiner’s anti-aircraft predictor. I use the choreography of its parts in the drone missions in 1944 though, to re-examine the model of enemy Galison argues is created. Drones intimate the enemy, aviator and robot, trouble the frameworks of defensive and offensive operation, and are both distinct from and intimately connected to the operators that guide them to their targets.

Galison distinguishes the enemy he accounts for from two other versions, a barely human Enemy Other, often aligned with the Japanese, associated with “lice, ants, or vermin to be eradicated”[76] and the target, “an anonymous object of air raids.”[77] Drones connect these enemies – they are servomechanisms, targets, and the Enemy Other, a technical analog to a suicide pilot. The logic of the enemy the drone choreographs multiplies distinctions between “us” and “them.” As an experimental assault weapon, the drone is positioned as analogous to kamikaze attacks, while the same system allows the remote pilots to “watch” their deaths on the television control screen and, in so doing, live. In World War II, these varying uses both function and fail (not unlike Weiner’s anti-aircraft predictor), producing an enemy target that is not premised on machine-like dualism, but an onscreen image that is, at once, close and distant.

Undoing Drones: Fahrney’s History of Guided Missiles

Delmar Fahrney, Commander-in-Charge of radio controlled aircraft beginning in 1936 and after World War II, and first commander of the Naval Air Missile Test Center in Point Mugu, California was central to the changing choreography of the drone as target and the drone as targeting system. He oversaw the radio controlled target planes given the code name drone, as well as early efforts to build the television guided assault drone. Today, military accounts of unmanned aircraft describe the pilotless planes developed under Fahrney as a predecessor to current unmanned combat air vehicles.[78] During his lifetime though, he struggled to gain acknowledgement for the projects. Fahrney’s efforts were only recently linked with unmanned aircraft vehicles, a military designation that emerged after 1987. In the early 1980s, when

Fahrney made a last attempt to promote his role in innovating warfare, pilotless planes were unimportant and he thought of the assault drone he had developed as a predecessor to the cruise missile.[79] The byline for Fahrney's article "The Birth of Guided Missiles," published in December 1980 in the Navy's *Proceedings*, is telling in this regard. The text evokes the operation of contemporary drones even as it situated the radio controlled planes as missiles.

> These were the pioneers. Led by Lieutenant Commander Fahrney […], a small group of naval officers, enlisted men and civilians demonstrated that radio-controlled, pilotless airplanes could attack moving targets at sea. The drones weren't called guided missiles then, but – argues the author – that's where guided missiles got their start.[80]

The passage describes how radio-controlled, pilotless aircraft were used to attack moving targets, which makes the statement "drones weren't called guided missiles" read as an anachronism; today, drones are, as they were in 1944, remote-controlled systems used for targeting. This would not have been the case in 1980 and in the article Fahrney argued drones were the first guided missiles.

Missiles however are typically tied to early rocketry, even though both the Army and Navy classified remote controlled assault drones as guided missiles during World War II.[81] After World War II, Wehrner von Braun and other German scientists collaborated on the development of many of missile systems built by the United States during the Cold War. These systems were rockets and used internal guidance systems, based on inertial or astral measurements, for navigation. They were maneuvered through a guidance system internal to missile, rather than radio and television controls I have discussed. Fahrney maintained his contribution to missiles was remote guidance, namely the control systems used by the Navy for the assault drones tested in 1944. This view went against the expectations for Cold War missiles. On March 12, 1981, Fahrney wrote to John Newbauer, editor of *Astronautics and Aeronautics*. He seized upon a recently published article in the magazine about a Navy colleague to promote drones developed under his command and their place in history. He wrote in the letter, "It is not too late … to set the record straight; that the U.S. Navy and not the Germans developed the first successful guided missiles – most historians point to the V-1 and V-2 missiles as ushering in the guided missile era and they had no guidance systems."[82] The letter to Newbauer makes no mention of his pioneering work developing pilotless aircraft. Rather, he explained his credentials by writing,

> After I retired as the first Commander of the Naval Air Missile Test Center at Point Mugu in Nov. 1950, I was awarded a … contract …to write the history of guided missiles – the project took more than two years covering trips to England to review their confidential files, the captured German and Japanese files, Army Air Corp files and [Navy] BuAer and BuOrd and CNO files. Out of tons of material we selected 120 volumes of pertinent letters and documents arranged according to chronological order from which I wrote a history of 1600 pages in 16 chapters.[83]

The "120 volumes of pertinent letters and documents," as well as the 1600 page manuscript, are at the National Archives, and are known as the "Collected Records of D.S. Fahrney." The claim he makes in "The Birth of Guided Missiles," "the rudiments of remote control and guidance, so vital to the missile art today, were conceived and developed in the early guided missile programs,"[84] similarly, underwrites the manuscript. In my reading, I have multiplied the strands of Fahrney's argument. I come back to his claim to have built the first guided missile in order to further complicate the ontological choreography of the drone.

The prevailing attitude toward Fahrney's claim the first assault drones were guided missiles is highlighted in the response he received from the editor of *Astronautics and Aeronautics*. In a short letter to Fahrney dated March 20, 1981, which I have quoted in its entirety, John Newbauer writes:

> I read your article in January, and it made me think you ought to read Leslie Simon's "The German Research Establishment," a two-volume soft-bound publication that carried a "Restricted" classification in 1952 at the NOTS technical library. It probably still resides there if nowhere else. Some of your claims seem reasonable, but others off the mark. After you read Simon's report, perhaps you would like to publish a critique of your Proceedings article in A/A. Please let me know how you do.[85]

Fahrney responded to Newbauer six days later in a letter dated March 26, 1981:

> I very much appreciated you letter forwarded to me by the U.S. Naval Institute which is the first comment I have received which lends the impression that some of my claims in the "Proceedings" article might be "off the mark" when compared with facts set down in Leslie Simon's books entitled "The German Research Establishment." Unfortunately, I have not seen Simon's work and therefore cannot determine wherein I may have made a claim that could not be supported by facts. [86]

Later in the letter, Fahrney explained that he "submitted 18 copies of the manuscript"[87] to the Navy and in the files, "are the replies I received from Von Braun, Wagner, Lusser, and Kramer for the German effort and from England, Sir Alwyn Crow and G.W.H. Gardner."[88] I found no further record of correspondence between Fahrney and Newbauer. In January, 1982, *Astronautics and Aeronautics* published an article by Fahrney though, "The Genesis of the Cruise Missile." It modified the assertions made in the earlier article, but it is not a critique. In the first article, "The Birth of the Guided Missile," Fahrney wrote, "It is not generally known that the world's first guided missile was designated, fabricated and tested in the United States more than two years before such a development occurred in Germany."[89] The *Astronautics and Aeronautics* article stated, "The cruise missile, in form and substance, was evolved and creditably functioning in the closing months of WWII as a part of the pilotless-aircraft program carried out by the Navy's Bureau of Aeronautics."[90]

Writing the *Proceedings* and *Astronautics and Aeronautics* articles in the early 1980s, when the shift to cruise missiles was already perceptible to those privy to political and technological changes occurring in the Department of Defense, Fahrney gained some recognition for his work. This was not the case when he wrote his manuscript in 1957 and ballistic missile development was at its height. In another series of letters, Fahrney writes to Rear Admiral Paul Stroop, Chief of the Bureau of Naval Weapons from the United States Naval Hospital in Philadelphia on November 28, 1960. The Bureau of Naval Weapons had merged the Navy's Bureau of Aeronautics and Bureau of Ordinance two years earlier and was charged with overseeing the procurement of naval aircraft and aerial weapons. In the letter to Stroop, Fahrney expressed concern about the history of guided missiles he had written in 1957. He explained, "I have had a lot of time to think about many things and one of my recurring thoughts concerns the status of the history of guided missiles."[91] In the letter, he acknowledged,

> It is, of course, abundantly clear to you that I have a very personal interest in the publication of this history because of the part I played in the pioneering effort: but I must submit that I am more concerned with an early presentation of the Navy's distinguished position as the precursor of a new and vastly important era of weaponry.[92]

Replying to Fahrney's letter, Stroop writes, "With regard to your question concerning the history of guided missiles, a number of factors have kept us from making progress … the Naval Institute after examining your manuscript felt that they were not in position to do the necessary rewriting."[93] A review of the manuscript by Lee Pearson, technical historian for the Navy, is more straightforward. He explained,

> Admiral Fahrney and I had a frank and friendly discussion of the problems involved in getting his manuscript prepared for publication. … Although we never discussed it, I gained the impression that our basic point of divergence is our differing estimates as to the quality of the manuscript he prepared – He considers it needs only an editorial 'cleaning up' while I feel much additional research, evaluation and a complete rewriting is required.[94]

Later in the memorandum, in a discussion of the possibility that a "popular history' might be published based on Fahrney's text, Pearson noted, "the manuscript, except insofar as it is classified, is probably in the public domain. … (Because of its poor quality, we are trying to classify the manuscript administratively as for 'Official Use Only'.)"[95] The efforts to keep the document classified were successful. The National Air and Space Museum has an incomplete copy of the manuscript, which leaves out chapters from the interwar period and beyond.

What is at stake in the claim that Fahrney's manuscript is of "poor quality?" Why did it remain classified,[96] even though the material was in the public domain? How does he fail to write what the Naval historian would claim is a history of guided missiles? The 1600 page document is, at times, difficult to read, unorganized and makes claims which prove grander than the evidence offered. As I have already indicated, *The History of Pilotless Aircraft and Guided Missiles* was marked by Fahrney's bias. Much of the material is copied verbatim from the reports it cites, while analysis and comparison of early guided missile projects is limited. Yet, I am not sure that Fahrney's weaknesses as a writer and historian are all that is implied in Pearson's assessment. In the manuscript, Fahrney argues remotely controlled weapon technologies developed in World War II failed not for technological reasons, but because they were not given support at critical junctures by the Navy. Recent innovations re-open the question that is at the heart of Fahrney's manuscript – were the technologies not yet effective for warfare or were they a technical system not yet ready to be received by military and political institutions? While ballistic missiles of the Cold War may have supported the argument that television and radio control were misguided innovations, the video and satellite controlled unmanned aircraft systems central to current military operations indicate how the earlier systems were prescient, regardless of whether they were the first attempts to create systems of these kind.

For me, it is an open question why Fahrney's manuscript was purposefully kept secret –is the work inadequate or had the history of unmanned aircraft had not yet found an audience? Later in his response to Fahrney, Admiral Stroop wrote, "I have given careful thought to your suggestion that a renewed effort be made to obtain recognition for the Navy's pioneers in the field of guided missiles."[97] Yet, citing the Navy's "stringent controls" with regard to such recognition, Stroop suggested this was unlikely and reminded him innovators who had insisted aircraft would be essential to naval warfare in the twentieth century had likewise been overlooked. At the end of the paragraph, Stroop observed, "It might be that the fresh look at the basic achievements which we will have when your history is rewritten, will provide a new approach to this problem."[98] In this remark, Stroop indicates how history writing ties to how acknowledgement is accorded and problems are approached. The re-writing of the Fahrney's history – his efforts to the contrary – has been occasioned by the present. In this way, Stroop's remark might be taken as comment on how analysis of early drones "provide[s] a new approach" not to the question of who should be credited for the innovation, but the more basic question of what drones and how they operate, technically and politically.

Part Two

Unmanning

Chapter 3

No-Body: The Firebee and Unmanning Cold War Reconnaissance

In 1953, photographs of Ryan Aeronautical's Firebee drone were made public for the first time. Having won a competitive contract from the Department of Defense to produce jet-powered target planes in 1948, the project had been in development for five years when the formerly-classified project appeared in aeronautical trade journals and the company's magazine. Firebee targets were designed to train surface-to-air and air-to-air defenses, replacing drone targets built during World War II. [1] Like their predecessors, the Firebee mimicked attack aircraft, although they now replicated the increased speed of jet planes. These air vehicles would also be developed for reconnaissance missions, changing the scope of drones. Images circulated by Ryan Aeronautical from 1953 show the Firebee drone flying over New Mexico, the iconic White Sands Desert and Organ Mountains in the background. The caption, written by an industry publicist and pasted on the back side of the photograph (figure 8), read: [2]

> Speeding on its lonely way over the desolate sands of New Mexico, the Ryan 'Firebee' pilotless drone presents a spectacle as eerie as an uninhabited missile from another planet. Linked with human intelligence by electronic radiation, the obedient Q-2 responds to commands from a remote-control ground station until its fuel is exhausted and an ingenious parachute recovery system brings it back to earth.[3]

The bulbous head of the pilotless plane, squat shape of its fuselage and short wingspan all distinguished the aircraft from drones that came before and manned aircraft of the time. Unlike earlier drones tested by human "safety pilots," the Firebee was designed without a cockpit and no human ever flew onboard. [4] The caption portrayed the drone "as an uninhabited missile from another planet," attributing alien-like qualities to the unmanned aircraft. Using the military designation, Q-2, it was also obedient, responding to transmitted commands, establishing a contradiction with the drone's "lonely" flight over the "desolate" desert. [5] Remote operators were linked to the aircraft by "electronic radiation" and "intelligent" signals, although they were invisible in the photograph. The image and caption set out the contradictions that underwrite unmanned aircraft: alien and human controlled, lonely and obedient, like an uninhabited missile and earthbound, nonetheless. I use unmanning, a concept that emerged for drone aircraft in the 1950s, to encapsulate how these ambivalences were enacted, using negation to link together and dissociate humans and nonhumans.

During the 1950s, contradictions found in the Firebee press release were further articulated through changing relations between technology and politics, also part of unmanning. After Francis Gary Powers' U-2 reconnaissance flight was shot down over the Soviet Union in 1960, industry and military advocates of the system would seized on the opposition between "manned" and "unmanned" to promote drones for aerial surveillance. While Powers was imprisoned in the Soviet Union, Ryan Aeronautical engineers and their Air Force promoters argued pilotless aircraft mitigated political risks, providing a technological solution to intelligence-gathering. Despite the linked network of humans and nonhumans drawn together by drone aircraft, unmanned reconnaissance became no-body, a technological replacement for the

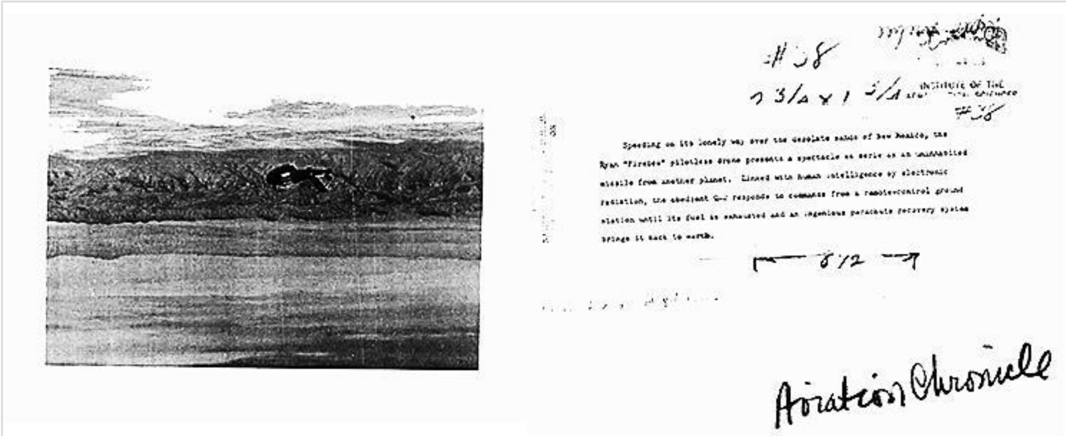

Figure 8. Firebee Drone and Caption. Ryan Aeronautical Press Release. May 21, 1953. National Air and Space Museum Technical Files, Washington, DC.

pilot who might be taken prisoner. Undoing this opposition, I examine what is at stake in the negated relationship: I ask how human and machine were interconnected during the Cold War, even as unmanning elided what was human with machine technologies and vice versa. *Nobody's Perfect,* a humorous promotional film about the breakdowns experienced in experimental test flights by manned and unmanned aircraft built by Ryan Aeronautical troubles the practices of containment that marked this period. Through irony, the film highlighted how separations between human and machine, as well as technology, industry and politics, come undone through ambiguity, failure and disconnection.

"The Bee with an Electronic Brain"

Training missions with Firebee target drones were declassified in 1953, although technical details related to the system remained secret. The Firebee became public through articles, photographs and captions that first appeared in 1953. I supplement these materials with technical reports that were released later, detailing the system's operation. While efforts to build the pilotless targets discussed earlier were documented by Delmar Fahrney's monthly reports to the Navy's Chief of the Bureau of Aeronautics, the Firebee relied on a new model of military-industrial relations. As such, materials about the Firebee come from an archival collection devoted to Ryan Aeronautical. Alex Roland explains how World War II transformed how military technologies were built: turning to "contracts with industries and universities, the government commissioned the best technical talent in the country and built up research infrastructure around them."[6] In the 1950s, these relationships were amplified. Military industries and universities in the United States lobbied directly in Washington for defense contracts and to promote their technological achievements. Articles about the Firebee linked the defense contracts held by Ryan Aeronautical to domestic politics and economics, promoting the technical developments as distinctly American, even as Firebee targets uniquely countered foreign enemies.[7] These associations between military and industry were iterated through the drone's name. William Wagner, former Vice-President of Public and Personnel Relations at Ryan Aeronautical writes in *Fireflies and other Unmanned Aerial Vehicles* that the "designation of the initial Q-2 drones as 'Firebees' combined the prefix of 'Fire' (from the Ryan FR-1 'Fireball' Navy Fighter) with the 'bee' drone insect description."[8]

President Dwight Eisenhower identified the military-industrial complex in a speech given in 1961, three days before he left office. [9] He warned:

> This conjunction of an immense military establishment and a large arms industry is new in the American experience. The total influence – economic, political, even spiritual – is felt in every city, every State house, every office of the Federal government. We recognize the imperative need for this development. Yet we must not fail to comprehend its grave implications. Our toil, resources and livelihood are all involved; so is the very structure of our society.[10]

Connections between military and industry in the Cold War, as well as their influence in multiple spheres of American life, as other commentators have noted, were paradoxically tied to changes that came about under Eisenhower's administration.[11] While the directive to maintain a permanent military mobilization came under Harry Truman's administration, the push for new war technologies during a presumed peacetime was furthered by events during Eisenhower's presidency, including hydrogen bomb tests by the United States and the Soviet Union, as well as the launch of the first satellites. Reconnaissance also became a key strategic measure during his administration. Technical research was proposed to counter Soviet developments, as well as monitor military activities worldwide, generating links between military, industry, universities, and Congress. In the process, technology became a justification for development unto itself. Roland observes: "The test of a weapons system was not its parity with the weapons systems of enemies or potential enemies but rather parity with the next generation of weapons systems that industry could envision."[12] The drone, which both simulated enemy targets and later served as a reconnaissance system to survey enemy territory, was a particularly poignant example of the ambiguity between technological threat and solution.

"The Bee with an Electronic Brain," (figure 9) published March 15, 1953, lauded tests of Firebee target drones in *Ryan Reporter*, a magazine published by Ryan Aeronautical, the company that designed and built the aircraft. With the bravado of self-promotion, the article noted, "The spectacular Ryan 'Firebee,' from which the curtain of secrecy was recently lifted by the Department of Defense, is America's newest turbo-jet, pilotless target drone, capable of near sonic speeds at high altitudes."[13] The sub-heading for the article read, "Ryan's Firebee, America's newest turbo-jet pilotless target, duplicates performance qualities of jet planes in combat over Korea."[14] The Firebee was American, even as it mimicked enemy jet planes, central to how the drone performed as a technology. The article described the Firebee: "Responding to ghost like controls that may be miles away, Ryan Firebee flashes across the sky, ready to simulate fighter plane tactics in sharpening anti-aircraft defenses."[15] In the passage, a passive controller -presumably a human being - is figured as a phantasm, motivating the response of the Firebee flashing across the sky. The reader was invited to see the drone *as if* it responded to the environment directly, even while the image and text invite contradictions between the desert landscape of New Mexico and a more distant one, invoked through ghost-like human control and the conflict in Korea implied by the article. "The Bee with the Electronic Brain" registered ground control as at once distant and disembodied, even as the Firebee apparently acted on its own.

The jet-powered target drone emerged as military aircraft developed during World War II became obsolete through the speed and power of jet engines. The Firebee target anticipated high-speed aircraft being built to fly faster than the speed of sound, calling for increased responsiveness by air defense forces. Yet, the drone also changed how pilotless aircraft were operated. Human pilots never tested the Firebee, rather the drone aircraft were from the beginning designed and engineered to be unmanned. This new sense of the Firebee was captured by the title, “The Bee with an Electronic Brain.” Not only was the drone aircraft likened to an insect, the electronic brain suggestively indicated the machine was capable of its own responses. The article explained that the drone used a “small black box containing a control stick and switches to govern engine speed and other flight conditions, and to transmit control signals to the drone.”[16] A black box, not the human controller, organized electronic transmissions sent to the drone, “governing” the mechanical functions of the Firebee. The article goes on to say, “By use of the ground remote control station, the “nolo” (no live operator) aircraft can be flown out-of-sight at high altitudes, while other men on the ground track it by electronic devices.”[17]


THE BEE WITH TH ELECTRONIC BRAIN

A "BEE" with an electronic brain signalizes one major phase of Ryan Aeronautical Company's concern with the "push-button" features of future airplane development.

The spectacular Ryan "Firebee," from which the curtain of secrecy was recently lifted by the Department of Defense, is America's newest turbo-jet, pilotless target drone, capable of near-sonic speeds at high altitudes.

Somewhat less than half the size of present-day jet fighters, the "Firebee" has performance characteristics virtually duplicating those of jet planes in combat over Korea. Therein lies its immediate value to the armed forces. By remote control from the ground, it can simulate high-speed, evasive tactics of enemy planes to offer the greatest challenge to the skill of anti-aircraft gunners, training in either ground-to-air, or air-to-air marksmanship.

Remote control commands also operate to recover the "Firebee" after its target run. A specially designed parachute system, integral with the drone, lowers the target without damage to its structure or delicate electronic apparatus, so that it can be used over and over.

The power plant of this clean-lined robot aircraft with sharply swept back wings and tail surfaces is a Fairchild J-44 turbo-jet engine of about 1000 pounds thrust. The engine is six feet long and 22 inches in diameter and weighs 300 pounds. The 1800-pound airframe is approximately 18 feet long with a 12-foot span.

Scores of successful flights have been made by the "Firebee" over the New Mexico desert while it was a secret project of the Air Force, Army and Navy at Holloman Air Development Center, Alamogordo, N.M. during the past two years. Technical cognizance of its development was held by the Air Force's Air Research and Development Command and Wright Air Development Center.

Push-button heart of the "Firebee" project is a small "black box" containing a control stick and switches to govern engine speed and other flight conditions, and to transmit command signals to the drone. By use of this ground remote control station, the "nolo" (no live operator) aircraft can be flown out-of-sight and at high altitudes, while other men on the ground track it by electronic devices.

Launchings of the "Firebee" have been successfully performed from the ground as well as from the belly and wings of twin-engine "mother" planes at Holloman ADC. Then it streaks ghostlike over the countryside, eerily obeying commands transmitted miles away.

Early in the "Firebee" project, it became apparent that its fullest utilization would depend on a practical recovery system. Hence Ryan and Air Force technicians developed a two-stage parachute deployment to decelerate the drone from speeds up to 600 miles an hour and lower it safely to the ground (RYAN REPORTER, Feb. 1, 1953). Activation of the parachute recovery system does not always depend on a command from the remote control operator. The smaller "drag" chute and the larger main chute

(Continued on page 16)

Ryan's Firebee, America's newest turbo-jet, pilotless target duplicates performance qualities of jet planes in combat over Korea

1. Streaking off "on its own" over the New Mexico desert, Ryan's spectacular "Firebee" pilotless jet-propelled target drone is shown at the instant of its release from belly of B-26 "mother" aircraft.

2. Responding ghost-like to controls that may be miles away, Ryan "Firebee" flashes [illegible] sky, ready to simulate fighter plane tactics in sharpening anti-aircraft defenses.

3. At the end of a target flight, the "Firebee" can be recovered undamaged for further use by a parachute system which decelerates drone from near-sonic speeds, and then lowers it gently to earth.

12

13

Figure 9. “The Bee with the Electronic Brain.” *Ryan Reporter*. March 15, 1953. National Air and Space Museum Technical Files, Washington, DC.

The Cold War drone extended and transformed drone aircraft built in the interwar, moving between the black box and how operators tracked unmanned aircraft from distant ground control units and launch aircraft. The description from “The Bee with an Electronic Brain” echoed themes set out in Delmar Fahrney’s account of the development of the Navy’s drone in 1936, using the term “nolo” to explain the remote operation of the Firebee. Like the earlier use of the term, the authors use it to emphasize how no pilot was aboard the aircraft, although in the case of the Firebee no human would ever be onboard. Further, the Firebee was “flown out-of-sight” and controlled by electronic tracking equipment. Relying not just on radio, the tracking devices used radar and altimeter readings to monitor the aircraft. The operators’ relationship to the drone no longer acted through the extension of human sight, either through line-of-sight radio control or television, and instead was relayed through electronic information graphed on control screens or heard as radar signals. There is no body in these relations – the pilot is removed from the plane and the human operator responded to electronic signals tracking the drone. Information stretches the distance between the operators and the aircraft, configuring transmissions through a black box and an electronic brain.

The use of the term “black box,” “electronic brain,” as well as a naturalized description of a technological system, all drew from the emergent study of cybernetics in the 1950s. In 1943, “Behavior, Purpose and Teleology” was published and served as a foundational text for the theory, while Norbert Weiner proposed the term cybernetics in 1948. Using the Greek word for steersman, cybernetics, Weiner introduced a multidisciplinary approach to the study of control and communication.[18] Aligning organisms and technologies, cybernetics conceived of both as systems of inputs and outputs, explained through their responses to environments, which articulated animals and machines as “a universe of black box monads.”[19] What I explore, however, was how the monadic unit, governed through inputs and outputs, enabled an elision between human, animal and machine, confusing the question of who or what responded to external conditions. The configurations of feedback not only linked human and machine – it also enabled their dissociation.

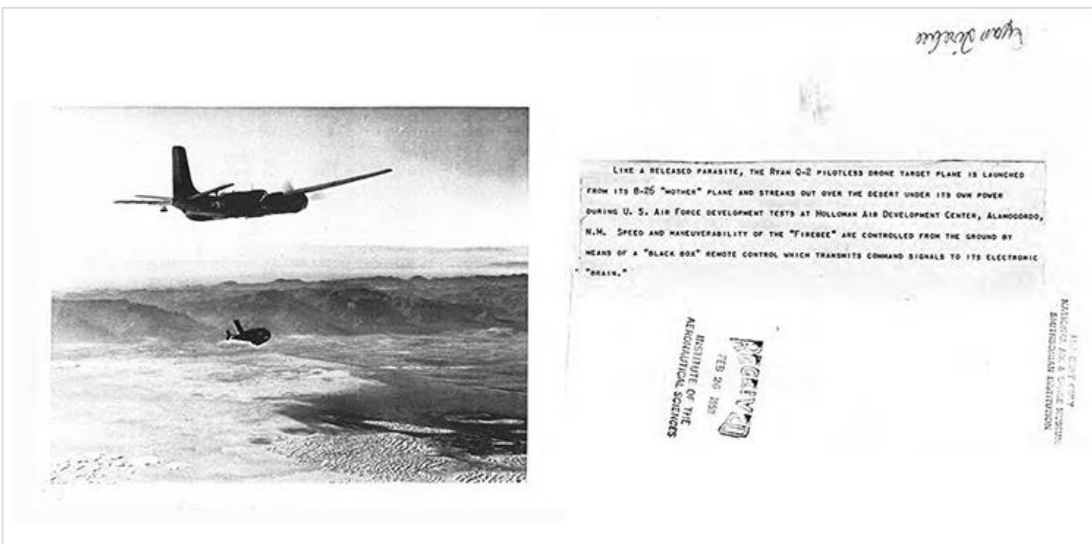

Figure 10. Firebee Drone / Launch Plane and Caption. Ryan Aeronautical Press Release. February 23, 1953. National Air and Space Museum Technical Files, Washington, DC.

Another image and caption, also written by Ryan Aeronautical in 1953, explicitly linked the black box control of the Firebee to the system’s onboard electronic brain (figure 10).

> Like a released parasite, the Ryan Q-2 pilotless drone target plane is launched from its B-26 “mother” plane and streaks out over the desert under its own power during U.S. Air Force development tests at Holloman Air Development Center, Alamogordo, N.M. Speed and maneuverability of the “Firebee” are controlled from the ground by means of a black box remote control which transmits command signals to its electronic “brain.”[20]

The caption presents the drone as at once a parasite, a bee and a baby. While it was commanded by the black box controls, the signals were captured through an electronic brain and the Q-2 "streaks out over the desert under its own power." The dependency between controller and controlled might be thought of as a parasitical relation. Unlike the drone target built by the Navy in 1936, the Firebee could not take-off or land. Rather, the system was either catapulted from the ground or released from pylons on a converted cargo plane and landed by parachute. The dependence of the drone on other aircraft, as well as its inability to perform what might be taken as the most basic functions of manned aircraft, are also implied in the drone's likeness to a parasite. After presenting the drone as a parasitical technology though, the next part of the caption tied the Firebee to the desert below. Written in the passive voice, it describes how a black box, not a human operator, transmitted command signals to the drone's electronic brain. Here, the reader is invited to think of the drone as behaving in response to inputs and outputs, transmitted from the ethereal landscape. The human was disembodied, figured instead as transmitted signals, while the drone, after being released on its own, responded to these commands through its "electronic brain." The dependency implied in the first sentence of the caption is cycled into the cybernetic operation that occurs in the second sentence. Responding to the inputs the Firebee parasitically uses, the aircraft streaks across the desert, *as if* its flight were a response to the environment.

In "Behavior, Purpose and Teleology," the authors distinguished between purposeful and purposeless behaviors in part to trouble tool-like understandings of machines, noting, for example, that a gun could have a purpose or be made "deliberately purposeless,"[21] in the case of random shooting. The text explained the gun's actions as a behavioristic response, triggered by context. In the next example, the authors observed "a torpedo with a heat-seeking mechanism,"[22] might be "intrinsically purposeful," as its response was always guided by its reaction to heat. Cybernetics described action relationally, occurring between object and environment. While human, machine and animal are all likened by this model, interactions, and not inherent attributions, guide the theory. In the Firebee, the black box transferred information between operators and the drone. This interaction was displaced by the drone's movement across the sky though, which seemed self-propelled.

"Black boxing" has been widely discussed in science and technology studies, although its use differs from the cybernetic system of inputs and outputs described above. The framework for the concept was laid out by Donald MacKenzie. He defined the black box through a quote by Charles Draper, founder and director of the Massachusetts Institute of Technology's Instrumentation Laboratory. Draper explained the black box was an ideal arrangement of a self-contained unit that would not be affected by external conditions. "Behavior, Purpose and Teleology," on the other hand, explained organism and mechanism as monadic units responding to their environments through inputs and outputs. In this case, the black box was not self-contained and instead a system for organizing information. The first definition of black box includes an example from an *Aeronautics* article written in 1932: "For the sending of control messages, there is located on the destroyer a little black box,"[23] explaining a black box is a "device which performs intricate functions but whose internal mechanism may not readily be inspected or understood; (hence) any component of a system specified only in terms of the relationship between inputs and outputs."[24] What is important about these black boxes is that they do not propose the self-containment that Draper emphasized. Rather, the black box was a locus for exchange albeit one in which the internal workings of the mechanism remained hidden.

For MacKenzie, the more specific meaning proposed by Draper ties to a broader definition of the black box, which has been adopted by science and technology studies: “It is a technical artifact – or, more loosely, any process or program – that is regarded as just performing its function without any need for, or perhaps any possibility of, awareness of its internal workings on the part of users.”[25] MacKenzie comes to this definition by showing how the guidance system invented by Draper troubled the idea of an apparently self-contained system, arguing the guidance technologies were inextricable from the social, scientific, military and political conditions that made its development possible. Extrapolating from this analysis, MacKenzie writes that “the more deeply one looks inside the black box, the more one realizes that ‘the technical’ is no clear-cut and simple world of facts isolated from politics.”[26] The black box controls I analyze on the Firebee, however, did not rely on a self-contained configuration to isolate the technical from the political. Rather, the black box linked human input and machine output by combining the two into a singular unit, which displaced human control onto the action of the organism-like machine and vice versa.

The Firebee acted *as if* it responded to its environment, even though examination of the inputs and outputs shows this feedback loop conflated human and machine to produce these reactions. The 1953 press releases provided few technical specifications for the system, which I draw instead from a declassified presentation, “Firebee I – A Case Study in Pilotless Aircraft Evolution,” written by Ryan Aeronautical engineers C. T. Turner and G. R. Cota, released with permission of the Air Force in 1981. “Firebee I” explained the original Q-2 flight control system, developed after Ryan was awarded the defense contract in 1948 for the jet-powered target drone, responded to five radio control commands – (1) climb, (2) dive, (3) right and left turns, (4) straight and level, and (5) engine rpm increase-decrease to control airspeed.[27] With only five commands, the radio controls were simpler than systems developed by the Navy during the interwar using a telephone dial. Yet, operating at high speeds, the jet-powered drone flew faster and farther than previous systems – out of the range of human sight. In the early test flights, the controller easily stalled the drone because there were no visual cues for operating the aircraft. This led to modifications implied in “The Bee with the Electronic Brain.” “Firebee I” explained how engineers pre-programmed the engine power and speed of the drone to correspond to certain climb and dive rates, which made it more difficult to stall. While the control box would send the signals to maneuver the aircraft, the speed and pitch associated with these changes would be automatically set through programmed responses, i.e. an “electronic brain.” The Firebee responded both to the input of the operator, as well as to its own pre-set controls.

Returning to “The Bee with an Electronic Brain,” the article explained the “push button heart of the Firebee project is a small ‘black box’ containing a control stick and switches to govern engine speed and other flight conditions, and to transmit control signals to the drone.”[28] Here, the black box functioned to organize the inputs and outputs between human and machine to set up the behavior of an apparently singular unit. Described as “the heart” of the Firebee, the control unit linked the output of the drone, “any change produced in the surroundings by the object,”[29] to the input, “any event external to the object that modifies this behavior in any way,”[30] relayed by radio transmission from the operator. The black box created a cybernetic system, even as the control unit, which linked human and machine, undid the singularity of the model. Further, the pre-programmed “electronic brain” added another layer of feedback, automatically stabilizing the response of the aircraft to the input of the controller, as determined by calculations set out beforehand. The drone’s responses were tied to programs and signals, which layered together human and technical action, even as the Firebee apparently "streaked out" across the sky on its own.

The black box controls of the Firebee organized human and nonhuman behaviors through a cybernetic system, even as the "black box" was used to separate human control from technological action. The elision of human engineering, design and control with a behavioristic model of technology provided the conditions for the concept of "unmanned" to emerge, which highlighted the difference between piloted and remotely operated aircraft, even though both relied on interactions between human and machines. Langdon Winner offers an early critique of science and technology studies, writing that despite the "colorful array of social actors, processes, and images therein, the box they reveal is still a remarkably hollow one," leaving one with a better understanding of the black box, little more. [31] Working through the black box of the Firebee, I emphasize less the self-containment produced by the black box and turn instead to how it aligned, connected and elided humans and machines. I respond to Winner's critique not by dissecting what was inside the black box, but analyzing how it was entangled with the mobilization of technology for political aims during the Cold War. Working from the organization of the cybernetic black box, I use the inputs and outputs to extend from the model of control used to operate the Firebee to its use for "unmanned" reconnaissance in 1960.

Technical Evolution, Technological Capabilities and the U-2 Incident

Lieutenant Colonel Lloyd Ryan, Deputy to the Chief of the Reconnaissance Division at the Headquarters of the United States Air Force, recalled being in the basement of the Pentagon in 1959: "we were discussing what we would do if and when a U-2 was shot down."[32] Ryan considered the matter with his commander, Colonel Harold Wood, over the next several days, and a possible solution was proposed during a visit by Ray Ballweg, vice-president of Hycon, manufacturer of the camera system aboard the U-2. Bellweg suggested the Air Force use drones for reconnaissance. Ryan recalled "our response, Hal Woods and mine, was, 'what drone?' We didn't know anything about drones."[33] At the time, Ryan Aeronautical supplied jet powered target drones to the United States Military, having won a design competition in 1948 for ground-to-air and air-to-air targets that operated at high subsonic speeds. The following year, Robert Schwanhausser, hired by the company after serving as an Air Force project engineer for the Firebee program at Holloman Air Force Base in New Mexico between 1952 and 1954, was placed in charge of the reconnaissance drone program. When he began working on the project, Schwanhausser met with Lloyd Ryan: "He was down in Reconnaissance Operations in a little cubicle. … He said if you could do this, this and this, I think we can put something together."[34] With coaching provided by Ryan and Bellweg, Schwanhausser and a team of nine engineers over the next three months would set out plans for a working prototype of a reconnaissance system based on the Firebee.

This account of the emergence of the drone reconnaissance program returns to relationships between military and industry discussed at the beginning of the previous section. It also notes how the sensitivity of U-2 flights to Soviet air defenses was anticipated within the military reconnaissance community. For Ryan and Woods, it was a question of time before the aircraft was shot down. Their internal discussion contrasted with the international crisis that followed Francis Powers's capture as a prisoner on May 1, 1960, news that surprised most people in the United States and rest of the world. The disjuncture between what was known and by who also played out in the decision to begin building a reconnaissance drone. Within the military, Ryan and Woods did not know about the target aircraft. Rather, the idea was suggested by Ray Bellweg, an industry representative, who secured a Hycon contract to build the cameras for the drone reconnaissance system in the process. Bellweg contacted Ryan Aeronautical, which led to Schwanhausser's appointment as project manager for the new program. Ryan Aeronautical, however, would not have known about the vulnerability of U-2, at the time, a highly classified program. Ryan would have indicated how to address this in the technical specifications set out for the project. Schwanhausser presented a proposal to the Air Force about the possibility of using an unmanned reconnaissance system two weeks before Francis Powers's U-2 was shot down. Shortly thereafter, Ryan Aeronautical received its first exploratory contract to develop unmanned reconnaissance.

The account told by Ryan and Schwanhausser differs from the analysis given in "Firebee I – A Case Study in Pilotless Aircraft Evolution," a 1981 report that analyzed the technical changes that motivated transformations to the Firebee throughout the Cold War. "Firebee I" examined the multiple uses of the Firebee not just as a target, but also as a reconnaissance system to collect photographic and electronic intelligence. The interactions between military, industry and global politics are conspicuously absent in the report. Rather, "Firebee I" framed the drone's development as a self-propelled, technical evolution. "Firebee I" starts with the specifications that were set out by the inter-agency competition that led to Ryan's defense contract for the Firebee in 1948. In order of importance, the new drone aircraft were to have: (1) a subsonic speed, .832 Mach, (2) endurance of over 30 minutes and (3) an altitude capability of 40,000 feet.[35] Consequently, engineers designed the Firebee with a compact body and short wingspan for speed. The authors note this posed challenges later on, when the use of the drone shifted from a target plane to a high altitude reconnaissance system. Modifications were explained through changes to the system's engineering – for example, lengthened wings, which increased the altitude capacity of the aircraft, a design change that stood in for its new military function as a reconnaissance aircraft. The drone was built through five major subassemblies: nacelle, wing, fuselage, tail cone and empennage. Each assembly, with the exception of the tail cone, was attached with four bolts, making it "easily assembled or dismantled."[36] The authors explain the design was a "simple, strong modular structure,"[37] which was taken apart and pieced back together in the multiple variations.

The authors of "Firebee I" frame transformations to the Firebee as an "evolution" based on shifting modulations tied to the design of the aircraft. They explain:

> The element which, more than any other factor, allowed the Firebee program to survive for such a long period of use was the ability to adapt to new and changing conditions. The total Firebee evolution was not planned. In fact, the growth of the Firebee targets program was like "Topsy" – it just grew.[38]

The authors refer to the "survival" of the drone through a figure of speech, "it grow'd like Topsy." The phrase describes something that grows without design, appearing to increase by itself. "Grow'd Like Topsy" comes from Harriet Beecher Stowe's *Uncle Tom's Cabin: Life Among the Lowly*. In Chapter 20, "Topsy," Miss Ophelia, a New Englander adjusting to the Southern plantation where she has moved, asks Topsy, a young slave girl:

"...Have you ever heard anything about God, Topsy?" The child looked bewildered, but grinned as usual.
"Do you know who made you?"
"Nobody, as I knows on," said the child, with a short laugh. The idea appeared to amuse her considerably; for her eyes twinkled, and she added, "I spect I grow'd. Don't think nobody never made me."[39]

What this exchange iterates is how "nobody" made Topsy, but rather she just grew. In the context of the technical report, the evolutionary growth was attributed to the technology – the program was not designed to expand and, instead, it made itself. Even though the evolution proposed by the authors is distinct from the cybernetic language of the black box and electronic brain in the 1953 press releases (or the question of God's creation raised in Stowe's book), both accounts emphasize the autonomy of the drone and the ability of the machine to respond and develop on its own. "Firebee-I" described the over-two dozen variations of the Firebee as an indication of the system's "survival," based on the modified assemblies internal to the technical system. "Nobody" created the Firebee, and it instead just expanded.

The drones developed in World War II framed the relationship between pilotless aircraft and remote controllers through an "insect-like" network, which linked the action of the operator and aircraft through commands sent by radio. The Firebee transformed these practices by presenting the technology as a machine-like organism. Framing the drone as a system that could be controlled remotely and at the same time operative through a "brain" internal to the technology provided a way of slipping between the role of the human operator, on the one hand, and the responses of the drone, on the other. It is the apparent ability of the technical system to react and respond to shifting conditions that underlie the emergence of "unmanned" aircraft as a political alternative to manned reconnaissance. Reconnaissance projects developed during the Cold War transformed drones from target aircraft to photography platforms that surveyed enemy territory. As the operation of the drone shifted from a "nolo" target to an "unmanned" spy plane, the drone is opposed to the body of the pilot. Exchanges between operator, engineer and machine modulated through the Firebee were characterized as a technical system with its own teleology.

The organization between technology and politics of this period is explored by Paul Edwards. He writes "the phrase 'closed-world discourse' describe[s] the languages, technologies, and practices that together supported the visions of centrally controlled, automated global power at the heart of American Cold War politics."[40] He follows how computers created and sustained such a discourse, through the practical construction of real-time military control systems and a metaphorical understanding of global politics as a kind of system.[41] Edwards observes how the logic of the closed world operated broadly:

> Containment, with its image of an enclosed space surrounded and sealed by American power, was the central metaphor of closed-world discourse. Though multifaceted and frequently paradoxical, the many articulations of the metaphor involved (a) globalism, (b) a many dimensional program with ideological, political, religious, and economic dimensions, and (c) far reaching military commitments that entailed equally far reaching domestic policies.[42]

I examine the closed world through aerial surveillance, which used the Firebee as a photography platform, along with the more well-known U-2 spy plane and Corona satellite program. These practices were framed as strategic reconnaissance and proposed to maintain and build American power through the ongoing collection of visual and electronic intelligence. I emphasize contradictions created through surveillance and open skies, as reconnaissance collection was secretly used to enact closed world strategies it rhetorically opposed. Edwards notes these tensions, pointing out closed world discourse sought to enclose the Soviet Union, which the United States described as a "closed society," and simultaneously aimed to shield capitalist nations from the spread of communism and extend the "capitalist world-system."[43] Underscoring these ambiguities, I ask how contradictions between humans and technologies were variously aligned and opposed in enacting America's Cold War policies, building on the conflation of disembodied human inputs and machine outputs in the previous section.

Uncertainties about the extent of the Soviet Union's nuclear arsenal, as well as the bombers and missile systems that might be used to deliver the weapons, were central to the insecurities that motivated American weapons development in the Cold War, imbricating universities, industry, and the military at an unprecedented scale. A 1951 report noted, "The problem of defense in the United States against air attack is characterized above all by lack of knowledge of what we have to defend against."[44] To the emerging challenge of countering the Soviet Union and the uncertainties faced by his administration, Eisenhower sought answers from the scientific community. In 1954, he commissioned James Killian, President of the Massachusetts Institute of Technology, to lead the "Technological Capabilities Panel." Killian explained the panel was "a technical task force to study ways of avoiding surprise attack by a searching review of weapons and intelligence technology."[45] The still partially-classified report focuses on whether the United States would be able to detect an attack from the Soviet Union, concluding that "there is a real possibility that a surprise attack might strike without useful, strategic early warning."[46] To counter these vulnerabilities, the panel report provided recommendations to the United States government to maintain the offensive advantage it claimed America held over the Soviet Union. The authors explained, "In the succeeding parts of this report, we have sought to point out the places where we need to carry through, to expedite, and to complete currently accepted improvements in our weapons systems which will provide new strength in both offense and defense."[47] The "Technological Capabilities Panel" renewed connections between science and the American government, which had been strained the year before after J. Robert Oppenheimer's security clearance was revoked. Stuart Leslie explains key recommendations of the panel bolstered research efforts at MIT, where Killian was President and, more generally, led to investments in industry and the academy to develop new military technologies.[48] The report, for example, highlighted the role of intercontinental ballistic missiles in future warfare; central to these projects were Charles Draper's previously-mentioned efforts to build a "black box" navigation system at MIT's Instrumentation Laboratories.

The panel's emphasis on technology extended beyond the build-up of arms. Killian selected Edwin Land, the founder of Polaroid to lead the subcommittee on intelligence for the "Technological Capabilities Panel." The subsection devoted to the topic observed: "We *must* find ways to increase the number of hard facts upon which our intelligence estimates are based."[49] As an answer to this call, the report claimed "revolutionary new techniques will be devised to give us facts and answers instead of assumptions and estimates."[50] Six paragraphs, about a half-page long, outlining key recommendations for the collection of intelligence remain classified, as does an entire section titled, “Intelligence: Our First Defense against Surprise.” While the precise recommendations are secret, Land and Killian were instrumental in securing Eisenhower’s approval to build the U-2, meeting with him privately to gain presidential support for the aircraft in 1954.[51] Beginning with this project, the secret worldwide collection of strategic aerial and electronic intelligence became part of the United States’ strategies of military mobilization, after Eisenhower’s “Open Skies” proposal for mutual surveillance was rejected at diplomatic meetings with the Soviet Union in 1955.

Plans to build the U-2 plane were first anticipated by advocates of strategic reconnaissance within the Air Force. The concept was discussed during a conference on aerial surveillance held by the Royal Air Force, the Royal Canadian Air Force and the United States Air Force in 1948. Strategic reconnaissance recommended the on-going, worldwide collection of aerial photography. The concept marked a pointed shift from earlier aerial reconnaissance, which was collected as part of wartime efforts. Instead, the strategy became part of peacetime military mobilization. A key proponent was former reconnaissance airman- turned-Kodak sales representative, Lieutenant Colonel Richard Leghorn. He explained,

> long-range strategic reconnaissance should be employed today as a means of peacetime spying against the Stalinist empire. As mentioned earlier, we are essentially at war even though this war today is limited, and we must have information on the Russian military and industrial system and capabilities, together with knowledge of Russian intent.[52]

The logic of being “essentially at war,” motivated Leghorn’s proposal, as did the uncertainties posed by the “closed” Soviet Union. Aerial surveillance became a strategy to monitor the enemy in a “peacetime” war waged through technological and industry build-up. As I suggested previously, strategic reconnaissance aimed to gain knowledge through containment, mapping onto the ambiguities of the closed world. Leghorn explained “today the Russians can block to a large extent all our techniques for gathering information, except military aerial reconnaissance.”[53] Technology as such would lead to stealth aircraft as “any aerial reconnaissance we conduct over Russia today must be extremely difficult or even impossible to detect.”[54] In 1951, called back to the military as a reservist, Leghorn re-issued his proposal, suggesting not only high-tech aircraft for reconnaissance but also guided missiles and unmanned aircraft. That year, Rand Corporation published a pamphlet on the topic, “Selected Readings in Aerial Reconnaissance.” Yet, Leghorn’s ideas were not widely integrated into the Air Force. Despite working with then-Colonel Bernard Schriever on a blueprint for future intelligence and reconnaissance needs, strategic reconnaissance was not widely pursued until after the “Technological Capabilities Panel,” set up by Killian.

Reviewing the United States’ intelligence capabilities for the “Technological Capabilities Panel” in 1954, Edwin Land seized upon strategic reconnaissance of the Soviet Union as a method to counter a surprise attack by the Soviet Union. He would have been familiar with Leghorn’s proposals, as he was a consultant on the blueprint Leghorn drafted in 1952.[55] Aerial photography would provide “hard facts” that Land claimed were necessary for American intelligence. Land likely came across Lockheed’s proposed U-2 plane, which had been rejected by the Air Force earlier that year while reviewing materials for the report. Even before the “Technological Capabilities Panel” had submitted their review, Land and Killian approached Eisenhower about funding the aircraft. They proposed that the U-2 be flown by the Central

Intelligence Agency (CIA), rather than the military, which they argued would help to secure its peacetime function.[56] Between 1956 and 1960, the U-2 was flown twenty-four times over the interior of the Soviet Union in top-secret missions known only to a small group of Air Force, CIA and scientists, as well as the President. Only four members of Congress were briefed on the flights, which remained secret until 1960.

In 1956, when the U-2 was first flown over the Soviet Union, ground-to-air defenses were unable to reach the aircraft, which flew out of the range of the missiles at the time, even though the flights were detected by radar. The flights were effective in collecting photographs of the Soviet Union, even though they were not undetectable.[57] After the launch of Sputnik in 1957, Soviet missile capabilities improved. Concerns about the susceptibility of U-2 reconnaissance to anti-aircraft missiles were reiterated by official reports by the Air Force and CIA in March of 1960.[58] Both concluded the latest Soviet surface-to-air missile could intercept a U-2 mission. Nonetheless, the CIA continued flights. On May 1, 1960, having received the go-ahead from Eisenhower, CIA pilot Francis Gary Powers took off from a secret American air base in Peshawar, Pakistan. Soviet radar tracked the plane from Afghanistan and the U-2 was shot down while flying over Sverdolvsk. Powers was able to bail out of the U-2 by parachute and was captured, along with what remained of the plane. What had happened to the U-2 was unclear, though, when it failed to arrive at the base in Norway.

Initially, the White House tried to cover-up the spy mission by claiming the U-2 was a weather plane that had flown off course. Soviet Premier Nikita Khrushchev exposed the fallacy of the American cover story by announcing the U-2 pilot was still alive on May 8, 1960. Powers' plight became a central story of the Cold War, which circulated widely within American media and abroad. The incident came just two weeks before Khrushchev was to meet Eisenhower in Paris, along with the leaders of France and England. On the morning of the summit meeting, May 16, 1960, Khrushchev described the spy flights as a "provocative act," and left before the talks began. He declared "we are unable to work at the conference … because we see from what position it is desired to talk to us – under threat of aggressive intelligence flights."[59] The speech underscored the contradictions of the American reconnaissance, which used so-called peacetime intelligence collection as part of its strategy of containment.

Within the United States, the incident did not lead to a reappraisal of the strategy, although Eisenhower did discontinue U-2 flights over the Soviet Union. Rather, the captured pilot was highlighted as a weakness and the pursuit of wholly technological reconnaissance methods gained traction. In the next decade, photographs from satellites and drone aircraft would become operational and while it was likely these methods were also detected as they flew over enemy territory, the systems remained largely secret and brought about minimal public discussion in part because there was no human body.[60] Exemplary of the ways "unmanned" reconnaissance was opposed to piloted flights was Schwanhausser's briefing for the Air Force Reconnaissance Panel at the Pentagon on April 21, 1960. He explained the Firebee could be modified to fly up to 1100 nautical miles at an altitude of 50,000 feet for reconnaissance and told the Air Force, "The use of U-2 manned vehicles for overflights of the territory of nations unfriendly to the United States creates, we believe, risks which are unnecessary to take. We feel there is a solution to this in the logical evolution of the unmanned Firebee drone system."[61] After Powers was shot down, Schwanhausser recalls that "things started to happen very rapidly."[62]

Ryan Aeronautical was given its first exploratory contract during the summer of 1960 for a project known as, "Red Wagon." Central to the early experiments were efforts to make the drone invisible to electronic detection by using non-conductive paint and radar absorbing blankets.[63] A letter from August 19, 1960, to Dr. Joseph Charyk, the Under Secretary of the Air Force, from T. Claude Ryan, the President of the company, outlined how Ryan Aeronautical would manage the program, as well as the facilities and working capital available for the project. While it appeared that everything had fallen into place, the contract that would have continued the project was not approved by the Secretary of Defense, who returned the proposal with a note: "I thought we weren't going in this direction."[64] William Wagner, former Vice-President of Ryan Aeronautical, explained, "More often than not the industry representative works the new project up through the military organizations, often with a green light at every stage, only to find at the top level that the project really belongs to another agency which is more apt to fund the program."[65]

"The logical evolution" of drone reconnaissance that Schwanhausser foregrounded in his presentation to the Air Force was not as straightforward as the claim may seem. While Francis Powers's capture by the Soviet Union in 1960 provided a foil for the project, opposing the risks of manned flights with the advantages of unmanned aircraft, it would take two more years for the project to be funded, as these contracts competed with reconnaissance aircraft and satellites.

Reports internal to the Air Force helped to lay out a position for drone reconnaissance emphasizing differences between manned and unmanned flights. In "Alternative Reconnaissance Systems," a position paper for the Air Force and Department of Defense in 1961, heading the list of gains offered by pilotless aircraft was that they "would assist in gaining Executive approval since the political risk is minimized due to the absence of a possible prisoner."[66] The report goes on to propose that future overflights would be: "Unmanned – for political, diplomatic and public acceptability; decreased detectability due to size; decreased design sophistication; increased operational flexibility; increased security and cover."[67] The Air Force awarded a $1.1 million dollar contract on February 2, 1962 to Ryan Aeronautical for four Q-2C Special Purpose Aircraft (SPA), which would be modified for photo reconnaissance and developed to evade detection by radar.[68] Beginning with this contract, Ryan Aeronautical would produce over twenty-nine versions of the Firebee reconnaissance system over the next thirteen years.

"Unmanning" figuratively negates the role of man, even as engineers, control pilots, industry executives and military decision-makers become increasingly tied not just to the networked operation of the remotely controlled drone, but to how the systems were designed and used politically. Returning to the closed-world discourse examined by Paul Edwards, I contrast the unmanned system with the cyborg he uses as a model. He writes,

> Cyborg discourse collaborated with closed-world discourse both materially, when artificial intelligence technologies and human / machine integration techniques were used for military purposes, and metaphorically, by creating an interpretation of the inner world of human psychologically as a closed and technically manipulable system.[69]

Human and machine relationships during the Cold War were also "unmanned," proposing not the integration of human and machine, but a dissociation between human and machine, articulated through the disembodiment of human control and the supposed autonomy of technology. The term, which replaced “nolo” to describe the operation of pilotless aircraft, points to the dissociation between human and machine, negating what is man, at least in name, while organizing human and machine relations as if they were a singular system.

Nobody’s Perfect

Donna Haraway’s theorization of the cyborg begins with irony, a point often overlooked in writings about her 1985 essay. She writes, “Irony is about contradictions that do not resolve into larger wholes, even dialectically, about the tension of holding incompatible things together. … At the center of my ironic faith, my blasphemy, is the image of the cyborg.”[70] Haraway’s “ironic faith” registers a possible challenge to the human and machine integration otherwise promoted in the article. Unmanned systems contain little of the promise that Haraway promoted in “A Cyborg Manifesto.” Emphasizing how human and machine were connected and negated through unmanned drones, irony in my account plays out in how “nobody” undergirds the technical system.

Described as “the company’s humorous movie, ‘Nobody’s Perfect,’ showing some of the most laughable, though occasionally serious, test flights which went berserk,”[71] the film disrupts the closed loop which elided human and machine through a cybernetic model. *Nobody’s Perfect* shows instead how engineers, remote pilots and military personnel are part of the black box configuration and its failure. Re-playing the countless crashes that occur in *Nobody’s Perfect*, the model of human input and machine output continuously comes apart and both break down. Indeed, the technical failures are humorous, in part, because the viewer thinks no human is harmed. If pilots or crew died in the aircraft crashes, the scenes would be tragic.[72] Yet, human and machine are likened as failures, even while the negative association is disavowed – nobody is perfect. In the end of the film, the company’s engineers are characterized as learning to “bury their mistakes,” which seems precisely what enables the ongoing obfuscation between human and machine action. Contradictions between human and machine, as well as their shared failure, may also point to the ways the false opposition between manned and unmanned might be undone, following instead, how human and machine, together, interact and fail.

The opening sequence of *Nobody’s Perfect*,[73] a fifteen minute, in-house promotional film by Ryan Aeronautical, shows a succession of eccentric, early aircraft: A bouncing, open air flying vehicle with a rotor wing on top, the “Pitts Sky Car,” never achieves lift-off, while the inventor of the ornithopter, a winged flying suit, falls leaping a few feet off a rock. A multi-winged, bicycle powered aircraft, the Gerhardt Cycleplane, collapses on the runway. At the end of the montage, a Ryan Firebee drone explodes as it is launched. In the slowed down shot, the careening drone flips through the sky as the aircraft bursts into flames, and the aircraft flies directly at the camera. The first three clips are drawn from an Army Air Corps film, *Aeronautical Oddities*,[74] a montage of news reel clips devoted to bizarre, experimental aircraft. The Ryan Aeronautical film adds the color footage from the Firebee crash to the sequence and the title of the film appears over the billowing smoke from the explosion. The letter “r” is backwards in the title, referencing both the company and the imperfections touted by the film.

The next shot, the words “Ryan Administration,” are posted on an otherwise anonymous outpost. Unexpectedly, after showing the Firebee in the opening sequence, the film turns to the role of the company in training Air Corps cadets. The voiceover announces: “During World War II, Ryan trained over 12, 000 Air Corps cadets. Training was rigorous. Pre-flight was demanding. They were all very healthy, mentally.”[75] In the sequence of images, uniformed personnel leave the building and are shown marching with what appear to be folders. The background music is a military march, rhythmically organizing the steps of the men. The image cuts to the pilots-in-training doing callisthenic exercises. The beat of the music is interrupted in the next shot by the buzzing sound of an aircraft. In the image, a series of men run through the frame with their arms outstretched like wings (figure 11). The shot comes just as the narrator says, “mentally,” and after they run through the screen the voiceover, pauses “Well, this is where they got their start.”[76]

Figure 11. Pilots in Flight Training (Stills). *Nobody’s Perfect*. 1972. San Diego Air and Space Museum Archives, San Diego, CA.

The first minute of the film brings together the folly of experimental aircraft and an aestheticized crash of the Firebee with the wry humor of Air Corp Cadet training. The human pilots, running in a training exercise with their hands outstretched like wings are presented as not dissimilar from the ostensibly mechanical failures shown in the first sequence. Connections between the breakdown of the human pilot and the imperfection of aircraft are emphasized in the next sequence – a training flight. Upbeat ragtime music plays in the background, while a flight instructor appears to be giving the onboard pilot instructions for a solo flight. He gestures into the distance and cleans the pilot’s windshield. The voiceover says, “We figure they reached the peak of their proficiency at about this time,”[77] as the aircraft taxis down the strip. The aircraft lifts slightly off the ground and falters, wavering just above runway below. The plane bumps up and down, while the shot cuts to the flight instructor who hopefully awaits lift-off. Continuing, the narrator explains, “You realize now why we had to wait at least one full generation before sending a man to the moon,”[78] as the plane never lifts into the air, wobbling now to the right and to the left, as the aircraft comes back around to runway and the flight instructor throws his cap to the ground in frustration. This sequence of the failure of the human pilot frames the rest of the film. Rather than opposing human success and mechanical failure or vice versa, failure connects manned and unmanned flight.

Figure 12. Flexwing Launch (Still). *Nobody's Perfect*. 1972. San Diego Air and Space Museum Archives, San Diego, CA.

The middle section of the film is devoted to Ryan Aeronautical's Flexwing projects. These include both manned and unmanned versions of a light weight aircraft, which were forerunners of hang gliders, tested in the 1960s for the National Air and Space Administration. Drolly the narration remarks: "In 1962, our advanced engineering group conned management into thinking Flexwing was the vehicle of the future."[79] At the desert test site, a Pterodactyl shaped aircraft is shown wobbling through the landscape. The next shot shows the aircraft, dangling from a crane. "One of the more saleable features of this bird was the ease with which it could be assembled."[80] The shot cuts to an engineer, who is underneath the billowing fabric of the *Flexwing*, while the narrator observes (figure 12): "Anyone with a ten ton crane and sixty helpers could have it ready to fly in a week's time under no wind conditions."[81] The lightweight aircraft, built for a single pilot with an open cockpit and a triangular wing on top, tracks down the runway, never lifting off more than a few meters above the ground. The voiceover notes, "It was recognized throughout the industry that the project Pterodactyl set aviation back fifty years."[82] The shot cuts from the pilot of the Flexwing on the runway to another headquarters sign: "Headquarters: Flexbee Flats – Dead Man's Lake Division." Flexbee is the name for the miniature, pilotless version of the Flexwing, although no distinction is made in the sequence. Rather, it is the continuity of the triangular aircraft and its ongoing failure that brings these scenes together. Showing the Flexbee rolling across the desert, the sound shifts to that of a train, as the system never achieves lift-off. In the next shot the triumphal, military marching music returns and, as an apparent solution to the problem the Flexbee appears on the roof of a military Jeep and is launched through the momentum of the motor vehicle. A group of onlookers look to the sky and the camera follows the Flexbee's trajectory and crash into the desert. Five more crashes are shown in the scene, while the sequence concludes with a Flexwing falling from the sky with a human figure attached. The narrator jests: "As a result of his good work on the drone, the project engineer was allowed to test out our first furrowing parachute."[83]

The sequence devoted to the Flexwing is replete with observers, engineers, technicians and test pilots, pointing to how the experimental aircraft, manned or unmanned, rely on human support systems that extend beyond their operation in flight. The humor of the short film, as opposed to the official photographs and films previously described, emphasizes how humans and technologies are entangled. Introducing the project engineer as part of aircraft development, he is linked to his projects in *Nobody's Perfect*, displaying the repetitive trials of testing, as well as the military-industrial context that enables the technologies success and unravelling. Here, "nobody" is rather the many bodies that constitute the failure of the project – drones, birds, dinosaurs and humans alike. As the system crashes and fails, the changes emerge not as a technical evolution, but through interactions between the engineers and technologies. Yet, as the Flexwing and Flexbee footage highlights, the associations can also be counter-productive, even as they are evolving.

Figure 13. Drone Crash with Mourners (Stills). *Nobody's Perfect*. 1972. San Diego Air and Space Museum Archives, San Diego, CA.

The next sequence shows a guided missile being tested against a Firebee target. In the shot, a uniformed soldier is on the telephone. The narrator explains: "The Army calls for a missile to kill the Firebee."[84] The background music is a waltz, as the missile is launched into the sky and splits in half. Continuing, the voiceover explains, "and this is what happens when one section of engineering works on thrust and the other section works on guidance."[85] The missile comes apart in two pieces and circles through the sky, as if it were an elaborate dance. The failure of the system, patterned as the missile continues to twist and turn, comes back to the humans who engineered the two parts of the system. For the Ryan Aeronautical film though, it is also a moment to note the success of the Firebee. With the words, "At MacGregor base they claim a high number of flights per target. But with missiles like this, who can lose? Boy, that Firebee is an elusive target,"[86] the missile comes crashing into the desert. Yet, failure is also shared by the Firebee. The narrator proposes, "Let's try again,"[87] returning to the Army soldier on the telephone. In the next shot, the Firebee is launched and crashes, producing a large explosion. A black cloud of smoke shoots up from the air and the film cuts to an aerial view of the crash (figure 13). Three men dressed in black walk over to inspect a crashed Firebee in the next shot. "We kept a professional staff of undertakers, mourners and rock kickers on the payroll,"[88] explains the voiceover. They pick up the parts of the Firebee strewn over the crash site, in the first of several scenes that highlight the pieces of the crashed drone.

Three men in short-sleeve shirts and trousers lay on a small knoll of grass. The voiceover notes, “At Tindell Air Force Base, Ryan has established an outstanding crew. The leisure and relaxed atmosphere depicted here is a result of their ability to turn a bird around faster than any other base in the world.”[89] Another crew member is draped over a reservoir. Calm string music is in the background. The music crescendos as the shot pans across to the drone and cuts to the control room. Changing tone, the narrator observes, “However, with their proximity to Cuba, they do have their little problems.”[90] A man enters with gun and a hand-written sign printed on the back of a manila folder: “Take this drone to Havana.”[91] There is a close-up of the demand and then a close-up of the drone hijacker. He is wearing military fatigues and sunglasses; he smokes a cigar and has a mustache - a caricature of a Cuban revolutionary (figure 14). The next shot shows the operator’s hand shifting the controls. Showing the analog display charting the drone’s course, the needle that marks the location of the Firebee moves sharply to the South. The brief scene is ambiguous as to why the Cubans would want a Firebee - would it be as a target? Or, does this part suggest other uses of unmanned aircraft, namely, surveillance? Early tests of reconnaissance drone systems coincided with the Cuban missile crisis and the sequence at Tyndall Air Force Base replays anxieties about the Cuban Revolution in the ground control station. The stereotyped actions of the Cuban revolutionary position the drone as part of a key geopolitical tension for the United States. Enacting the capture of the drone’s remote pilots, however, undoes the strategic advantages of an “unmanned” aircraft.

Figure 14. “Relaxed Atmosphere” and “Little Problems” (Stills). *Nobody’s Perfect*. 1972. San Diego Air and Space Museum Archives, San Diego, CA.

The seemingly mundane practice of monitoring the flight of the drone through information transmitted to the control room is intensified in the scene. When the graphic position of the drone, marked by a needle drawn line on the map, suddenly moves south, the otherwise leisurely and relaxed crew from Ryan Aeronautical is implicated in a national crisis. The mediations marked out by the needle are envisioned as part of America’s Cold War conflicts. Yet, the scenario is a scene of counter-insurgency, rather than a stand-off between the two superpowers. In this way, the closed world between the United States and the Soviet Union offers a limited view of the struggles during the Cold War. The sequence instead points to contemporary uses of unmanned combat air vehicles, although the drone is a target for the terrorist, instead of the reverse.

Near the end of the film, the control room scene returns, in a series of jump-cuts between the ground unit and the launch of a Firebee from a DC-130A aircraft. A close-up shot of the hands from two operators competing to work the knobs in the control room appears. The voiceover says, "I think the elevator should be up. No, down."[92] The film cuts to the "mother" plane set to launch drone aircraft in the air. The voiceover continues, "Get your hand off there. Up. Down."[93] The image again cuts to a shot of the DC-130A and returns to the competing hands on the control panel. "No, up, down, down."[94] The drone is launched from the mother plane and crashes into the wing of the launch aircraft, causing a large explosion. "Up, I told you so."[95] The narrator proclaims, "Sheesh,"[96] while the image returns to the frustrated pilot trainer from the beginning of the film. This section flashes back to the opening sequence, which examined the folly of human flight and narrates the fallibility implied through distance between ground control and the remotely-piloted aircraft as satire. The sequence of film, however, is based on what Robert Schwanhausser recalled as "the only near fatality we ever had in the drone program,"[97] complicating the simple joke of the distance between the control unit and the aircraft (figure 15).

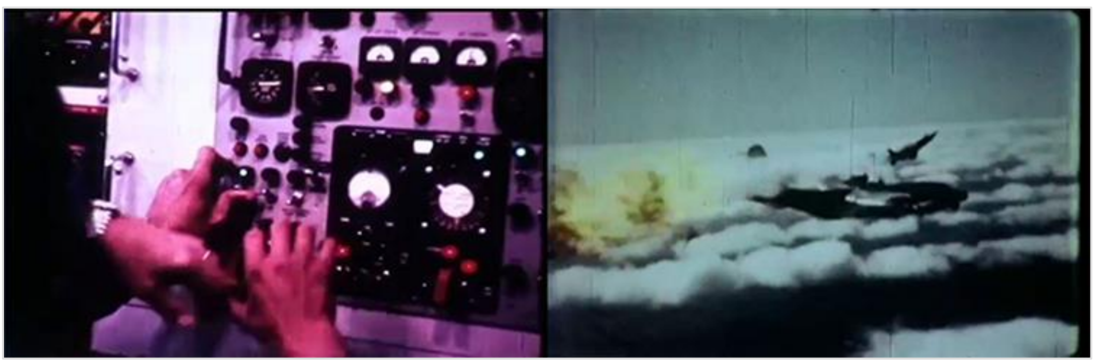

Figure 15. Up-Down Launch (Stills). *Nobody's Perfect*. 1972. San Diego Air and Space Museum Archives, San Diego, CA.

In an official report submitted by Bob Todd and Bernie Paul, the Ryan Aeronautical engineers who were onboard the launch plane, they noted on January 3, 1966 that "the DCA-130A launch aircraft proceeded outbound shortly after noon to the launch point."[98] After the aircraft was joined by a photo plane and a chase aircraft, the two technicians checked to verify "all systems were operating properly."[99] Their report explained:

> The countdown continued normally with launch occurring at the 'zero' count from the remote control site. "Bird clear" was called out after the drone dropped away normally, but after bottoming out 10 to 15 feet below the right pylon it began moving forward, then suddenly pitched up at about a 20 degree angle impacting the number 4 starboard engine.[100]

Afterwards, there was an immediate explosion, the debris from the crash punched a hole in the fuselage and six feet of the horizontal stabilizer was torn off. Bernie Paul recalled: "As soon as the film from the chase plane could be developed we had a debriefing and only then did I realize the imminent danger that was involved because it was terrifying to see that huge fireball rip right into the launch plane."[101] Paul explained the incident was caused by "some failure in the circuitry which had caused an up-elevator position on launch. After that we made some circuitry changes."[102]

Removed from the context of the incident, the still darkly-humorous sequence stages an interplay between the two competing operators in the control room and the drone launch. In the film, the two sets of hands attempting to modify the control knobs are the apparent cause of the Firebee's sudden upswing after the launch. *Nobody's Perfect* explains the explosion as a result of a disagreement between two operators, controlling the drone from the ground. The voiceover's repeated back-and-forth between up and down, though, is transformed by Paul's explanation that the sudden upward motion of the drone was caused by circuit failure. In the film, human hands stand in as the cause of the Firebee's upward turn as it is launched from the DC-130A. The inclusion of the shot in the humorous film was possible only because no one was harmed in the incident and the DC-130A safely landed thirty minutes after calling "May Day." Unlike the rest of the film, human bodies are largely absent in this sequence. In the close-up of the two sets of hands, their competing movements on the control panel are separated from the rest of their bodies, while the shot of the Firebee's launch offers no indication of the pilots and technicians aboard.

Figure 16. Strewn Parts of Drone Crash (Still). *Nobody's Perfect*. 1972. San Diego Air and Space Museum Archives, San Diego, CA.

The last sequence of the film returns to the image of the exploding Firebee on a launch pad found in the opening shot. The narrator says "and here a fearless fighter pilot rushes to an alert."[103] Reminding the viewer that the Firebee is a simulated target, the first shot shows the fighter pilot jogging calmly to the aircraft on the runway, while the second shot is sped up to make it look as though the pilot is rushing to the cockpit of a fighter jet. Cutting to the drone on the launch pad, for the first time, the film uses a feminized voice. In a husky tone, she counts down, "4-3-2-1- Blast off – hah."[104] The drone whirls through the air as it bursts into flames. As metal parts are strewn through the air, the drone crashes behind a large outcropping of bushes in front of a nearby building. The music ends and the voiceover explains, "If we have learned nothing throughout the history of our developmental work, our engineering department has learned very well how to bury their mistakes."[105] On a beach, in a sped up shot of a man shoveling, a pile of dirt rises on the screen. In the next shot, Richard Strauss' *Thus Spoke Zarathustra* provides the background music for a slow panning shot of the debris from the drone (figure 16), as the closing credits roll. [106] This is the same, iconic music from *2001 Space Odyssey,*[107] which was used in the scene picturing the triumph of the ape with the bone tool he used to violently kill a beast-of-prey. Referencing this, the scene in *Nobody's Perfect* instead enacts irony between human and machine in the final sequence, as the engineers bury their mistakes and the triumph of technology is depicted as a spectacular, aestheticized crash. These ambiguities are what is expressed through unmanning. Drones ostensibly negate what is human even as human and machine become ever more entangled. The repeated failures and numerous drone crashes do not integrate human and machine, however. Rather, they are marked by the ambivalences, contradiction and irony between human and machine, linked through negation. In the end, there is literally "no-body," merely the strewn and broken parts of the drone.

Chapter 4

Drones Above and Below: Reconfiguring Territory Through Unmanned Reconnaissance

A *Time* magazine article, "Reconnaissance: Cameras Aloft: No Secrets Below," from December 28, 1962 included a brief remark by President John F. Kennedy: "The camera, I think, is going to be our best inspector."[1] The article came in the aftermath of the Cuban missile crisis, which brought the United States and the Soviet Union to the brink of nuclear war. On October 14, 1962, U-2 reconnaissance flights captured photographs of medium-range ballistic missile installations in San Cristobal, Cuba, precipitating the stand-off between the United States and the Soviet Union.[2] The incident foregrounded the significance of strategic reconnaissance in the Cold War and extended how the United States pictured national security. Tracking enemy activity from the sky came to be seen as protecting the United States from nuclear threats and Americans were invited to view reconnaissance as part of the nation's defense. Positioning viewers as looking from above, the aerial view was both opposed to what was below, tied to a way of seeing territory that presumed technical mastery. This viewpoint was presented as given, the fact of the land below.

Countering the assumptions of this view, I show how reconnaissance was produced through a constellation of practices, which tie aerial images to social, technical and political practices. Through the Cuban missile crisis, I explore how Americans were positioned as viewers of strategic reconnaissance and I trace the global politics implied by this relation. The production of aerial reconnaissance operated not just through the camera, but by layering together networked human and nonhuman parts, variously exposed and concealed. As reconnaissance imagery becomes part of how national security was pictured, the first top-secret drone missions surveyed for targets in experimental missions in the American Southwest, suggesting a different framework for watching from above: one that is concealed and framed offensively. Top-down visibility and secret reconnaissance missions are in tension with each other and these contradictions are operative in the use of drones in Southeast Asia and the Middle East. Aerial imagery operates through layers and fragmentation to reveal and conceal territory, reconfiguring how national protection and international interventions are enacted.

Learning to See from Above

The photographic imagery of medium-range missile installations in San Cristobal, Cuba, captured on October 14, 1962 led to an intense campaign to collect visual and electronic intelligence over Cuba during the next days, while the National Security Council deliberated on the United States' response. Speaking for the first time on October 22, 1962 about the discovery of the missile sites on national television, Kennedy began by observing:

> This Government, as promised, has maintained the closest surveillance of the Soviet military buildup on the island of Cuba. Within the past week, unmistakable evidence has established the fact that a series of offensive missile sites is now in preparation on that imprisoned island. The purpose of these bases can be none other than to provide a nuclear strike capability against the Western Hemisphere.[3]

In his opening remarks, the United States government's close surveillance becomes "unmistakable evidence," transforming the collected images from their strategic use to monitor the actions of Cuba and the Soviet Union to the grounds for Kennedy's military sanctions. As evidence, the surveillance is unequivocal, "none other than to provide a nuclear strike capability,"[4] and Kennedy uses these "facts" to announce "a strict quarantine on all offensive military equipment under shipment to Cuba is being initiated,"[5] as well as "the continued and increased close surveillance of Cuba and its military buildup."[6] The speech tied the "evidence" from surveillance to the military measures taken by the United States for the protection of the country.

On October 28, 1962, the crisis ended after Radio Moscow announced the Soviet Union would remove missile installations from Cuba in exchange for an agreement from the United States not to invade the island. The day before, an American U-2 pilot, Major Rudolph Anderson, was shot down by surface-to-air-missiles and died in the resulting crash, leading to another push for unmanned reconnaissance. Based at the time at the Atlantic Missile Range in Cape Canaveral, Florida, Robert Schwanhausser, head project engineer for the top-secret reconnaissance drone, remembered how "the Ryan people were trying to figure out how their [reconnaissance] drone work might be continued. … Without a doubt they could do a job in Cuba."[7] Working in the Air Force Reconnaissance Division in 1962, Lloyd Ryan explained "there was a great reluctance to deploy the system,"[8] though, and recalled how General LeMay, the Air Force Chief of Staff personally cancelled a mission to Cuba with the system in November. Ryan says, "It was due to the unknown nature of just how good it would be, and whether we were giving away a capability that we might want to save for bigger game."[9] Based in a restricted hanger, the engineers could not discuss their project with the military personnel on high alert on the base in the midst of crisis. The reconnaissance drone was known only to the project engineers and a select group of military commanders. While the drone was not deployed to Cuba, the death of Anderson, as well as the limitations of satellite reconnaissance, did lead to more funding for the project and after the Cuban missile crisis, Ryan Aeronautical was given the go-ahead to build thirty-eight new drones over the next two years.[10]

Funds provided for the experimental project pointed to the ongoing significance of surveillance, as indicated in the article by *Time*. "Reconnaissance: Cameras Aloft: No Secrets Below" explained how reconnaissance continued to watch Cuba after the missile crisis, elaborated through the role of the camera. The uses for surveillance articulated in the article are suggestive of what underwrote the development of drones, even though no mention was made of these emerging capacities, guarded by secrecy. The article referenced the quotation by Kennedy, "The camera, I think, is going to be our best inspector,"[11] to explain:

> The President's brief, blunt remark was deliberate understatement. For months the Cuban skies have belonged to U.S. photo planes—soaring, diving, circling, appearing and disappearing on swift, unexpected tangents. Diplomats may still argue about on-site inspection of Cuban missile bases, but the question is almost academic. Under the prying eyes of U.S. aerial cameras, Cuba lies as exposed as a nude in a swimming pool.[12]

In this account, manned flight appears unmanned, and cameras and planes appear as if they operate without human involvement. The actions ascribed to the photo plane use a curious collection of descriptors: soaring, diving, circling, appearing, disappearing, swift, and unexpected. They emphasize unpredictability and stealth, attributing a dizzying array of maneuvers to reconnaissance operations. These actions claim the *skies* above Cuba for the United States, thickening airspace through the maneuvers of the camera planes. The air is opposed to the territory of Cuba below, exposed and naked under the camera's "eyes." The image claims to provide the United States complete access to the territory below. The article suggests that unlike diplomatic arguments about the land, the view from the reconnaissance camera makes discussion about what is happening on the island moot. The aerial camera exposes the land, producing the territory below as known and inspected, watched for the safety of the United States.

On February 6, 1963, the United States government offered an even more in-depth explanation of the new role of surveillance. John T. Hughes, an image analyst for the Defense Intelligence Agency, appeared on national television in response to doubts about the withdrawal of nuclear weapons from Cuba. In an hour and twenty minute presentation, he walked the viewer through a series of images to show that no nuclear threat remained on the island (figure 17). The next day, *The New York Times* described the briefing as "one of the most unusual showings of such materials ever made by a government."[13] Classified images from reconnaissance overflights had been shown to reporters, published in news reports and shown on television. The briefing was "unusual" though, because it showed viewers how to see the images from the perspective of a defense analyst, situating both the government and American public as viewers of reconnaissance imagery used for their protection. Reconnaissance, the presentation argued, was a way to monitor Cuba and provided evidence of America's safety.

Figure 17. Cuban Missile Crisis Briefing by the Defense Intelligence Agency, Still. February 6, 1963.

Robert McNamara, Kennedy's Secretary of Defense, introduced the briefing. He explained the threat of a nuclear missile strike by the Soviet Union from bases in Cuba had been mitigated, stating, "It is our purpose to show you this afternoon the evidence on which we base our conclusions."[14] He called on Hughes, trained as a teacher and a geographer, to show why. The briefing was probably not unlike the presentation Hughes had given earlier that day to the President and his advisers. The *New York Times* report summarized by noting the presentation "proceeded from prints showing open fields and woodlands last August and September, to the same sites in near-readiness for missile operations in October, and the same sites in dismantled condition today."[15] The photographs set the missile technologies against the island landscape, and their appearance and disappearance was tied to a natural view of territory, a point underscored by the *New York Times* summary. While Hughes is clear these images have been captured by American intelligence missions, pointing to the shadow of one of the government planes in a slide, he presents the photographs as if they speak for themselves. The photographs use labels to indicate the critical features of the imagery, which Hughes points to in his briefing, teaching the viewer to see the photographs *as if* the explanations were unnecessary. The presentation produced a way of seeing that claimed to expose Cuba, know its potential to threaten the United States and through this same practice of seeing counter the enemy threat.

In Hughes' presentation, aerial intelligence becomes a mechanical view-from-the-sky, providing evidence of what is happening on the ground below. This view aimed to assure American television viewers they are protected by monitoring enemy territory from above. The pictures leave out how they are produced, contextualized and analyzed and are instead shown as a way of seeing Cuba. As images of Cuba, the military and political practices that frame the photograph are not evident. Yet, the images were contextualized to enact divisions between America and enemy territory, positioning America above and enemy territory below. Turning to the experimental drone aircraft also tested in 1962, I examine how practices of gathering reconnaissance were layered into the photographs, enacting a hunt for targets on the ground. Adding to the use of reconnaissance as evidence and protection, I explore how aerial images were also "exceptional."

"Big Safari:" Experiments with Unmanned Reconnaissance in America 1962-1964

Beginning in February 1962, the Air Force funded the conversion of a Firebee target drone for reconnaissance through a program called "Big Safari," set up ten years earlier. Its mandate was to fund reconnaissance aircraft offering "flexibility to respond to high-priority, dynamic operational requirements for programs that involve a limited number of systems that require a rapid response."[16] Its practical function, as Lloyd Ryan of the Air Force Reconnaissance Division explained, was to provide "an expedited method of avoiding the complexity of going through what is now the Systems Command – the old R&D command – with all the approval chains."[17] The Lightning Bug aircraft based on the Firebee were the first unmanned reconnaissance system funded by "Big Safari." Today, the program continues to be used for the rapid conversion of aircraft, notably, in 2000 to weaponize the reconnaissance RQ-1 Predator drone, completing a prototype deployed in Afghanistan sixteen months later. The quick reaction contract given to Ryan Aeronautical on February 2, 1962 called for the conversion of four drones into photo reconnaissance systems in ninety days, leading to the experimental prototypes I discuss below.

“Big Safari,” the name for expedited funding program to convert aircraft into reconnaissance planes, is worth pausing on for the territorial imaginary it invokes. While I found no explanation for the designation, “Big Safari” is evocative of strategic reconnaissance – a hunt where, presumably, the hunted have no idea they are being watched and surveyed. This view of reconnaissance is distinct from the image of protection put forth to the American public during the Cuban missile crisis. "Safari" suggests a particular kind of view, using the relation between the hunter and hunted to figure how monitoring and watching through the camera operates. State protection, in a period defined through the threat of nuclear weapons, correlated knowledge of enemy actions with military power and national protection. At the same time, there was a corresponding attempt to make this same knowledge secret. It was not just that the surveyor “knew” the enemy, but also that the enemy did not know that the surveyor knew. “Big” encompasses the aspects of the program that make it exceptional – funding was expedited and the programs were highly secretive. As indicated by the “Big Safari” mandate, projects were “of sufficient importance and priority to warrant preferential treatment, quick reaction and extraordinary procurement procedures.”[18]

Working with the “Big Safari” time constraint, Ryan Aeronautical engineers relied on the design of the Firebee to guide the development of the reconnaissance drone. The most significant modification was to the navigation system. The Firebee flew using dead reckoning, relying on pre-set course of the altitude, distance and direction to be travelled. The first navigation unit was built using a timer-programmer from a telephone stepping-switch and a gyro compass, which would guide the direction of the aircraft based on time intervals. This system would later incorporate Doppler radar. Other modifications to the target drone aircraft included a thirty-five inch section spliced into the fuselage to carry sixty-eight additional gallons of fuel, extending the range of the aircraft to over 1,000 miles. The nose of the aircraft was modified for the Hycon camera system, also used in U-2 reconnaissance planes. Two large film magazines would unspool the film in opposite directions, which maintained equilibrium in the aircraft. The camera system captured the territory below on large format negatives, as the film unrolled during flight. On April 20, 1962, engineers flew the drone aircraft off-range for the first time, completing a circuit through the American southwest. Traveling 761 miles to Wendover, Utah, the drone completed the round-trip flight in 98 minutes, monitored continuously from a launch plane and by ground tracking. The Lightning Bug returned to within 1800 yards from the pre-selected landing spot. In the next flight, which occurred the following week, the drone travelled over 1000 miles and made seventeen course reversals capturing images of resolution targets on the ground as it completed a circuit over the American Southwest. In the third flight, the drone unexpectedly opened its parachute and landed in the Magdalena Mountains over a hundred miles from its retrieval site.[19]

When Robert Schwanhausser, lead project engineer for drone reconnaissance at Ryan Aeronautical, remembered the project in an interview in 1971, he told three stories about the first test flights between Holloman Air Force Base and Wendover. The first story involved the decision to use the Hycon camera, as opposed to a mock-up in the first long-distance flight. At Holloman Air Development Center, Schwanhausser recalls “the Lt. Colonel who was in charge of the drones at the time felt very responsible about this high priced so-called piece of equipment.”[20] He and the government in-plant representative for the project, Jim Regis discussed their options. “We decided that with all the chips being down, let’s go for broke. If we lost the bird,[21] hell, we lost the bird, but if we lost the bird and still had some good film, we would prove our point and we just wanted to prove we could take some pictures."[22] Here, the objective of capturing aerial imagery through the reconnaissance drone trumped possible hazards – an all-in gamble. The photographs were justified through the mastery proven by the images and the risks involved in the project underscore its significance. Just prior to the launch of the drone from the DC-130 aircraft, the Lieutenant Colonel showed up. At the time, Schwanhausser recalled "we were having a wonderful flight, it was a marvelous flight, everything was just great."[23] Meanwhile, the Colonel left and went straight to the base commander. "We were notified that we were going to be thrown off base, that it had better be a damn good flight, because it was going to be our last flight."[24] Their success countered the Colonel's reaction. Schwanhausser says "we did continue to fly at Holloman. [And in] the meantime we created a tremendous scene,"[25] eventually smoothed over by interventions by commanders in Washington, D.C.

The exceptional characteristics of the project are reiterated in Schwanhausser's re-telling. Going against the orders of the Lieutenant Colonel, the risk implied is part of what makes the operation "big." In the second flight, the reconnaissance drone flew over the Wendover corridor again. In this story, it is the film captured through the drone that is "big." In this mission, the camera took pictures of resolution targets on the ground below. This tested the navigation system onboard the modified Firebee, as well as the camera. After recovering the drone following its parachute descent into Holloman Air Force Base, Schwanhausser remembered "the big excitement was to get the take, the film, and to go process it and see what we had. … We flew straight to Los Angeles and were met in Los Angeles by Ray Bellweg and we went straight to this very secret facility they had for processing which I couldn't get into."[26] After processing the film, Schwanhausser recalls combing through the footage for the targets. "About 6 o'clock in the morning we found the resolution targets on the film and they were damn good. … We immediately flew the film, as you'd expect, to Washington for presentation purposes and carried on with the flight test program."[27] The story highlights what it took to find the targets *after* the photographs had been taken. Surveillance incorporated not just the drone's flight, but processing the film in Los Angeles and having human observers identify the targets. When they were found, the film was then flown to Washington, D.C. and presented, tying the images to the cross-country trips that produced the pictures and situated the project as "big."

On May 3, 1962, the same drone was flown for another flight. On the return leg of the flight from Wendover, Utah, a momentary loss of connection between the drone and the altimeter tracking system caused the automatic parachute recovery system on the drone to be activated. The drone landed at 8,000 feet altitude between two peaks in the Magdalena Mountains 120 miles from Holloman Air Force Base. A military helicopter was sent to pick up the drone, but with the wind and high altitude, the helicopter didn't have enough lift and also crashed. Schwanhausser remembered, "Now we've got both an Army helicopter and a classified drone with all its secret gear splashed on the mountain side."[28] The Air Force recommended the drone be burned to keep the security of the project from being compromised. At the time, though, there were only two working models of the unmanned system. Ryan Aeronautical, instead, sent a crew of its civilian employees "armed with guns in their holsters as a security precaution" to retrieve the drone.

> By four o'clock we had completely disassembled the bird. Two Air Force trucks had broken down trying to get to the site. In the meantime we had 'conned' an Army sergeant with a weapons carrier into helping haul some assemblies out. By later afternoon we had

> the bird sitting in a meadow, some of the assemblies resting on old tires so they wouldn't get banged up.[29]

The landing and disassembly of the drone occurred over the weekend. By Tuesday, the system was ready to be flown again. "We flew it over the same area and took stereoscopic pictures of the chopper that had crashed into the mountains."[30]

In the third flight of the program, the drone crashed in a remote location of New Mexico's mountains and the secrecy of the reconnaissance drone was potentially compromised, though the remote location protected the highly classified project. The Ryan project engineers set aside the recommendations of the Air Force to destroy the aircraft and instead disassembled the drone at the crash site and re-constructed its body. A failed flight became a success when the aircraft was flown again a few days later. The two previous test flights indicated the extraordinary qualities used to promote unmanned reconnaissance: In the first, drone reconnaissance defied expected protocols. The second shows the "big excitement" of finding the resolution targets, which pictured the drone's success. This final example, which could have spelled the end of the project as it crash landed in the mountains, adds to this analysis by suggesting how failure was incorporated into the extraordinary qualities of the "Big Safari" funded program.

In the last crash, the drone being flown was produced by reconnaissance – a given view of the world. A similar logic was at play in how the missions remained secret, obscured within the New Mexico landscape. Previously, I examined a series of images and captions of the Firebee target used in press releases that introduced the drone in aeronautical and airspace magazines. Flying above White Sand Desert in 1953, the jet-powered drone was described as "a spectacle as eerie as an uninhabited missile from another planet."[31] Undulating mountains below the drone are flattened by the aerial perspective and the Firebee is seemingly caught between the skies and rippling desert sand, suggesting an almost ethereal plane. Yet, the otherworldly qualities of the desert also locate the drone above White Sands Missile Range and Holloman Air Force Base, centers for experimental flight, missile tests and other secret experiments during the Cold War. The white sand dunes in the desert moreover, are iconic markers of the area, captured for example in black and white photographs taken by Edward Weston and Ansel Adams of the region.[32] At once, the photograph was of a desert landscape and a military test range, although the latter remains invisible. Before, I used these images to analyze how human operators became a spectral presence in the drone's flight. The same might be said for the way the landscape operated in the photograph, which naturalized the drone against the backdrop of the desert, obfuscating the military, political and industrial relations that shape the scene below.

As I have been unable to find the reconnaissance images taken during the drones' test flights,[33] I use the aerial images taken of the target drone operating over White Sand to ask what is produced through this aerial view from the sky. Focusing on the invisible layers in the photographs, I suggest what might be unseen in other aerial views was also captured in these images of the Firebee in the desert. Like the reconnaissance imagery I described earlier, I consider how a constellation of technical and natural features produce the photograph as given and leave out the practices tied to its making. Landscape,[34] I think, offers one way of framing these processes – an image that erases the conditions that produce this view by presenting itself as land. This argument is found in the term, which articulates both a representation of the land, an image, as well as land itself, a view experienced by the onlooker. Landscape, in this way, naturalizes representation, doubling over the ways land and landscapes are articulated. What is typically hidden in these views is how they are formed in and through relations to humans – what might be thought of as their secret. W.J.T. Mitchell explains landscape operates "*as if* nature were imprinting and encoding its essential structures on our perceptual apparatus."[35] The *as if* functions to "erase the signs of our own constructive activity in the formation of landscape as meaning or value, to produce an art that conceals its own artifice, to imagine a representation that 'breaks through' the representation into the realm of the nonhuman."[36] Beyond mere concealment, landscape materializes a set of relations as given qualities. Produced between humans and nonhumans, landscapes are representations and the land, mediating sight by layering together practices of exposure and concealment.

Let me briefly explore how Mitchell's ideas relate to the desert landscape of White Sands. In the photographs of the Firebee from 1953, the sand dunes in the empty desert and the evocation of an "uninhabited planet" cover the military and political formations also in the territory below. In 1941, public land grazing licenses in the region were cancelled and the sparsely vegetated area around Alamogordo, New Mexico (a planned community built to support the El Paso and Northeaster Railroad) was established as a large-scale military base. This re-purposing of public lands occurred throughout the American West during World War II.[37] Designated as the Alamogordo Bombing and Gunnery Range in 1941, the area would be renamed the White Sands Proving Ground in 1945. The name change came just prior to the Trinity Test held at the site on July 16, 1945, when scientists from the Manhattan Project detonated the first atomic bomb in White Sands Desert.[38] The region served as a missile test site throughout the Cold War and continues to be closed periodically for this purpose. Today, Holloman Air Force base is the primary training center for pilots and sensor operators of MQ-1 Predator and MQ-9 Reaper unmanned combat air vehicles.

In between the White Sands Proving Ground and Holloman Air Development Center is White Sands Desert National Monument, founded in 1936 as a tourist destination. Administered by the National Park Service, this portion of the desert geographically adjacent to the two military bases is described as follows:

> Rising from the heart of the Tularosa Basin is one of the world's great natural wonders - the glistening white sands of New Mexico. Great wave-like dunes of gypsum sand have engulfed 275 square miles of desert, creating the world's largest gypsum dunefield. White Sands National Monument preserves a major portion of this unique dunefield, along with the plants and animals that live here.[39]

The monument is a natural preserve in the midst of the two military sites, making public a partitioned section of the desert that is otherwise secret and off-limits. More than twenty feature films have been made at the monument[40] and the National Park Service estimates "90% of every make and model of cars produced in the United States have been to White Sands to photograph or film their featured cars."[41] To maintain the secrecy of the military installations below, the photograph of the Firebee similarly positions the aircraft above the rippling sand dunes.

The scene of the drone in the desert overwrites the political and military contexts that shape land through the mediation of landscape. Yet, these obfuscations are incomplete, which suggest limitations to erasures I describe above, both in the case of landscape and drone reconnaissance. Although the drone crash in the Magdalena Mountains did not compromise the project in 1962, drone aircraft did become public knowledge several years later, after an unexpected landing of a reconnaissance drone occurred over Los Alamos. This event is instructive because it shows how secrecy and erasure enacted through the drone only partially obscure its operations. On August 6, 1969 a headline in the *Albuquerque Journal* read “Secret Something Falls to the Earth.” The article described “the emergency descent by parachute of a super secret unmanned aircraft in full view of Los Alamos residents,”[42] bringing a classified unmanned reconnaissance system built by Ryan Aeronautical into the view of the public. The article described the drone “dangling from a bright orange and white parachute,”[43]as it eventually landed “behind the fences of a security-conscious Los Alamos Scientific Laboratory technical area.”[44]

Speculation about unmanned aircraft being used for purposes other than target training had circulated since Ryan Aeronautical began testing the systems at the beginning of the Cold War. In January 1968, White Sands Missile Range inadvertently mentioned the classified drone reconnaissance tests in an end-of-the-year press release of base activities, giving away the code name for the project, Firefly. The report explained, “Firefly will test a special purpose vehicle. Initial flights will originate over the White Sands Missile Range with later flights originating from above the Pacific Ocean and terminating over White Sands Missile Range.”[45] Descending over Los Alamos, the drone interrupted the secrecy that cloaked their use in airspace above the United States, as the converted unmanned reconnaissance aircraft was exposed, rather than the ground below. The article remarked, “Reverberations from the thud of the graceful bird’s landing on the northern New Mexico plateau, 150 miles away from White Sands, was felt all the way to Washington.”[46] Attempts to keep the reconnaissance drone secret splashed into headlines, as an Associated Press wire article “Sudden Landing Unveils New Drone” put together the inadvertent release of information from White Sands the previous year with the drone landing at Los Alamos. After the incident, the Air Force acknowledged the existence of the Firefly for reconnaissance, though it gave few details about the program.

Fireflies and other UAVs described how the Ryan engineers and military personnel addressed the incident. At the Holloman Air Force Base ground control unit, panel lights signaling a control failure came on after the drone had been flying for three hours. The only option for the controllers on the ground was to “hit the ‘panic button,’ which released the parachute … permitting it to descend with minimum damage so that it might be recovered.”[47] Art Rutherford, who was aboard the DC-130 launch plane that tracked the flight, later recalled “everyone was looking out the windows to see if they could spot the bird. We were flying over an area of deep arroyos, with a big complex of factory building or hangers in between.”[48] In addition to being equipped with a parachute for landing, the reconnaissance drone also released inflatable attenuation bags to cushion its descent, which released at 9000 feet. The “droopy bags” popping out of the curiously shaped aircraft 2000 feet above ground as the drone descended by parachute into Los Alamos attracted attention. Rutherford remembers when they arrived at Los Alamos, “Our Special Purpose Aircraft had landed right in the middle of the driveway, the right wing skidding under the guard rail. … the news people were there, pressed up against the perimeter fence or up in trees to get a better overview.”[49] Employees of the Atomic Energy Commission at Los Alamos, familiar with classified operations, asked few questions about the project. The incident, however, might have caused a much greater disaster. “The drone was dripping fuel as it came down, drifting over the main plutonium processing plant. Had it gone down there they would have had to evacuate the area."[50]

The account of the Firefly reconnaissance system coming down over Los Alamos unexpectedly links two threads of Cold War research. The confluence of the drone and plutonium processing juxtaposed two of many efforts to produce secrecy in Cold War America. The near crash of the reconnaissance drone over Los Alamos broke the secrecy of the classified mission and knowledge of the project transformed as the drone landed. Joe Masco's comments on the territory around New Mexico point to these contrasts: "there can even be a surreal quality to the overlapping claims in contemporary New Mexico … a cultural space that is Native American, Catholic, New Age, and military industrial, an arena that deconstructs U.S. national security as readily as it creates it."[51] His research examines Los Alamos through competing practices of secrecy, exposing borders between ways of knowing. Studying the Pajarito Plateau, the current site of Los Alamos, Masco observes how government practices overlaid Native American ways of knowing the site. He writes, "The arrival of the Manhattan Project on the Pajarito Plateau thus not only brought together multiple secret societies – those supporting U.S. military nuclear science and Pueblo theocracies – but also rival systems of knowledge and knowing."[52] Masco argues these different modes of knowing continue to operate in Los Alamos, complicating the blanket of secrecy that protects the area, which both claims to serve national security, while complicating what is at stake in these interests.

The unexpected intersection of top-secret nuclear weapons development and the reconnaissance drone points to the multiple forms of secrecy operative in the name of security. In the flights and failures examined above the efforts taken to produce the exceptional qualities of the drone, the "big" photographs captured by the system and its crashes, indicate how the drone is intertwined with relations connected to the ground below. Tuning to the still partially classified drone reconnaissance mission from the Vietnam War era, I shift from the layered images of aerial reconnaissance captured over New Mexico to tensions between who knows and sees what through drone missions in Southeast Asia. Promoting the unmanned aircraft, *Fireflies and other UAVs* noted how drones collected "quite a bit of 'honey' in the way of intelligence-gathering during reconnaissance missions in Vietnam."[53] The drones' "honey" complicates the photographs status as evidence, suggesting multiple layers to the ostensibly flat aerial images. Like the drones' flights over New Mexico which proposed multiple relations to the land below and exceeded a given view of the land, the flights and Southeast Asia transformed relations between above and below in the context of changing global relations, marked both by oppositions between the United States and the Soviet Union explored previously and counter-insurgency.

Southeast Asia, the "Buffalo Hunter" Report and Vertical Sovereignty

In response to American naval engagements with North Vietnamese torpedo ships on August 2, 1964 in the Gulf of Tonkin,[54] Congress authorized President Lyndon B. Johnson to use American military forces in Southeast Asia.[55] Immediately following this authorization, reconnaissance drones were deployed to Southeast Asia and during the next nine years, would fly over three-thousand missions. The reconnaissance drone system would be remodeled according to at least two dozen configurations, with contracts ranging from a few aircraft to hundreds. Thousands of images would have been captured by drone aircraft, although only a few have been released to the public. Beyond what was seen and what was not, I ask how these classified missions reconfigure relations to the territory below, extending the protections provided by aerial photography, as well as the drone's "Big Safari." How did the secret ways of knowing proposed by reconnaissance photography operate? How was tracking and monitoring tied to new divisions, which distinguished not just between the East and the West but also above and below?

On August 4, engineers from Ryan Aeronautical received word that the high-altitude reconnaissance drones built by the company would be deployed. As an industry contractor, the Ryan Aeronautical engineers were central to the operation of the drone aircraft, reflecting the role played by Ryan Aeronautical not just selling the systems but training the Air Force in their use. Yet, their role also points to questions about who knew and saw what. While Ryan Aeronautical was an important promoter of the use of drones for aerial reconnaissance, the personnel had no official access to the reconnaissance imagery they collected. Schwanhausser later remarked the biggest challenge in the early days of the program was "a human relations problem,"[56] emphasizing tensions in the networked operation of humans and nonhumans that made drone flight possible. He says, "We wanted the bird to look good and we wanted the Air Force to look good and we needed to have a lot of cooperation."[57] As lead project engineer, his interest in the program's success was perhaps not always shared by personnel. Drone reconnaissance, carried out by Ryan engineers and Air Force personnel who programmed the missions and tracked the planes on the ground and in the sky, was monotonous. The missions required a different set of relations between the aircraft and operator than those typical of manned flights usually flown by the Air Force, underscoring what was at play in the "human relations problem." Schwanhausser noted that during the first eighteen months, Ryan employee, Dale Weaver, "flew practically every mission and he ended up flying more combat missions than any Air Force guy because they were rotating and we were just leaving Dale there."[58]

In the encounter between Ryan Aeronautical and the Air Force in the reconnaissance drones' first missions, secrecy partitioned the operation of the drone and the images produced. At the same time, this disjuncture was aligned against the enemy territory being watched. Drone reconnaissance was first based in Okinawa, Japan at the Kadena Air Base in 1964. The unmanned aircraft were prepared at Kadena and launched in the air from a Lockheed DC-130 Hercules plane fitted with pylons to carry two drones over Southeast Asia and China. In Taiwan, the landing of the unmanned aircraft was monitored by personnel in a "radar van," which served as a mobile ground station to track and recover the reconnaissance aircraft. Drones were picked up by helicopter after they descended by parachute in Taiwanese territory and the film would be shipped via courier jet to be processed at Air Force Strategic Air Command in Omaha, Nebraska. On the first mission they flew,

> the bird landed in a rice paddy so the impact switch wasn't triggered, the chute did not disconnect and the bird was dragged until it flipped on its back. An Army helicopter came in and picked the bird up in a hurry as we were attracting a lot of strangers who appeared out of the bushes and woodwork.[59]

The reconnaissance drones intertwined a number of layers. The system was launched from Japan, flown over Southeast Asia, recovered in Taiwan and the film was transported via courier jet to be developed in the United States. The images captured by the drone remained classified, although, another Ryan Aeronautical employee, Ed Sly explains “while we didn’t see the results … we understand the camera brought back significant information.”[60] At the same time, the top-secret mission was seen by individuals in Taiwan when the drone landed in a rice paddy. While there would have been no public acknowledgement of the program in the United States, people in Taiwan watched the drone’s recovery by military helicopter. Moreover, the offhand remark about the “strangers who appeared out of the bushes and woodwork,” suggest that even while alliances between nations like the United States, Japan and Taiwan made the missions possible, there was simultaneously a “stranger” who was presented as outside these operations – the person on the ground.

The systems built by Ryan Aeronautical were, as far as I can tell, never used in the Soviet Union, even though divisions between East and West motivated their development. Rather, the thousands of missions flown by drone aircraft were primarily staged in Vietnam, other parts of Southeast Asia, China and later, in the Middle East, where the Israeli government used drones for its own reconnaissance missions. Drones operated both on the ground and in the sky, producing a global patchwork that was multivalent and transformable, even as their use as a surveillance system positioned the networked actions in opposition to enemy territory. Partitions and separations are suggested not just by friendly and enemy territory, but also by what is secret, what is not, and for whom, which variously link and disjoin military and industry operators, as well as relations to the ground. The confluence of these multiple elements fragments the seamlessness of the aerial view and the land surveyed below.

The views produced through the drone might instead be framed through its programmed navigation system and the inevitable errors that were part of its flights. The navigation system of the drone operated through a series of plotted points, preset prior to the reconnaissance missions. I provide two accounts: the first from an official United States Air Force history of the drone aircraft and another from a letter by Schwanhausser. The Air Force history explained,

> Drones had self-contained guidance systems consisting of a programmer compass, Doppler equipment, and an autopilot. Before each mission, operators programmed each drone’s system to guide the drone from its launch point along a pre-planned track over the reconnaissance targets, then to a recovery area.[61]

The description accounted for the drone’s flight based on a series of planned points. The Doppler system checked the location at seven mile intervals through the radar signals, while an altimeter maintained the aircraft’s altitude. In case the system lost connection to radar, the drone was also programmed by dead-reckoning, which would direct the flight based on the distance traveled over time. In a letter from October 2, 1964, Robert Schwanhausser explained pre-flight operations:

> By approximately 3:30 a.m. the operations crew arrives from the Command Post and commences programming the birds. This is done with USAF people on one bird and Ryan on the other. One man reads the program while another patches it. Then the two fellows change places and the patcher reads while the other checks. Then the Ryan and USAF crews exchange birds and check each other. In addition each crew has done their own planning and program calculations independently and then cross-checked each other.[62]

Programming is labor intensive and would last several hours, layering together multiple inputs in the process of establishing the flight path for the reconnaissance missions. The drones were usually launched between seven or eight in the morning, after three to four hours of setting the navigation program. Schwanhausser's explanation emphasized how the patchers checked, re-checked and cross-checked their work, pointing to the potential for error.

Programming was not the only challenge to navigation. The series of pre-planned points that were to guide each mission often resulted in some degree of loss, which could be due to weather conditions and other external factors, as well as equipment failure. On a flight on September 21, 1964, "The course was about 2 degrees to the left of the intended course. … After the first leg it rolled out onto its new bearing about 8 n.m. short but on a perfect heading."[63] Or four days later, "The bird was dropped in a very poor launch area due to navigation difficulties with the launch aircraft."[64] And on September 29, 1964, "the first 60% of the leg appears to be 2 degrees left and then changes to an almost convergent heading. The drone was 34 n.m. long on this leg and our information shows a very slow, wide turn."[65] In total, this model flew seventy-eight missions, averaging 2.6 missions per vehicle before the aircraft was lost or broken beyond repair.[66]

One month into their mission at Kadena Air Force Base in Okinawa, Japan, the drone reconnaissance unit was transferred to Bien Hoa, South Vietnam. During the next eighteen months, the system would be redesigned, leading to the production of twenty-eight more drones. While manned reconnaissance captured much of the aerial intelligence over Vietnam, increased anti-aircraft defenses and the challenges of monsoon weather led to the development of additional drones. In 1969, Ryan Aeronautical was purchased by Teledyne, another defense industry firm. Between 1969 and 1973, after becoming Teledyne Ryan Aeronautical, the company received over fifty contracts for unmanned aircraft. One of the largest contracts was for a low flying reconnaissance drone, flown between 1970 and 1972 in top-secret missions known as "Buffalo Hunter." In over 1,000 missions, the drones attempted to track over thirteen-thousand high priority targets and captured photographs of close to five-thousand sites, approximately a forty percent success rate.[67]

On July 24, 1973 a confidential report about "Buffalo Hunter" was submitted by Air Force Major Paul W. Elder, as part of Project CHECO – Contemporary Historical Examination of Current Operations. The opening pages explain:

> The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in USAF [United States Air Force] airpower being employed to meet a multitude of requirements. These varied applications have involved the full spectrum of USAF aerospace vehicles, support equipment and manpower. As a result, operational data and experiences have accumulated which should be collected, documented, and analyzed for current and future impact on USAF policies, concepts and doctrine.[68]

"Buffalo Hunter" addresses drone reconnaissance as part of the measures used by the Air Force to address counterinsurgency. The description is different from earlier portrayals that had emphasized the protections provided by unmanned aircraft against the capture of the pilot as a prisoner or the political risks involved in reconnaissance. Rather, drone aircraft are among a spectrum of measures used in the "unconventional" warfare environment in Vietnam.

The tone of the report, which evaluates the systems for future uses, differs from the accounts offered by Ryan Aeronautical of the projects. "Buffalo Hunter" focused on the significance of the intelligence captured by the drone and the role the system played in mission planning. Although the technical details are accounted for, the report examines military strategies enacted by the drone, adding to the socio-technical innovations described above. Elder analyzes the system's effectiveness in gathering intelligence and how this information was used by commanders in a "counterinsurgency and unconventional warfare environment." An echo of irony appears in the introduction of the report nonetheless. Elder explains,

> These reconnaissance operations functioned under tight security; and to maintain that security the reconnaissance directors changed the nickname of the operation several times. … By the BUFFALO HUNTER era, however, the drone's use was no longer a tightly-held secret. Howard Silber in an Omaha *World-Herald* editorial said that the 'Buffalo Hunter can spot a water buffalo standing belly-deep in the muck of a rice-paddy.' Although water buffalos were hardly the reconnaissance target for the drones, Silber's wry assessment of the capability is an accurate one.[69]

While earlier names for the project were more innocuous, "Buffalo Hunter" like "Big Safari," the program used to initially fund the development of the unmanned reconnaissance aircraft, evoked the perspective of a hunter as the operative model for reconnaissance. This was reiterated through Elder's retelling of the double meanings contained in Silber's mention of the project. Using the code name to hide what the drone would have been actually looking for, namely targets, a water buffalo in a rice-paddy stand in for what would be captured through the low-level drone reconnaissance and its ability to "see" details on the ground. This also sets up the opposition proposed by the "unconventional" warfare environment in Vietnam. Elder's report argued American technical innovations were part of their presumed advantage, even though, line of sight above the jungle of Vietnam were often obscured.

Despite the secrecy of the missions, "Buffalo Hunter" also explained how drone photographs had already circulated publicly, which underscored separations between reconnaissance images and the socio-technical contexts that produced them. Significantly, the reconnaissance imagery captured by the drone showed evidence of a new threat. "Aerial photography [from drone aircraft] provided the 9 January 1967 issue of *Aviation Week and Space Technology* with the first U.S. photograph of the Soviet … heat-seeking air-to-air missile, the missile being under the wing of a MIG-21 aircraft airborne over North Vietnam."[70] Even before the Firefly's secrecy was compromised, landing over Los Alamos in 1969, images collected by the drone in Vietnam appeared on the cover of one the main aviation journals in the United States. The photographs provided intelligence about air-defense and as evidence, this image of Soviet missiles circulated widely, partitioned from the drone aircraft that produced them. This account in the "Buffalo Hunter" report complicated what was secret and what was not. Images and the ability of drone reconnaissance to capture targets on the ground in high resolution circulated in the United States with no knowledge of the unmanned reconnaissance missions. At the same time, as Elder writes, "The North Vietnamese were undoubtedly familiar with the dwarf aircraft that regularly buzzed their cities, airfields, rail lines, bridges, roads and waterways."[71] Secrecy operated through layers, covering and exposing different aspects of the networked operations, be it the target, the imagery or the aircraft.

The Air Force divisions that deployed the drones, based first in Bien Hoa Air Base in South Vietnam and later in Da Nang Air Base in Thailand, were separated from targeting and track planning, which was done by Strategic Air Command (SAC) in Omaha, Nebraska. The second part of the "Buffalo Hunter" report is devoted to "Mission Planning," and is a focal point for evaluating the use of unmanned aircraft. "Mission Planning" showed how efforts to collect reconnaissance were partitioned, as well as the competing goals that framed the production of images. The report explained time-sensitive targets would have to be approved by SAC and the air division active in the region wanted more direct control of the drones, especially given that drones were the only aircraft that could be flown low enough to collect intelligence during cases of high cloud cover. For example, "[General Lavell] described the target request procedures as 'cumbersome, time-consuming, and insufficiently responsive to urgent requirements to develop or revise BUFFALO HUNTER missions in response to changing threat and weather conditions."[72] Challenges to targeting were construed in terms of responsiveness, emphasizing the losses from missed targets due to environmental condition and error, but also tied to delays in making decisions in the changing conditions of war.

The "Buffalo Hunter" report positioned the drone reconnaissance system against the Vietnamese insurgency, even as details fragment this opposition through internal conflicts in military and industry, strategic air command and the deployed flight division, as well as the large percentage of error. Elder concluded the report by nonetheless noting the changes foretold by the unmanned aircraft:

> It is appropriate that the story of the reconnaissance drone be told at a time when the effectiveness of the North Vietnamese air defenses has demonstrated the need in modern aerial warfare for 'stand-off' delivery systems – for remotely piloted vehicles – of all types. As a possible forerunner of such systems, the drone has flown hundreds of missions over hostile areas and the operation has never lost a crew member.

The possibilities of "stand-off" operations were also used to promote the television guided assault drone in World War II and like these previous systems, the protection of military personnel underwrite accounts of drone's success. In concluding "the operation has never lost a crew member," the report iterated the logic that today guides the use of drones for reconnaissance and combat. Yet, the development of drone aircraft was not continued after the Vietnam War and by the late 1970s unmanned aerial vehicles were recalled as a failed project.

The reconnaissance drones flown for "Buffalo Hunter" missions used a camera that captured 180 degrees of lateral coverage on the ground, exposed on 1,800 feet of seventy millimeter film. At 1,500 feet in altitude, the camera was capable of 120 nautical miles of continuous photographs. Returning to the images collected by drone reconnaissance, I read the enormous photographic strips produced by the drone as a fragmented and layered view of the ground below. In *Lightning Bugs and Other Reconnaissance Drones*, Wagner includes two strips of photographs from the 180 degree lateral shots (figure 18). The first strip, which captured the thatched roofs of villages, small ponds of water and agricultural fields in the distance, is cropped to expose the anti-aircraft installations in the top quadrant of the photograph. The first re-framing showed the military site adjacent to the crop fields, while the final enlargement showed only the batteries. Like the photographs of the Cuban missile installations it is numbered, indicating the seven operational guns at the site. The final version asks the viewer to see as a defense analyst.[73]

The photograph strip shows another picture though, connecting the military installations, agricultural fields and houses – a juxtaposition obscured in cropping the image to show enemy threats.

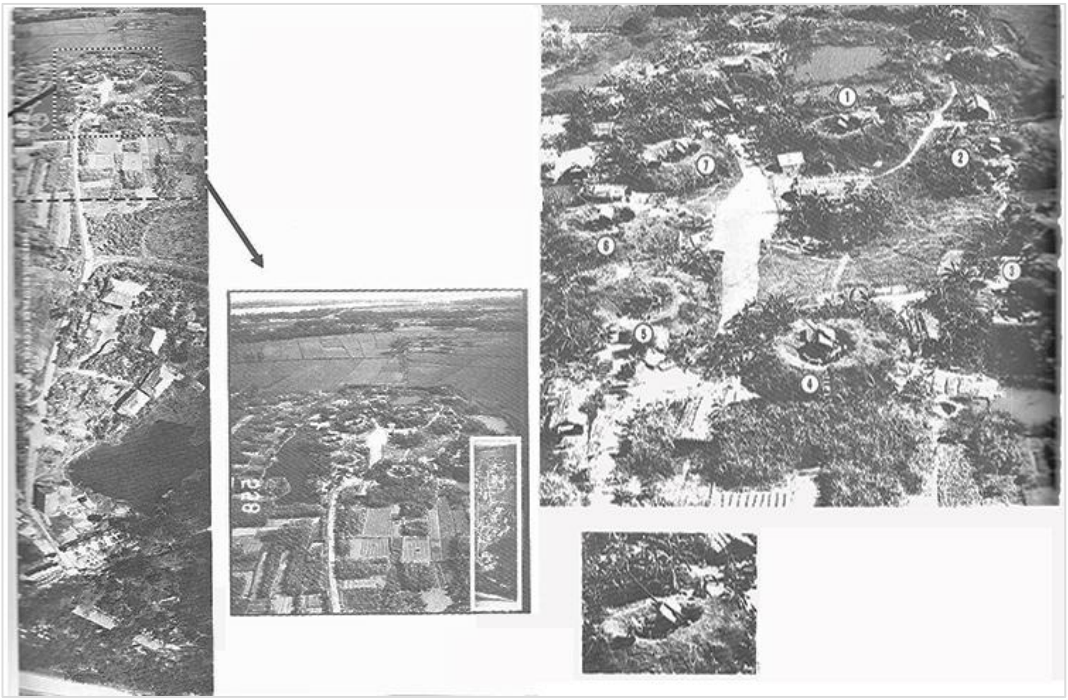

Figure 18. Drone Reconnaissance Imagery. United States Air Force. October 6, 1968. Adapted from Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 1982.

This multi-layered view from the sky, which both showed and obscured the land below, was articulated further when the drone didn't function, as shown in the second photographic strip:

> On one mission in October 1968 when the low-altitude control system wasn't working properly, [the reconnaissance drone] came back with a truly spectacular picture. Instead of flying about 1500 feet over North Vietnam it came in at about 150 over the terrain, flying under a major power transmission line and taking a remarkable series of photos in which natives in coolie hats can be seen on the road staring up at the drone overhead.[74]

The image is a panoramic shot captured by the drone as it flew under the power lines with an electrical tower at the top of the photographic strip (figure 19). Walking on the road below are a number of people looking up into the sky, seeing what is invisible in the picture – the drone overhead. Even as the description of the photograph divided the viewer from the "natives," this encounter is not cloaked by the invisibility of reconnaissance claimed through its association with a "safari" or "hunt." What the image indicates instead is how these views, particularly the sixty percent that did not find their assigned target, were partial, layering together ways of knowing and seeing that juxtaposed the view of the defense analyst with the people on the road looking back. Drone reconnaissance watched, looked and tracked, setting the groundwork for the aerial bombing missions that would follow later (even as the drones also got lost).

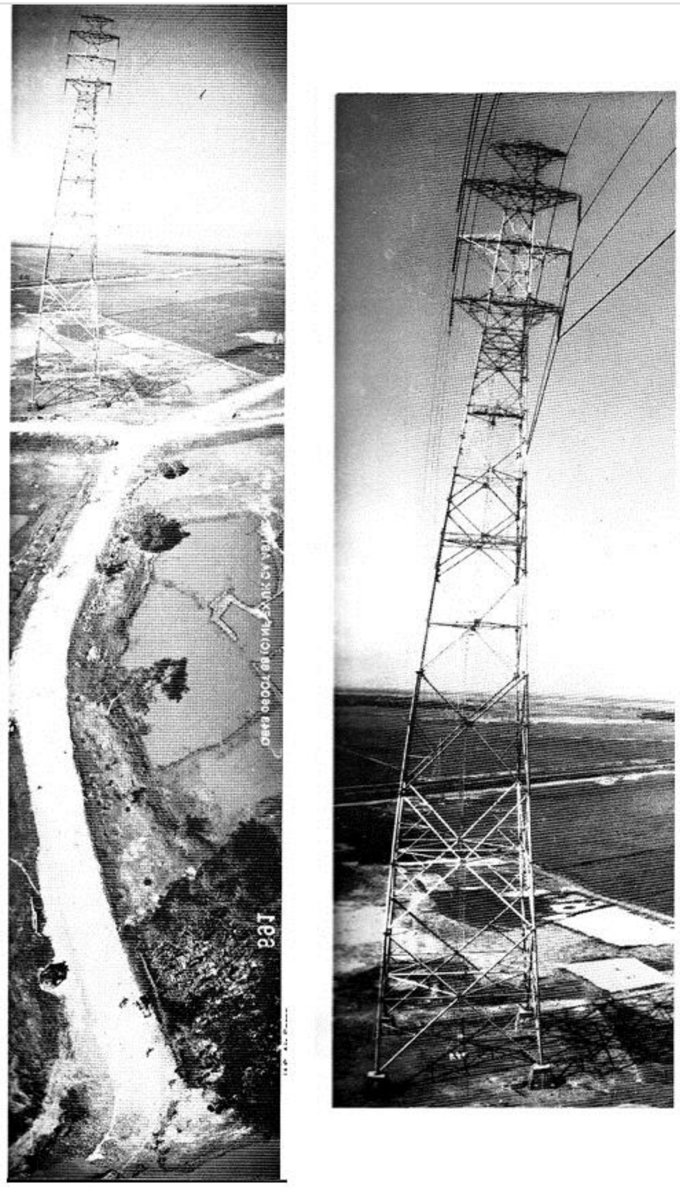

Figure 19. Drone Reconnaissance Imagery. United States Air Force. October 6, 1968. Adapted from Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 1982.

In research mostly undertaken during World War II, Carl Schmitt examined the history of international law to question how territory would operate in what he calls a new global *nomos*, at once a spatial, legal and political order that emerged in the twentieth century. Schmitt explained that prior to the twentieth century the global *nomos*, established in the sixteenth century, relied on the tension between land war, based "on a clear spatial relation between an effectively present occupying authority and the population of the occupied territory,"[75] and wars at sea, which "lack any possibility of realizing this relation of protections and obedience."[76] Air power defied these distinctions and intervened in both these modes of warfare. Schmitt wrote:

> Today, it is no longer possible to abide by traditional spatial concepts and to consider airspace to be a mere appurtenance or component of either land or sea. From above and

> below, this can be thought of only naively, from the perspective of an observer who, from the surface of land or sea, looks up and down, up and down, while bombers pass in the airspace overhead and execute their missions from the sky to the earth.[77]

In this passage, Schmitt shows how airpower undoes the horizon of the battlefield, flipping the axis of warfare. The bombers execute their missions from the sky to earth, stretching out the field of action as they pass overhead. As Schmitt suggests, it is perhaps naïve to conceive this relation from above and below, the bombing from above may not even register to the targets below (at least, not until it is too late), while the streaking aircraft speed beyond the horizon. Yet, as I argued above, reconnaissance is produced to situate the viewer as precisely this kind of observer, a way of looking that was claimed for national protection, even as it was funded by "Big Safari." I add to Schmitt's analysis the significance of ongoing reconnaissance, which mobilized this separation between above and below both in peacetime and war as a new picture of the globe.

Schmitt argued the division between above and below transformed relations of enmity, disrupting the status of opposition which had previously operated between European states. For Schmitt, legal enmity was set out between almost equal opponents. Writing as jet-powered aircraft, atomic bombs and missile technologies come to shape strategies between nations and distributions of global power, Schmitt posited a shift in these relations. He wrote, "The victors consider their superiority in weaponry to be an indication of their *justa causa*, and declare the enemy to be a criminal because it is no longer possible to realize the concept of *justus hostis*."[78] Schmitt went on to explain "the discriminatory concept of the enemy as criminal and the attendant implication of *justa causa* run parallel to the intensification of the means of destruction and the disorientation of theaters of war."[79] Despite the fallibility of the drone missions and their relative lack of success in picturing targets below, the systems nonetheless operated precisely as a way to configure technical superiority. This tied to how the reconnaissance imagery produced a way of knowing the territory below and resulted in asymmetries and disorientation.

Achille Mbembe writing more recently also relies on divisions between above and below to articulate the conditions of vertical sovereignty, which he argues, like Schmitt, transform global relations.

> Under conditions of vertical sovereignty and splintering colonial occupation, communities are separated across a y-axis. This leads to a proliferation of the sites of violence. The battlegrounds are not located solely at the surface of the earth. The underground as well as the airspace are transformed into conflict zones. There is no continuity between the ground and the sky. Even the boundaries in airspace are divided between lower and upper layers.[80]

Pictured from above, the questions raised by sovereignty shift, transforming "under what practical conditions is the right to kill, to allow to live, or to expose to death exercised? [And] who is the subject of this right?"[81] The y-axis, for Mbembe, leads to multiple sites of violence and distributions of power, setting out new boundaries in air space and disturbing how ground and sky are related. Replacing the horizon between states, Mbembe argues instead,

> Everywhere, the symbolics of the top (who is on top) is reiterated. Occupation of the skies therefore acquires a critical importance, since most of the policing is done from the

> air. Various other technologies are mobilized to this effect: sensors aboard unmanned air vehicles (UAVs), aerial reconnaissance jets, early warning Hawkeye planes, assault helicopters, an Earth-observation satellite, techniques of "hologrammatization." Killing becomes precisely targeted.[82]

Socio-technical systems in this passage, named through an array of aerial platforms to survey, collect and target, indicate an alignment between the techniques of controlling populations and ordering space. Contemporary targeted killings tie together these orders, as individuals within certain territories are put to death as criminals through unmanned combat air vehicles. At the same time, the layers presented thicken what is seen from the air. The dominance of air space becomes "high ground," strategically positioned for "effectiveness of sight, self-protection, panoptic fortification that generates gazes to many different ends."[83]

In Cold War America, military and political developments operated on the assumption that technology made "the world so small that it can be overseen and managed easily."[84] Strategic reconnaissance was critical to this formulation, as a military strategy it operated through seeing and watching from above. Tensions between above and below, however, troubled the claim that the world could be managed easily – one might instead ask who sees what and why? Intertwined with these divisions was the protection of the pilot and domestic territory, which layered onto operations inside and outside of the United States. Secrecy obscured and revealed elements of these missions, juxtaposing different ways of knowing and seeing. The practices produced changing territorial configurations, tied to how reconnaissance imagery simultaneously protected, monitored and oversaw the land below, even though, as Vietnam suggests, it was not controlled.

The Middle East and New Origins

Former Ryan Aeronautical employees, William Wagner and William Sloan mention the company's film *Nobody's Perfect* in *Fireflies and Other UAVs* in a chapter about reconnaissance drones sold to Israel. To negotiate the sale of the system, a team from the Israeli Air Force traveled to the United States in June 1970. They visited Firebee operations at Tyndall Air Force Base in Florida and White Sands Missile Range in New Mexico, ending their tour at the company headquarters in San Diego, California. The authors write,

> While in San Diego their host, Bob Schwanhausser, arranged a screening of the company's humorous movie 'Nobody's Perfect.' … In addition to chuckles all around, the willingness to show such incidents (they occur in every company's experience) brought this positive reaction – 'It was great. It sold us, because any company which can laugh at its own mistakes, has obviously fixed them well.'[85]

The filmic structure of *Nobody's Perfect* operates through irony, a reading that might be furthered through the contradictory use of failure to sell the unmanned reconnaissance system. The humor of drone crashes underscores the selling point made by Ryan Aeronautical for drone reconnaissance. It was not just that the company had "fixed" its mistakes, but that the use of unmanned system would mitigate risks. While I did not find another mention of the film, the archive at the San Diego Air and Space Museum includes numerous interviews, newspaper clippings and magazine articles about the sale of the reconnaissance systems to Israel.[86] Known as 124I, the system was the first unmanned reconnaissance drone that Ryan Aeronautical sold internationally, although its 124 model number categorized the system with target drones, which had also been exported to Japan. The 124I were used to collect visual and electronic intelligence over Egypt and Syria, most notably in the Arab-Israeli War in 1973 and remained in use by Israel until the mid-1990s.

As with the international sale of all military systems, the contract had to be approved by the United States State Department. This approval was for a target drone, although it was openly known that this would not be the system's use. Robert Schwanhausser, in-charge of the drone reconnaissance program at the time, explained:

> Ray Bellweg was Vice President of Teledyne Ryan in charge of our Washington office. He had been in on reconnaissance drones from the very beginning and handled the paper work through the State Department. He presented the whole story and openly explained that we were using the 124I nomenclature but that it was indeed a military reconnaissance vehicle.[87]

In the book, Wagner and Sloan add, "because reconnaissance drones, being unmanned, are considered nonpolitical – and being unarmed are not attack vehicles – the State Department considers them defensive in nature rather than offensive."[88] The 124I continues to be listed as a target drone in Teledyne-Ryan Aeronautical's classification of unmanned aircraft. [89] At the same time, in-house publications indicated the drone was a platform for two cameras that alternately collected low altitude and high altitude imagery.[90] The 124I is an open contradiction, claiming to be a target for air defense, while its purpose was to collect intelligence. The ambivalence between these uses, which was exploited in gaining State Department approval for the sale of the system, underscores the contradictions enabled through the drone. Unmanned aircraft reconfigured territory not just by dividing between above and below, but by also confusing what was protection and what was defense, what was political and what was not.

The 1973 Arab-Israeli War was a nineteen day conflict between Israel and the surrounding Arab states, fought in Egypt and Syria. The Ryan drones, which had been sold to Israel in 1971, were used during the war to collect reconnaissance, particularly, of well-defended areas like the Suez Canal. Drone crashes during the conflict made the use of these new systems evident. In 1974, the Israeli Air Forces Journal *Heil Ha'avir* published an article about the aircraft, promoting their use as an alternative to the risks of piloted reconnaissance. This was salient as Israel had lost numerous pilots and aircraft in 1973 due to improved air defense systems used by Egypt and Syria.[91] The sale in 1971 of the Ryan Aeronautical reconnaissance drone also coincided with Israeli investments in the development of unmanned aircraft. Today, it is the largest exporter of military drones in the world.

William Wagner wrote *Lightning Bugs and other Reconnaissance Drones* in the 1970s: "when Pentagon officials read the manuscript, they politely suggested that its publication be postponed indefinitely. By the time 'Security Review' would have finished censoring the story … there wouldn't be much left worth printing."[92] At the time of its publication, in 1982, efforts to build unmanned aircraft were largely de-funded. Benjamin Schemmer, editor of the book and

Armed Forces Journal International writes: "As this book comes off the press, not one U.S. remotely piloted vehicle is operational; indeed, the *only* 'RPV' [remotely piloted vehicle] that Teledyne Ryan Aeronautical now has in production is its original Firebee target drone [emphasis in text]."[93] Wagner was able to publish his account because unmanned aircraft pursued during the Vietnam War was framed as a flawed strategy, even as the possibility that technologies could replace human reconnaissance continued to motivate military developments. The view of the world from above remained central to military strategies, although questions persisted about how drones would operate in the airspace between the ground and the stratosphere.

On June 9, 1982 at the outset of the Lebanon War, Israeli forces attacked the Bekaa Valley in Lebanon. In two hours of intensive fighting, Israel took out the vast majority of the surface-to-air-missile defenses in place, as well as at twenty-two aircraft in the "largest air battle since the Korean War." Israel's losses were minimal. Central to their strategy were unmanned aircraft, modified to transmit video-images in real time to the military commanders, as well as the use of drones as decoys. In "The Bekaa Valley War," Rebecca Grant explains how the systems transmitted video in a section of the essay titled "The Hunt Begins:"

> Remotely Piloted Vehicles provided video. Israel had one squadron of RPVs; … it had limited night-time capability, but the squadron was enough … to keep at least two RPVs in the air all the time. Israeli RPVs helped provide constant locations of the Syrian SAM [surface-to-air-missiles] batteries.[94]

Ralph Sanders provides other details of the Bekaa Valley battle in "An Israeli Military Innovation: UAVs:"

> When the assault began, UAVs cruised the battlespace emitting dummy signals. Syrian radar operators thought that Israeli planes were attacking and launched most of their SAMs against unmanned vehicles. As the Syrians reloaded and were vulnerable to air attack, Israeli fighters struck with telling effect.[95]

Many of today's military historians point to this battle as a starting point for the technologies, including reconnaissance drones, cruise missiles and unmanned combat air vehicles that would first be used by the United States in the Iraq War in 1991, as well as the operations tied to the Global War on Terror, beginning in 2001. American forces, which were on stand-by as the United States negotiated a cease-fire between Israel and Lebanon, began efforts to acquire the drone used to transmit video shortly after this battle. The Navy version of the aircraft became the Pioneer, tested by the United States Navy in 1985 and used in the Iraq War in 1991. Other drones used by the Israeli Army in the battle were the 124I Firebee that it had purchased in 1974, after the Arab-Israeli War in 1973 had left Israel with only two working models, as well a smaller system built by Northrop, the *Chukar*, also acquired in the early 1970s.[96]

Even though American technologies were also deployed in battle, it is not uncommon to point to Israel as the leading innovator of contemporary drones, which is suggested by the title of Sanders' article, "An Israeli Military Innovation: UAVs." He argues that the sensitivity of the region, concerns about the capture of prisoners and the economic advantages of unmanned air vehicles guided the systems development in Israel, using arguments that paralleled the promotion of drones in the United States. Even though the air battle at Bakaa Valley does mark a significant transformation in the use of drones – they use real-time intelligence and electronic information to coordinate actions between manned and unmanned aircraft – I want to thicken the story of their origin, which also relies on the system sold by Ryan Aeronautical to Israel as a target.

To untangle how drones network humans and nonhumans shows interconnections that change geographical, national and human limits in unprecedented ways. These links are also sources of division, clouded through the secrecy that is used in all levels of the system's development from its design to its use and subsequent reviews. Piecing together how drones produced aerial reconnaissance and the ways these images were used does not reveal an all-seeing view from the sky. Instead, it shows multiple, contradictory layers that are marked by tensions between protection and attack; possibility and failure; and above and below. The drone dissimulates, as it acts globally, make claims to both evidence and secrecy; protection and attack. Such a view complicates what is presumed in seeing the world below, even as it indicates the significance of drone flight in reconfiguring territory.

Conclusion

In first frame of a United States military video the title card explains: "Multi National Division Baghdad, MND-B, Soldiers fire missile from UAV, kill two terrorists, 3:30 a.m., April 9, 2008."[1] Before any images appear, a short text adds, "Soldiers using an unmanned aerial vehicle observed a group of terrorists with weapons attacking Iraqi Security and Coalition Forces with small arms fire in northeast Baghdad. The crew guiding the UAV fired one Hellfire missile and killed two of the armed terrorists."[2] The video is a little over a minute, made from a grainy, infrared footage. Crosshairs frame the center of the visible image. The border is redacted, blacking out what would be the pilot's control panel readings on the edges of the screen. In the initial seconds of the video, shots are fired from a gun by two dark figures who appear amidst a row of parked cars and structures. The images register the heat of the human bodies, which contrast with the light to medium grey color of the surrounding vehicles and structures. The camera follows the figures, as they run toward the bottom of the screen. In the posted video, the initial shot is shown again after several seconds, this time zooming in on an individual, who raises a weapon, gunfire bursting into the sky. It is the same shot from the opening second of the video, repeating the sequence to frame the actions of the blotchy figures. As the video focuses on the shooter, the weapon's fire appears as black streaks against a monotone background, making the attack clear. The human figures scatter through the parking lot, running to the buildings at the bottom of the screen. As if it were a chase scene, the camera tries to follow the shooters as they disappear around a corner and appear again, re-captured as the camera zooms in on the structures in the bottom part of the frame. The viewer then sees the four figures standing in an alleyway behind a building. After a moment, they begin running again. Approaching the edge of the frame, there is a sudden explosion, inking over the image in black, as fragments explode in the air. The hellfire missile strike consumes the screen and the image immediately cuts to black (figure 20). The entire sequence is silent.

The short piece of UAV footage, found on the Department of Defense (DOD) military videos website, invites a particular way of seeing. I offer a reading of the sequence as a conclusion because it foregrounds the tensions articulated by the aircraft: Who is human? Who is an enemy? And how is this experienced onscreen? My genealogy troubles the encounter proposed through the video screen, even as it raises questions about what is seen and the facts proposed by the titles that frame the video. The video's title card identifies the figures as terrorists and the perspective through the UAV as that of a soldier. Unlike many press accounts, which describe the UAV strikes in the passive voice or attribute the action to the drone, the image is attributed soldiers, invisible in the sequence, who are opposed to the terrorists onscreen. Shot at night using an infrared camera, the figures are identified through their movements, a potentially threatening pattern against an otherwise static backdrop. The one minute film stands for how the Department of Defense would like to situate unmanned combat air vehicles, even though the footage would be an anomaly in the hundreds of thousands of hours collected by drone aircraft since 2001. The sequence – one of the few featuring footage from UAVs on the official DOD website – was likely selected because the actions of the figures can be clearly identified as hostile. This is emphasized by repeating the shot of the figure shooting the weapon, which opposes the viewer to the scene below. Still partially illegible to the untrained viewer when the first shots are fired in opening moments of the video, the clip shows the shot again, zooming in on the shooter. Beginning with the close-up, the camera movements apparently respond to the gunfire as if the viewer were threatened. Rather than emphasizing the protected position of the distant watcher, the scene establishes an antagonism between the figures and the operator. The camera attempts to locate the figures as they run across the lot to the nearby structures, where they are found, hidden behind one of the buildings. As they begin running again, the sequence is utterly transformed by the Hellfire missile strike, obliterating the image with pitch black, exposing the intensity of the fiery explosion in infrared reversal.

Figure 20. MND-B Soldiers Kill Two Terrorists (Stills). Multi-National Division Baghdad, "MND-B Soldiers Kill Two Terrorists," April 9, 2008.

Even though the video opposes the "soldier" and "terrorist," the Hellfire missile strike establishes the technological advantage of the "soldier," responding to the small-arms fire by obliterating the human targets. Once the scene has been set up to portray a defensive counter-attack, the scale of the missile strike overwhelms the chase scene that has come before. The inky black explosion insists the "soldier," literally, is on top. Unlike the majority of the drone strikes carried out between 2009 and 2014 through a secret Central Intelligence Agency (CIA) program, the scene from 2008 video corresponds with the occupation of Iraq by American armed forces. The confusion between what the camera on the UAV sees and the action of the soldier is invited, in part, by this occupation. Yet, this immersive view is also embedded in the segment of images, which tracks, follows and responds to the actions of the figures onscreen. As mentioned previously, this video was likely uploaded on the DOD website because it enacts a familiar chase scene, positioning the viewer as pursued even though the Hellfire missile strike undoes this relationship, insisting instead on the mastery of technology.

Three important aspects of the video are obscured: its context within the rest of the footage taken by the UAV, deployed for up to twenty-four hours at a time; the instrument panel readings which would be used by the pilot to maneuver the aircraft following the headings provided by the sensor operator; and the sound that would have accompanied the image. How would this scene be different were it viewed after hours of monotonous footage? Why is the text and graphic overlay redacted? Is this information, actually, more important than the image? And who was the pilot and sensor operator in communication with, when the decision was made to carry-out the missile strike? The limitations of seeing through the UAV are significant here. The cat-and-mouse chase invites the viewer to watch the scene as if it were unfolding before her. Yet, this immersive engagement is produced by interactions between a pilot and sensor operator, networked through radio, digital and visual communication. The video captured by the UAV can be watched by military personnel at the Pentagon or it can be transmitted to forces on the ground. Who the soldiers are and where they are located are far from singular; in some cases, the information is shared with allies, underscoring the distinction between soldiers and terrorists – not warring countries.

The tensions between what is seen in this video and what is unseen are indicative of the contradictions I argue underwrite the development of drone aircraft and are examined through my research genealogically. Connecting and disjoining human and nonhuman, actions through drone aircraft are networked, even as they are opposed to an enemy onscreen, pictured below. The cat-and-mouse chase sets out the defensive reaction of the drone, while the Hellfire explosion insists on the technical superiority of the drone. The viewer is invited to watch and survey, which becomes how the drone strikes and kills. At the same time, drones invite a politics of dissociation, which relies on obfuscating these tensions through division and displacement, separating human and nonhuman, who is protected and who is not, and what is near and what it far. Turning to these tensions though, what would it mean to read against these dissociations? How do contradictions enacted by the humans and nonhumans networked through drone aircraft simultaneously question the system's very operation? Questions raised by unmanning, I propose, are not about the negation of man, but rather, call for an interrogation of how negations are enacted between humans and nonhumans and the stakes of these relations at once proximate and distant.

Endnotes

Introduction

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[28] See, for example, Missy Cummings et al., "Automation Architecture for Single Operator Multiple UAV Command and Control," *The International Command and Control Journal* 1, no. 2 (2007): 1-24.

[29] See, for example, Ben Grocholsky, James Keller, Vijay Kumar, and George Pappas. "Cooperative air and ground surveillance," *Robotics & Automation Magazine, IEEE* 13, no. 3 (2006): 16-25.

[30] Cullen, "The MQ-9 Reaper Remotely Piloted Aircraft," 2011. The dissertation is redacted and significant portions of his argument are obscured. The claims I make are based on what can be read of the argument.

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Chapter 1

[1] William Standley, from Chief of Naval Operations (CNO) to Naval Bureau of Ordinance (BuOrd), c.c. Bureau of Engineering (BuEng), Bureau of Aeronautics (BuAer), Washington, D.C., March 23, 1936, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[2] Delmar S. Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, (unpublished manuscript, United States Navy, Washington, D.C., 1957), 190. Collected Records of D. S. Fahrney, RG 72, NARA II.

[3] A. D. Bernhard, from Plans to Chief of BuAer via Asst. Chief of the BuAer, August 19, 1935, Washington, D.C., Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[4] Kenneth P Werrell, *Archie, Flak, AAA, and SAM: a Short Operational History of Ground-Based Air Defense*. (Maxwell Air Force Base, Ala: Air University Press, 1988), 2-3. Werrel points out air defense is largely unexamined by military historians, explaining "the subject of ground-based air defense systems is neglected for a number of reasons. First of all, research is difficult because source material is fragmented. Even more significant is the fact that the topic does not have 'sex appeal.' Readers are more interested in aircraft than the weapons that bring them down" (xv). However, he goes on to write, "Despite this neglect … ground-based air defense systems are important. They have been involved and have impacted on most air conflicts and have achieved notable success in some" (xvi).

[5] Allan R. Millet, “Patterns of Military Innovation in the Interwar Period,” in eds. Williamson Murray and Allan Millet, *Military Innovation in the Interwar Period*, (Cambridge: Cambridge University Press, 1996), 333.

[6] See Zaloga, *Unmanned Aerial Vehicles: Robotic Warfare 1917-2007*. During World War I, efforts were made to test remotely flown and autonomously operated aircraft as aerial torpedoes by the Army Air Corps. They were led by Charles Kettering, Orville Wright and Elmer Sperry. Known as the Kettering Bug, the project was top-secret and remained experimental. No mention is made of this project by the Navy and it is possible that they were not aware of the earlier tests, which pre-date their project to the experiments from 1923-1924.

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[11] Naval Attaché Report No. 778, Great Britain, July 25, 1935, Queen Bee, Technical Files, National Air and Space Museum Archives, Washington, D.C.

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[14] Ibid.

[15] While no evidence is provided to support Fahrney’s claim that the name followed the bee reference made by the English, the monthly reports and semi-annual reports for the radio controlled target planes after November 1936 begin using the term drone, meaning a robot plane. Moreover, that Fahrney makes the connection between the drone and the functioning of a target plane the basis of its naming merits further consideration of how the insect relates to the technical developments.

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[20] Bruno Latour. "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts," in Bijker and Law, eds. *Shaping Technology, Building Society: Studies in Sociotechnical Change*, (Cambridge: MIT Press, 1992), 254.

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[22] Fahrney, Monthly Report of Progress, September 1936.

[23] The use of capital letter, quotation marks and other punctuation directly follows conventions used in the reports I cite. Over the course of the war, the code name "DRONE" shifts to DRONE to Drone to drone and the meaning of the term as a radio controlled target plane enters the *Oxford English Dictionary* in 1946.

[24] D. S. Fahrney, from Commander-in-Charge of Radio Controlled Target Planes to Chief of the Bureau of Aeronautics, Monthly Report of Progress, March 10, 1937, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[25] D. S. Fahrney, from Commander-in-Charge of Radio Controlled Target Planes to Chief of the Bureau of Aeronautics, Monthly Report of Progress, October 8, 1936, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[26] D. S. Fahrney, from Commander-in-Charge of Radio Controlled Target Planes to Chief of the Bureau of Aeronautics, Semi-Annual Report of Progress, December 30, 1936, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[27] Bruno Latour. *Politics of Nature: How to Bring Sciences into Democracy*, trans. Catherine Porter (Cambridge: Harvard University Press, 2004), 62.

[28]Fahrney, Semi-Annual Report of Progress, December 30, 1936.

[29] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 215.

[30] Fahrney, Semi-Annual Report of Progress, December 30, 1936.

[31] D. S. Fahrney, from Commander-in-Charge of Radio Controlled Target Planes to Chief of the Bureau of Aeronautics, Monthly Report of Progress, April 8, 1937, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[32] Ibid.

[33] Ibid.

[34] D. S. Fahrney, from Commander-in-Charge of Radio Controlled Target Planes to Chief of the Bureau of Aeronautics, Monthly Report of Progress, November 15, 1937, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[35] Gilbert Simondon, *Du Mode d'Existence des Objets Techniques,* (Paris: Aubier, 1958), 10. "L'opposition dressée en entre la culture et la technique, entre l'homme et la machine, est fausse et sans fondement … et qui constitue le monde des objets techniques, médiateurs entre la nature et l'homme."

[36] Ibid. "La culture se conduit envers l'objet technique comme l'homme envers l'estranger quand il se laisse emporter par la xénophobie primitive."

[37] Ibid. "la machine est l'étrangère; c'est l'étrangère en laquelle est enfermé de l'humain, méconnu, matérialisé, asservi, mais restant pourtant de l'humain."

[38] Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 204.

[39] Ibid., 204-205.

[40] Fahrney, Monthly Report of Progress, April 8, 1937.

[41] Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 208.

[42] Ibid.

[43] Ibid., 209.

[44] Ibid.

[45] Ibid., 211.

[46] Fahrney, Monthly Report of Progress, November 15, 1937.

[47] Ibid.

[48] Ibid.

[49] Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 213.

[50] Ibid.

[51] in Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 230.

[52] D. S. Fahrney, from Commander-in-Charge of Radio Controlled Target Planes to Fleet Gunnery Officer, July 29, 1938, San Diego, CA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[53]Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 211-220.

[54] Ibid., 231.

[55] Robert S. Ehlers Jr, *Targeting the Third Reich: Air Intelligence and the Allied Bombing Campaigns*, (Lawrence, University of Kansas Press, 2009), 17.

[56] Williamson Murray, "Strategic bombing: The British, American, and German experiences," in *Military Innovation in the Interwar Period*, eds. Williamson Murray and Allan Millet (Cambridge: Cambridge University Press, 1996), 97.

[57] In Roger G. Miller, *Billy Mitchell: 'Stormy Petrel of the Air,'* (Office of Air Force History, Washington D.C., 2004), 33.

[58] Murray, "Strategic Bombing," 107.

[59] D. S. Fahrney, Memorandum for Chief of the BuAer and Division of Fleet Training, August 15, 1938, San Diego, CA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[60] D. S. Fahrney, Officer-in-Charge of Radio Controlled Aircraft to Chief of the BuAer, August 29, 1938, San Diego, CA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[61] J. S. McCain, Commanding Officer to Commander-in-Chief US Fleet; Commander Aircraft, Battleforce; Commander Battleforce, August 29, 1938, San Diego, CA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[62] Ibid.

[63] Ibid.

[64] Ibid.

[65] Ibid.

[66] Fahrney, August 29, 1938.

[67] McCain, August 29, 1938.

[68] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 238.

[69] Ibid.

[70] Murray, "Strategic Bombing," 98.

[71] Delmar S. Fahrney, Officer-in-Charge of Radio Controlled Aircraft to Chief of the BuAer, Procedure for a dive bombing practice by a drone on the U.S.S. Utah, September 11, 1938, San Diego, CA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[72] Walter Brown, Commanding Officer to CNO; Commander Base Force; Commander-in-Chief United States Fleet, September 17, 1938, San Diego, CA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[73] Ibid.

[74] Ibid.

[75] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 249.

[76] Samuel Weber, *Targets of Opportunity: On the Militarization of Thinking*. (New York: Fordham University Press, 2005), viii.

[77] Ibid.

[78] Ibid., xi.

[79] Rey Chow, *The Age of the World Target: Self-Referentiality in War, Theory, and Comparative Work*. (Durham: Duke University Press, 2006), 12-15.

[80] Ryan Bishop, Gregory K. Clancey, and John Phillips. *The City as Target*. (Abingdon, Oxon: Routledge, 2012).

[81] Weber, 130.

[82] Ibid., 4

[83] Ibid.

[84] C. L. Miller, "Visit to U. S. Army Material Division, Wright Field, Dayton, OH" to Plans, July 20, 1936, Washington, D.C., Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[85] Reginald Denny to Rear Admiral D. S. Fahrney, January 6, 1958, New York, NY, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[86] Ibid.

[87] Ibid.

[88] Ibid.

[89] Ibid.

[90] Ibid.

[91] E. M. Powers and R. Fink, “Acceptance Tests of Denny Radio Controlled Target Plane.” Air Corps, Material Division, Wright Field, Dayton, OH, October 18, 1938, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[92] Denny, January 6, 1958.

[93] Powers and Fink, October 18, 1938.

[94] D. S. Fahrney to the Bureau of Aeronautics, June 21, 1939, Philadelphia, PA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[95] Ibid., 278.

[96] Ibid., 279.

[97] Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 277.

[98] Ibid.

[99] R. J. Jones. Survey of Firings of Radio Controlled Aircraft, 1940, Philadelphia, December 27, 1940, Philadelphia, PA, Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[100] D.S. Fahrney to CinC, Chief of the BuAer, April 3. 1939, San Diego, CA. Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[101] W. D. Leahy, CNO to H. P. Jones, CinC, July 6, 1939, Washington, D.C., Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[102] in Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 295-296.

[103] Ibid., 296.

[104] See Myron Smith, *Pearl Harbor, 1941 (A Bibliography), (*Westport, CT: Greenwood Publishing Group, 1991), for a comprehensive bibliography.

[105] Headquarters of the Commander-in-Chief, “Anti-Aircraft Action Summary – World War II,” *The Navy Department Library,* accessed September 8, 2013, http://www.history.navy.mil/library/online/antiaircraft_action_summary_wwii.htm.

[106] Radioplane, 1945. Radioplane Technical Files, National Air and Space Museum Archives, Washington, D.C.

Chapter 2

[1] Oscar Smith, Commodore United States Navy to Lieutenant Robert Jones, November 26, 1944. Washington, D.C., Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[2] James Hall, *American Kamikaze,* (Titusville, FL: J. Bryant, 1984).

[3] Ibid., 214.

[4] Ibid., 203.

[5] Ibid., 214.

[6] Ibid.

[7] See Albert Abramson, *Zworykin – Pioneer of Television*, (Champaign, IL: University of Illinois Press, 1995); Gary Edgerton, *Columbia History of Television*, (New York, NY: Columbia University Press, 2010).

[8] in Edgerton, 46. See also Kenneth Bilby, *The General: David Sarnoff and the Rise of the Communications Industry*, (New York, NY: Harper and Row, 1986).

[9] V. K. Zworykin, "A Flying Torpedo with an Electric Eye," April 25, 1934. Reprinted in *RCA Review*, (September, 1946), 359. Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[10] D. S. Fahrney, Commander-in-Charge of Radio Controlled Target Planes to the Chief of BuAer, August 6, 1936, Washington D.C., Target Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[11] Hall, 54.

[12] Ibid., 55.

[13] Marshall McLuhan, *Understanding Media: The Extensions of Man*, (Cambridge, MA: The MIT Press, 1964), 10.

[14] Ibid., 352.

[15] Ibid.

[16] William Uricchio, "Television's First Seventy-Five Years: the Interpretive Flexibility of a Medium in Transition," in ed. Robert Kolker, *The Oxford Handbook of Film and Media Studies,* (Oxford: Oxford University Press, 2008), 288.

[17] Hall, 61.

[18] Zworykin, 359.

[19] Ibid.

[20] Ibid., 359-360.

[21] Ibid., 360.

[22] The claims made by Zworykin and, later in the chapter, Oscar Smith could be related to contemporary discussions of suicide bombing, which have observed, in spite of the differences between the cases, how missions by Japanese *Tokko Tai* are related to terrorist tactics, notably, the attacks on September 11, 2001. Japanese efforts differ significantly from the more recent events, however, as they were carried out under the auspices of a nation state. See Emiko Ohnuky-Tierney, *Kamikaze, Cherry Blossoms, and Nationalisms: the Militarization of Aesthetics in Japanese History*, (Chicago, IL: University of Chicago Press, 2002).What nonetheless seems significant, and I point out here, is that American military technologies are counterposed to Japanese suicide missions, suggesting how technological developments are thought of as both replicating enemy tactics, but without the same risk to American life. This links to critiques made by Talal Asad, *On Suicide Bombing*, (New York, NY: Columbia University Press, 2007), which indicate how the apparatus of the American state justifies certain kinds of warfare in the name of protecting American lives, while condoning acts of violence carried out without the institutional and technological apparatus of the military as terrorism.

[23] Zworykin, 360.

[24] Ibid., 361.

[25] Donald A. MacKenzie, *Inventing Accuracy: An Historical Sociology of Nuclear Missile Guidance*. (Cambridge, MA: MIT press, 1993), 214.

[26] Ibid., 384.

[27] Uricchio, 289.

[28] Wiebe E Bijker, "How is technology made?—That is the question!," *Cambridge Journal of Economics* 34, no. 1 (2010): 69.

[29] MacKenzie, 371.

[30] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 318.

[31] Ibid., 313.

[32] Ibid., 325.

[33] Walter Webster, Manager of NAF to Chief of the BuAer, August 22, 1941, Philadelphia, PA, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[34] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 338. He explains further, "Since the established aircraft industry could not be used, design called for a plastic plywood airplane powered by the flat air-cooled 150 h.p. engine. (a) Simplicity in design and structural arrangement for economical manufacture. (b) readily assembled and disassembled in a short period of time (c) plane must occupy a minimum of space when crated for shipment. (d) tricycle

landing gear must be designed for easy jettisoning." The TDR model drones were, in part, manufactured by piano producers who were able to satisfy these requirements"

[35] in Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 339.

[36] See Albert Axell and Hideake Kase, *Kamikaze: Japan's Suicide Gods*. (London: Longman Publishers, 2002), 40-44, for an account of Japanese pilot who crashed his aircraft, which had been shot down, into an American ship during Pearl Harbor. There is, however, no Suicide Corps in Japan until 1944.

[37] in Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 371.

[38] in Ibid., 372. In discussions of the proposals Fahrney noted: "The reasoning behind this large expansion was generated from the study of new weapons in World War I; with particular reference to the British introduction of the tank and the German introduction of gas; and the failure of each to have sufficient supplies on hand to exploit the advantage gained."

[39] J. H. Towers. Chief of BuAer to Vice-Chief of Naval Operations, June 29, 1942. Washington, D.C., Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[40] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 373.

[41] Ibid., 394.

[42] Ibid., 386.

[43] While a test in 1943 had indicated the ability of drones to be launched off a carrier, the TDRs being developed were designed for take-off from a runway.

[44] Ibid., 396-399.

[45] Ibid., 401.

[46] E. J. King CNO to Vice-Chief of Naval Operations, September 8, 1944. Washington, D.C., Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.

[47] See Murray and Millet, 1996 for international context and Stephen McFarland, *America's Pursuit of Precision Bombing, 1910 – 1945*, (Washington, DC: Smithsonian Institution Press, 1995).

[48] John R. Glock, "The Evolution of Air Force Targeting," *Air and Space Power Journal* 26, no. 6 (2012): 151.

[49] See Sven Lindqvist, *A History of Bombing*, (New York, NY: New Press, 2001); Toshiyuki Tanaka and Marilyn Blatt Young. *Bombing Civilians: a Twentieth-Century History*, (New York, NY: New Press, 2009); Tami Davis Biddle, *Rhetoric and Reality in Air Warfare: the Evolution*

of British and American Ideas about Strategic Bombing, 1914-1945, (Princeton, N.J.: Princeton University Press, 2002).

[50] See Robert Ehlers, *Targeting the Third Reich: Air Intelligence and the Allied Bombing Campaigns*, (Lawrence, KS: University Press of Kansas, 2009).

[51] Glock, 153.

[52] Ibid.,. 155.

[53] Denis Cosgrove and William L. Fox, *Photography and Flight* (London: Reaktion, 2010), 55.

[54] "Basic Encyclopedia," *U.S. Legal*, http://definitions.uslegal.com/b/basic-encyclopedia-military-law/ (accessed September 8, 2013).

[55] "Service Test of Assault Drone," July 30, 1944, National Air and Space Museum Motion Picture Archives, Steven F. Udvar-Hazy Air and Space Center, Chantilly, VA. The motion picture archivist explained to me that the tape was given to the assistant director of the Smithsonian, a former member of the U.S. Military, anonymously and he donated to the NASM archives, rather than the Smithsonian archives. Part of the film is available at "Service Test In-Field of TDR-1 – WWII, Torpedo Drone," *YouTube*, accessed September 18, 2013. www.youtube.com/watch?v=8RQcUtzAe98

[56] NOLO stood for "No Live Operator." See chapter 1.

[57] "Service Test of Assault Drone," 1944.

[58] Ibid.

[59] Ibid.

[60] Ibid.

[61] Ibid.

[62] Ibid.

[63] Charis Thompson, *Making Parents: the Ontological Choreography of Reproductive Technologies*, (Cambridge, MA: The MIT Press, 2005), 8.

[64] in Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 416.

[65] Army reports refer to the drone as a robot.

[66] E. E. Partridge, "Summary of Navy Drone Project," memorandum Major General USA to Commanding General, Eighth Air Force, Report on Aphrodite Project, January 20, 1945. War Weary Willies, Miscellaneous Decimal Files, RG 236, NARA II.

[67] Ibid.

[68] Ibid.

[69] in Fahrney, *The History of Pilotless Aircraft and Guided Missiles,* 404.

[70] Ibid., 339.

[71] Nick T. Spark, "Command Break," *Proceedings*, United States Naval Institute, 2005, accessed September 8, 2013, http://stagone.org/?page_id=20.

[72] Ibid.

[73] Fahrney, *The History of Pilotless Aircraft and Guided Missiles*, 429.

[74] Peter Galison, "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision." *Critical Inquiry 21* no. 1 (Fall / Winter 2004): 231.

[75] Ibid, 265.

[76] Ibid, 230.

[77] Ibid.

[78] Newcome, 2004; Zaloga and Palmer, 2008. Both authors claim the assault drones built by Fahrney and tested during World War II were the first unmanned combat air vehicles used in warfare.

[79] Fahrney's role in developing cruise missiles is examined by Kenneth Werrell. *The Evolution of the Cruise Missile*. (Maxwell Air Force Base, Ala: Air University, Air University Press, 1986). It uses examples now found in the history of unmanned aircraft.

[80]Delmar S. Fahrney, *"The Birth of Guided Missiles." United States Naval Institute Proceedings* 106 (December 1980): 54.

[81] Assistant Chief of Air Staff, Material and Services Division, "Guided Missiles Development Status and Availability," January 28, 1945. Decimal Files, Records of the Army Air Forces, Record Group 18 (RG 18), National Archives Building II, Washington, D.C (NARA II).

[82] Delmar Fahrney to John Newbauer, March 12, 1981. Delmar Fahrney Technical File. National Air and Space Museum Archive, Washington, D.C.

[83] Delmar Fahrney to John Newbauer, March 12, 1981. Delmar Fahrney Technical File. National Air and Space Museum Archive, Washington, D.C.

[84] Fahrney, "The Birth of the Guided Missile," 60.

[85] John Newbauer to Delmar Fahrney, March 26, 1981.

[86] Delmar Fahrney to John Newbauer, March 26, 1981.

[87] Ibid.

[88] Ibid.

[89] Fahrney, "The Birth of the Guided Missile," 54.

[90] Delmar Fahrney, *"The Genesis of the Cruise Missile," Astronautics and Aeronautics Journal* (January 1982): 34.

[91] D.S. Fahrney to P. D. Stroop, November 28, 1960. Delmar Fahrney Technical File. National Air and Space Museum Archive, Washington, D.C.

[92] Ibid.

[93] P. D. Stroop to D.S. Fahrney, January 10, 1961. Delmar Fahrney Technical File. National Air and Space Museum Archive, Washington, D.C.

[94] Lee Pearson, "Interview with Delmar Fahrney," March 17, 1960. Delmar Fahrney Technical File. National Air and Space Museum Archive, Washington, D.C.

[95] Ibid.

[96] While it is clear that, in the 1960s, the manuscript was intentionally kept classified, the bureaucracy associated with declassifying documents may have played a role in keeping the materials secret. See James David, "Two Steps Forward, One Step Back: Mixed Progress Under the Automatic/Systematic Declassification Review Program," *American Archivist* 60, no. 2 (Fall/ Winter, 2007): 219-251.

[97] Stroop, January 10, 1961.

[98] Ibid.

Chapter 3

[1] See Northrop-Grumman Corporation, "Targets Overview," accessed April 13, 2014. http://www.northropgrumman.com/Capabilities/BQM74EAerialTarget/Documents/TGTS-Fact-Sheet.pdf. In World War II, Radioplane led the manufacture of drones, providing training targets to the Army and the Navy. As explored in this chapter, the *Firebee* replaces this system, even though Radioplane, acquired by Northrop in 1950, continued to develop unmanned aircraft. My focus on the *Firebee* is based on its continuous use by all three branches of the military for over six decades. Ryan Aeronautical, the developer of the system, was acquired by Teledyne in 1969. Teledyne-Ryan was bought by Northrop-Grumman in 1999 and now manufactures the target.

Claims made about the system today, e.g. “The BQM-34 Firebee is the most capable and reliable high performance aerial target system. The primary mission of Firebee is to simulate tactical threats by enemy aircraft and missiles for defense readiness training, air-to-air combat training and the development and evaluation of weapons systems,” are not unlike those made by Ryan Aeronautical when the system was introduced publicly in 1953.

[2] The technical files at the National Air and Space Museum (NASM), from which these photographs and captions are drawn, are collections of news clippings, press releases and photographs. I focus on the images that circulated publicly in 1953, usually, indicated through a stamp on the back of the photograph of the date it was received by the Institute of the Aeronautical Sciences, which would publish articles about new aircraft. The materials from the Institute of Aeronautical Sciences were subsequently archived by NASM.

[3] Ryan Aeronautical. Photograph. (Received May 21, 1953, Institute of the Aeronautical Sciences.) A/BQM-34 Technical Files, National Air and Space Museum Archives, Washington, D.C.

[4] Safety pilot was the name given to the human pilots who tested the drone aircraft when the systems were developed in the interwar. See the discussion chapter 1 for more details.

[5] The military designation was later changed to A/BQM-34, which applied both to target drones and to the reconnaissance systems modeled on the Firebee. The reconnaissance aircraft were coded through various insect names including Lightning Bug and Firefly. Other model names included Compass Arrow and Compass Cope. In this chapter, I use the name Firebee to refer to both target and reconnaissance drones (much like the military designation).

[6] Alex Roland, *The Military-Industrial Complex*, (Washington, D.C.: American Historical Association, 2001), 25.

[7] Ibid, 14.

[8] William Wagner and William P. Sloan, *Fireflies and Other UAVs (Unmanned Aerial Vehicles)*. (Arlington, TX: Aerofax, 1992), 16.

[9] Roland points out the Eisenhower’s formulation draws from C. Wright Mills, *The Power Elite*, (New York, NY: Oxford University Press, 1956). The address is also discussed in Charles J.G. Griffin, “New Light on Eisenhower’s Farewell Address,” Presidential Studies Quarterly 22, no. 3 (Summer 1992): 469 – 479. In the Vietnam era, the military-industrial complex is taken up by social scientists and historians. See, for example, Steven Rosen, ed., *Testing the Theory of the Military-Industrial Complex*, (Lexington, MA: Heath, 1973). While the build-up of weapons during the Cold War is unique to American history is it not without precedent. This is explored by Paul Koistinen, *The Military-Industrial Complex: A Historical Perspective*, (New York, NY: Praeger, 1980). See also William McNeill, *The Pursuit of Power: Technology, Armed Force and Society since A.D. 1000*, (Chicago, IL: University of Chicago Press, 1982) and Merritt Roe Smith, ed., *Military Enterprise and Technological Change: An American Perspective*, (Cambridge, MA: The MIT Press, 1985).

[10] Dwight D. Eisenhower, “President Dwight D. Eisenhower’s Farewell Address” (speech, Washington, DC, January 17, 1961), *Our Documents* http://www.ourdocuments.gov/doc.php?flash=true&doc=90.

[11] Roland, *The Military Industrial-Complex*, 3-4.

[12] Ibid., 15.

[13] “The Bee with an Electronic Brain,” *Ryan Reporter*, March 15, 1953, 12. A/BQM-34 Technical Files, National Air and Space Museum Archives, Washington, DC.

[14] “The Bee with an Electronic Brain,”12.

[15] Ibid., 12-13.

[16] Ibid., 13.

[17] Ibid.

[18] Geoffrey Bowker, “How to Be Universal: Some Cybernetic Strategies, 1943-70,” Social Studies of Science 23, no. 1, (1993): 107-127. Cybernetics is what Bowker has called a “universal science,” even as his article points to the ways cybernetics emerges in the immediate aftermath of World War II. The reach of cybernetics during the Cold War was wide ranging, including biology, ecology, computer science, communications studies, social sciences and the arts, and it is the ways that the theories became part of language used to describe the Firebee in 1953 that I attend to in this section. It is unclear to what extent cybernetics informed the engineering decisions made during the process of building the Firebee between 1948 and 1953, although, the press releases rely on the ubiquity of the ideas. Other discussions of cybernetics in this period include: Katherine Hayles, How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics, (Chicago, IL: University of Chicago Press, 1999); John Johnston, The Allure of Machinic Life: Cybernetics, Artificial Life, and the New AI, (Cambridge, MA: MIT Press, 2008); Jean-Pierre Dupuy, The Mechanization of the Mind: The Origins of Cognitive Science, trans. M. B. DeBevoise (Princeton, NJ: Princeton University Press, 2000).

[19] Galison, “The Ontology of the Enemy: Norbert Weiner and the Cybernetic Vision,” 265.

[20] Ryan Aeronautical, Photograph, (Received February 26, 1953, Institute of the Aeronautical Sciences.) From: A/BQM-34 Technical Files, National Air and Space Museum Archives, Washington, DC.

[21] Arturo Rosenblueth, Norbert Weiner, and Julien Bigelow. “Behavior, Purpose and Teleology,” *Philosophy of Science* 10, no. 1 (January 1943): 19.

[22] Ibid.

[23] "black box, n," *OED Online*, December 2013, Oxford University Press, accessed February 23, 2014, http://www.oed.com/view/Entry/282116?redirectedFrom=black box.

[24] Ibid.

[25] MacKenzie, *Inventing Accuracy*, 26.

[26] Ibid., 381.

[27] Ibid., 26.

[28] "The Bee with the Electronic Brain," 13.

[29] Ibid., 17.

[30] Ibid.

[31] Langdon Winner, "Upon Opening the Black Box and Finding it Empty: Social Constructivism and the Philosophy of Technology," *Science, Technology and Human Values* 18, no. 3 (Summer 1993): 374-375.

[32] Lloyd Ryan, interview by William Wagner, February 15, 1971, 1. Ryan Aeronautical Files, San Diego Air and Space Museum, San Diego, CA.

[33] Ibid.

[34] Ibid.

[35] Turner & Cota, "Firebee I – A Case Study in Pilotless Aircraft Evolution," 4.

[36] Ibid., 14.

[37] Ibid., 5.

[38] Ibid.

[39] Harriet Beecher Stowe, *Uncle Tom's Cabin: Life among the Lowly*, (Boston, MA: Houghton, Mifflin & Co., Publishers, 1879), 268.

[40] Paul Edwards, *The Closed World: Computers and the Politics of Discourse in Cold War America*, (Cambridge, MA: The MIT Press, 1996), 7.

[41] Ibid., 8.

[42] Other histories that examine the Cold War through a technological lens, for example, Walter McDougall, The Heavens and the Earth: A Political History of the Space Age (New York, NY: Basic Books, 1984) and Thomas P. Hughes, Rescuing Prometheus, (New York, Y: Pantheon,

1998). I rely on Edwards' formulation because the questions raised in his analysis of computers offer a useful counterpoint for my study of drones.

[43]In chapter 4, I turn from a the division between East and West that informs Edwards theory and complicate this formulation of the Cold War with Carl Schmitt's idea of *nomos* organized through air power, dividing between above and below. This complicates the formulation of the Cold War as divided between the United States and Soviet Union, pointing to the role of other states and movements. This history is examined in S.J. Ball, *The Cold War: An International History, 1947-1991*, (London: Arnold Publishers, 1998). It has also been suggested in recent re-evaluations of the period by science and technology studies. See also Gabrielle Hecht, *Entangled Geographies: Empire and Technopolitics in the Global Cold War* (Cambridge, MA: The MIT Press, 2011).

[44] Rand Corporation, *Air Defense Analysis*, (Santa Monica, CA: Rand Corporation, 1951).

[45] In Philip Taubman, *Secret Empire: Eisenhower, the CIA, and the Hidden Story of America's Space Espionage*. (New York,, NY: Simon and Schuster, 2003).

[46] *Report by the Technological Capabilities Panel of the Science Advisory Committee*. (Washington, D.C., February 14, 1955), *Foreign Relations of the United States, 1955–1957, National Security Policy, Volume XIX, Document 9* https://history.state.gov/historicaldocuments/frus1955-57v19/d9.

[47] Ibid.

[48] Stuart W. Leslie, *The Cold War and American Science: The Military-Industrial-Academic Complex at MIT and Stanford*, (New York, NY: Columbia University Press, 1993).

[49] *Report by the Technological Capabilities Panel of the Science Advisory Committee*.

[50] Ibid.

[51] Taubman, *Secret Empire*, 100-109.

[52] Richard S. Leghorn, "Aerial Reconnaissance," in *Selected Readings in Aerial Reconnaissance,* edited by Amrom Katz, (Santa Monica, CA: Rand Corporation, 1951), 9.

[53] Ibid.

[54] Ibid.

[55] Taubman, *Secret Empire*, 54; See also Gregory Pedlow and Donald Welzenbach, *The CIA and the U-2 Program, 1954-1974*, (Darby, PA: DIANE Publishing, 1998).

[56] Ibid., 103-108.

[57] Ibid., 187.

[58] Ibid., 298-299.

[59] Nikita Khrushchev, “Summit Conference Statement.” (speech, Paris, France, May 16, 1960), *Modern History Sourcebook*, accessed April 8, 2014, http://www.fordham.edu/halsall/mod/1960summit-statements1.html.

[60] Studies of the CORONA program tend to focus on the capacity for global imagery, not how it is contrasted with “manned” reconnaissance. See John Cloud, "Imaging the World in a Barrel CORONA and the Clandestine Convergence of the Earth Sciences," Social studies of science 31, no. 2 (2001): 231-251. In the case of drone aircraft, four pilotless drones with Ryan markings were shot down over China between 1964 and 1965. The Chinese government displayed the drones at the Chinese People’s Revolution Museum in Peking and the event was reported by American media. However, the event is largely forgotten. See Wagner, Lightning Bugs, 74-79.

[61] in William Wagner, *Lightning Bugs and Other Reconnaissance Drones: the Can-Do Story of Ryan’s Unmanned ‘Spy Planes,’* Fallbrook, CA: Armed Forces Journal International, 1982, 13.

[62] Schwanhausser, interview William Wager, n.d. RRS#1, Ryan Aeronautical Collection, San Diego Air and Space Museum, San Diego, CA.

[63]Ibid.

[64]Wagner, *Lightning Bug and Other Reconnaissance Drones*, 18.

[65] Ibid.

[66] in Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 20.

[67] Ibid., 19.

[68] Lightning Bugs, 23

[69] Edwards, *The Closed World*, 27.

[70] Donna Haraway, “A Cyborg Manifesto.” in *Simians, Cyborgs and Natures: The Re-Invention of Nature.* (New York, NY: Routledge, 1991), 149.

[71] Wagner and Sloan, *Fireflies and Other UAVs*, 53.

[72] Ray Torick, for example, was killed in the launch of a D-21 Lockheed drone and died in the incident. The gravity of this crash due to his death is distinct from the Firebee crashes in *Nobody’s Perfect*.

[73] *Nobody’s Perfect,* Film (1972; San Diego, CA: Ryan Aeronautical), San Diego Air and Space Museum Archives, San Diego, CA.

[74] *Aeronautical Oddities,* Film (n.d.; Army Air Corps), San Diego Air and Space Museum Archives, San Diego, CA.

[75] Ryan Aeronautical, *Nobody's Perfect*.

[76] Ibid.

[77] Ibid.

[78] Ibid.

[79] Ibid.

[80] Ibid.

[81] Ibid.

[82] Ibid.

[83] Ibid.

[84] Ibid.

[85] Ibid.

[86] Ibid.

[87] Ibid.

[88] Ibid.

[89] Ibid.

[90] Ibid.

[91] Ibid.

[92] Ibid.

[93] Ibid.

[94] Ibid.

[95] Ibid.

[96] Ibid.

[97] Ibid.

[98] in Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 103.

[99] Ibid.

[100] Ibid.

[101] Ibid., 105.

[102] Ibid., 105.

[103] Ryan Aeronautical, *Nobody's Perfect*

[104] Ibid.

[105] Ibid.

[106] Richard Strauss, *Thus Spoke Zarathustra*, 1896.

[107] Stanley Kubrick and Arthur C. Clarke, *2001: A Space Odyssey*, (USA: Metro-Goldwyn-Meyer, 1968).

Chapter 4

[1] "Reconnaissance: Cameras Aloft: No Secrets Below," *Time*, Dec. 28, 1962.

[2] Numerous published accounts explore the details of the Cuban Missile Crisis, the intelligence that was collected and the decisions that it precipitated. I point to the event, however, to examine how reconnaissance imagery, which had been extremely secret in the 1950s, circulates to the American public in this event and the role images play in the Cold War crisis. For further analysis of intelligence operations, see James Light and David Welch, *Intelligence and the Cuban Missile Crisis*, (London: Frank Cass, 1998); Dino Brugioni, *Eyeball to Eyeball: The Inside Story of the Cuban Missile Crisis*, (New York, NY: Random House, 1991). The event is also examined in Edward Keefer, Charles Sampson and Louis Smith, *Cuban Missile Crisis and Aftermath. Vol. 9. Foreign Relations of the United States, 1961-1963,* (Washington, D.C.: Government Printing Office, 1996).

[3] John F. Kennedy, "Address on the Cuban Crisis October 22, 1962" (speech, Washington, D.C., Oct. 22, 1962), accessed April 18, 2014 http://www.fordham.edu/halsall/mod/1962kennedy-cuba.html.

[4] Ibid.

[5] Ibid.

[6] Ibid.

[7] Robert Schwanhausser, interview by William Wager, "RRS#5, March 3, 1971" 2. Ryan Aeronautical Collection, San Diego Air and Space Museum Archives, San Diego, CA.

[8] in Wagner, *Lighting Bugs and other Reconnaissance Drones*, 50.

[9] Ibid.

[10] “Table 3.3.-1 History of TRA Government Contracts Related to Remotely Piloted Vehicles 1962-1987,” Ryan Aeronautical Collection, San Diego Air and Space Museum Archives, San Diego, CA.

[11] “Reconnaissance: Cameras Aloft: No Secrets Below,” *Time*.

[12] Ibid.

[13] Tom Wicker, "M'Namara Insists Offensive Arms Are out of Cuba," *New York Times (1923-Current File),* Feb 07, 1963. accessed, April 28, 2014, http://search.proquest.com/docview/116515797?accountid=14496.

[14] Ibid.

[15] Ibid.

[16] William Grimes, *The History of Big Safari*, (New York, NY: Archway Publisher, 2014), 2. The former United States Air Force Colonel’s self-published book includes excerpts from the Air Force documents that initiated the program. For the significance of the Big Safari program to the development of contemporary drones see, Richard Whittle, “Predator’s Big Safari,” 2011 and Thomas P. Erhard, “Unmanned Aerial Vehicles in the United States Armed Services: A Comparative Study of Weapon System Innovation,” 2000.

[17] Wagner, *Lightning Bugs and other Reconnaissance Drones*, 23.

[18] Grimes, *The History of Big Safari*, 2.

[19] Ibid., 26-32.

[20] Robert Schwanhausser, interview by William Wagner, “RRS#3, March 3, 1971” 2. Ryan Aeronautical Collection, San Diego Air and Space Museum Archives, San Diego, CA.

[21] “Bird” is a slang term used by Ryan Aeronautical personnel to refer to the drone. The name can also be used for helicopters.

[22] Schwanhausser, interview by William Wagner, “RRS#3, March 3, 1971” 2.

[23] Ibid.

[24] Ibid., 3.

[25] Ibid.

[26] Ibid.

[27] Ibid.

[28] Wagner, *Lightning Bugs and other Reconnaissance Drones*, 30.

[29] Ibid.

[30] Ibid.

[31] Ryan Aeronautical. Photograph. (Received May 21, 1953, Institute of the Aeronautical Sciences.) A/BQM-34 Technical Files, National Air and Space Museum Archives, Washington, D.C.

[32] See, for example, Ansel Adams, "Dunes, Hazy Sun, White Sands National Monument," 1941 (Ansel Adams Gallery); Ansel Adams, "Sand Dunes, White Sands National Monument, New Mexico," 1942 (Philadelphia Art Museum); Edward Weston, "White Sands, New Mexico," 1941 (Los Angeles Museum of Contemporary Art).

[33] I spoke with the curator of the National Archives photography collection about this. As of 2013, the aerial images captured by drone flights in this era have not been made public, although select images, some of which I discuss below have circulated in official reports, press releases and in books and media.

[34] Discussions of landscape include accounts from geography, environmental design, history and art history. I point to Mitchell's argument – that landscape is a medium, as the analysis maps on to the movement between the concept in multiple disciplines. See also Denis Cosgrove, *The Iconography of Landscape: Essays on the Symbolic Representation, Design and Use of Past Environments*, 2nd ed., (Cambridge: Cambridge University Press, 1989); William Cronon, ed., *Uncommon Ground: Re-Thinking the Human Place in Nature* (New York, NY: W.W. Norton and Company, 1996) and Chandra Mukerji, *Territorial Ambitions and the Gardens of Versailles*, (Cambridge: Cambridge University Press, 1997).

[35]William J. T. Mitchell, "Imperial Landscape," in *Landscape and Power, 2nd ed.*, ed. William Mitchell, (Chicago, IL: University of Chicago Press, 2002), 15.

[36] Ibid., 17

[37] See, for example, Rebecca Solnit, *Savage Dreams: A Journey into the Landscape Wars of the American West*, (Berkeley, CA: University of California Press, 2000); Valerie Kuletz, *Tainted Desert: Environmental and Social Ruin in the American West*, (New York, NY: Routledge, 1998); Shiloh Krupar, *Hot Spotter's Report: Military Fables of Toxic Waste* (Minneapolis, MN: University of Minnesota Press, 2013).

[38] A classic account of the Trinity Test is: Lansing Lamont, *The Day of Trinity*, (New York, NY: Atheneaum, 1965); see also, Ferenc Szasz, *The Day the Sun Rose Twice*, (Albuquerque, NM: University of New Mexico Press, 1984).

[39] National Park Service, "White Sands National Monument – Home Page," *White Sands National Monument*, April 11, 2014, accessed April 17, 2014, http://www.nps.gov/whsa/index.htm.

[40] White Sands has served as the set for western and science fiction films alike, including *My Name is Nobody* and *The Man who Fell to the Earth* in the 1970s and *Young Guns II* and *Transformers* more recently.

[41] National Park Service, "History of Commercial Filming at White Sands," *White Sands National Monument*, Nov. 18, 2011, accessed April 17, 2014, http://www.nps.gov/whsa/planyourvisit/upload/filming_history_11_18_11.pdf.

[42] Wagner and Sloan, *Firefly*, 29; see also Bill Stockton, "'Firefly' is Shrouded in Secrecy," *Alamagordo Daily News* (Alamagordo, NM), Aug. 5, 1969. Charles D. La Fond, "Air Force Learns it's Tough to Keep a Secret," *Washington Waveguide* (Washington, D.C.), Sep. 1969; "Drone Test Pattern Outlined," *Aerospace Daily*, Nov. 22, 1968. These materials are all found in the Ryan Aeronautical Collection, San Diego Air and Space Museum, San Diego, CA.

[43] Ibid.

[44] Ibid.

[45] Ibid., 31

[46] Ibid., 29

[47] Ibid., 32

[48] Ibid., 33

[49] Ibid., 33

[50] Ibid.

[51] Joseph Masco, *Nuclear Borderlands: the Manhattan Project in Post-Cold War New Mexico*, (Princeton, NJ: Princeton University Press, 2006), 35.

[52] Ibid., 130.

[53] Wagner and Sloan, *Fireflies and other UAVs*, 16.

[54] See Edwin Moïse, *Tonkin Gulf and Escalation of the Vietnam War*, (Chapel Hill, NC: University of North Carolina Press, 1996) for a detailed analysis of the August 2 – 4, 1962 and the escalations that resulted because of this incident.

[55] I examine the Vietnam War through the lens of drone aircraft and is limited, as such. See Edwin Moïse, *Vietnam War Bibliography,* revised March 29, 2014, accessed April 28, 2014,

http://www.clemson.edu/caah/history/facultypages/edmoise/bibliography.html for a comprehensive bibliography.

[56] Robert Schwanhausser, interview by William Wager, "RRS#7, March 3, 1971" 1. Ryan Aeronautical Collection, San Diego Air and Space Museum Archives, San Diego, CA.

[57] Ibid.

[58] Ibid.

[59] in Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 55.

[60] Ibid.

[61] Paul W. Elder, "Buffalo Hunter," (San Francisco, CA: Department of the Air Force, Directorate of Operations Analysis, Jul. 24, 1973), 4.

[62] in Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 62.

[63] Ibid., 63.

[64] Ibid., 63.

[65] Ibid.

[66] Ibid., 93. See also "Table 3.3.-1 History of TRA Government Contracts Related to Remotely Piloted Vehicles 1962-1987."

[67] Elder, "Buffalo Hunter," 32.

[68] Ibid., xi.

[69] Ibid., xii.

[70] Ibid., xi.

[71] Ibid., 2.

[72] Ibid. 17.

[73] Wagner, *Lightning Bugs and Other Reconnaissance Drones*, 204-205.

[74] Ibid., 136-137.

[75] Carl Schmitt, *The Nomos of the Earth: in the International Law of Jus Publicum Europaeum,* trans., G. L. Ulmen, (New York, NY: Telos Press Publishing, 2006), 318.

[76] Ibid.

[77] Ibid., 319.

[78] Ibid., 321

[79] Ibid., 321

[80] Achille Mbembe, “Necropolitics,” trans. Libby Meintjes, *Public Culture* 15, no. 1 (2003): 28.

[81] Ibid., 12.

[82] Ibid., 29.

[83] Ibid.

[84] Schmitt, *Nomos of the Earth*, 354.

[85] William Wager and William P. Sloan, Fireflies and Other UAVs (Unmanned Aerial Vehicles). (Arlington, TX: Aerofax, 1992), 52.

[86] “Israel, 124I,” Ryan Aeronautical Collections, San Diego Air and Space Museum Archives, San Diego, CA.

[87] Robert Schwanhausser, interview by William Wager, “RRS#1, 24 Nov 71, Background on the Israeli Program,” 5. Ryan Aeronautical Collection, San Diego Air and Space Museum Archives, San Diego, CA.

[88] Wagner and Sloan, *Fireflies*, 53.

[89] I consulted with a number of scholars and archivists about finding the export license in the State Department records; these records, however, have been destroyed.

[90] “TRA Drone / RPV Systems Data,” (Chart, San Diego, CA, n.d.). Ryan Aeronautical Collection, San Diego Air and Space Museum, San Diego, CA. An identical chart can be found in the A/BQM -34 Technical File, National Air and Space Museum Archives, Washington, D.C.

[91] The original article and translation, “First – Unveiling – RPV’s In Service of the IAF,” *IAF Journal*, 1974, are in the file “Israel, 124I,” Ryan Aeronautical Collections, San Diego Air and Space Museum Archives, San Diego, CA.

[92]in Forward, *Lightning Bugs and Other Reconnaissance Drones*, no page number.

[93] Ibid.

[94] Rebecca Grant, “The Bekaa Valley War,” *Air Force Magazine* 85, no. 6 (June 2002): 60.

[95] Ralph Sanders, “An Israeli Military Innovation: UAVs,” *Joint Force Quarterly*, no. 33, (Winter 2002-2003): 115. Note the publication date of both these articles is 2002, coinciding

with new investments by the United States for drone technologies used in the Global War on Terror.

[96] “First UAV Squadron (1971-2007),” *Israeli Air Force*, accessed April 18, 2014, http://www.iaf.org.il/4968-33518-en/IAF.aspx. See also John Kreis, “Unmanned Aircraft in Israeli Air Operations,” *Air Power History* 37, no. 4, (Winter 1990): 46-50.

Conclusion

[1] Multi-National Division Baghdad, “MND-B Soldiers Kill Two Terrorists,” Dvids: Defense Video and Imagery Distribution System, April 9, 2008. Accessed May 11, 2014, https://www.dvidshub.net/video/37449/mnd-b-soldiers-kill-two-terrorists#.U2-TGnavj54.

[2] Ibid.

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