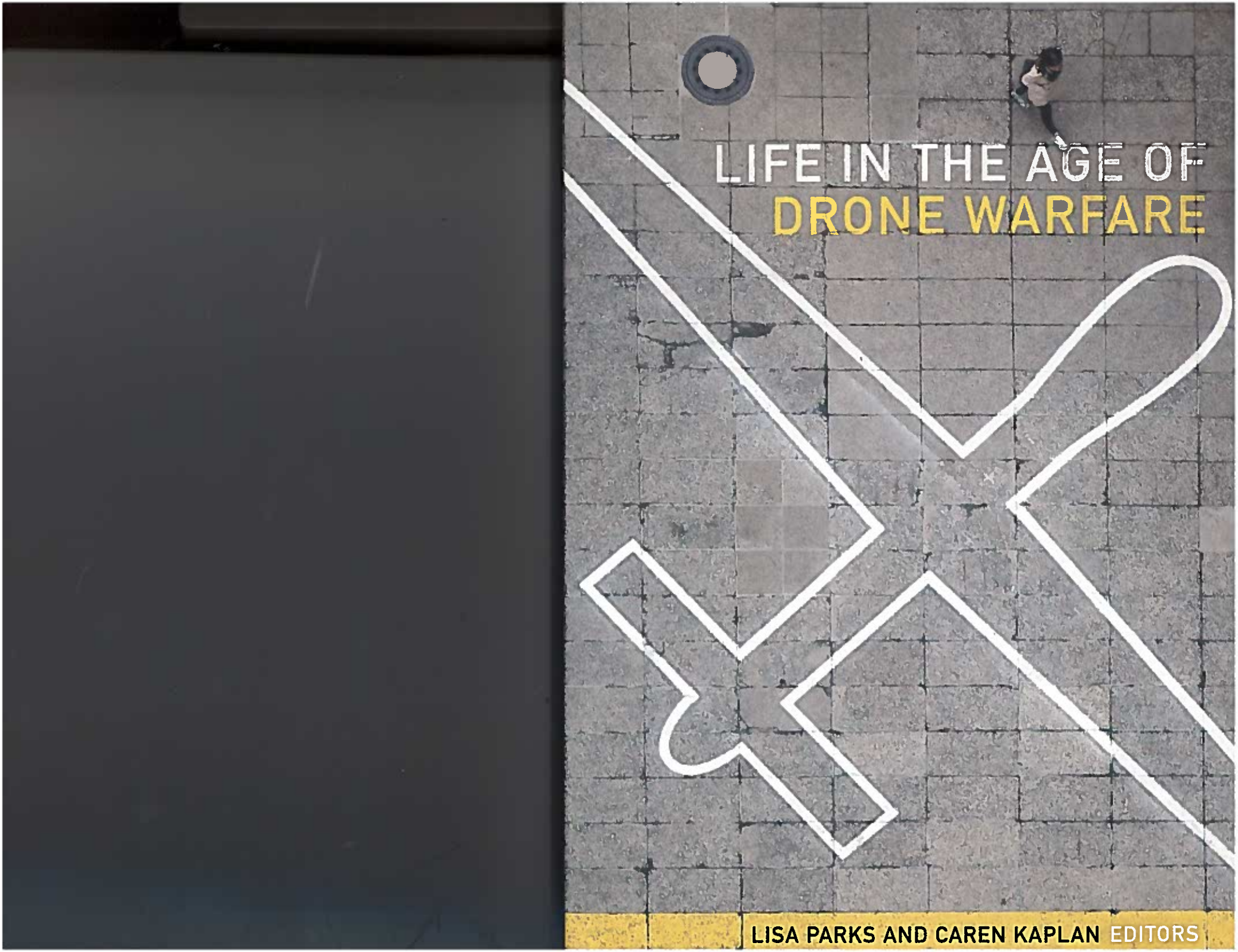
LIFE IN THE AGE OF
DRONE WARFARE
LISA PARKS AND CAREN KAPLAN EDITORS

LIFE IN THE AGE OF DRONE WARFARE

LISA PARKS AND CAREN KAPLAN, *Editors*

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AMERICAN KAMIKAZE

Television-Guided Assault Drones in World War II

KATHERINE CHANDLER

IN 1937 THE UNITED STATES Navy set up a review board to explore the feasibility of adding television to a radio-controlled pilotless aircraft tested earlier that year by the Naval Research Laboratories and the Naval Aviation Factory. Known by the code name "Drone," the project began in 1936. A small team of navy engineers and personnel was tasked with developing an unmanned aircraft that would mimic aerial assaults to train anti-aircraft gunners. Remote operators used radio-transmitted commands to guide the direction and speed of the drone, while an onboard gyroscope stabilized the pilotless vessel. A controller on the ground would maneuver the aircraft for takeoff and landing. Once airborne, another operator following the pilotless plane aboard a control aircraft would guide the drone in the sky.[1] The distance between the radio controller and the drone was limited to the operator's line of sight. Vladimir Zworykin, an engineer who led Radio Corporation of America's (RCA) concurrent efforts to build television, proposed that by adding a camera and monitor to the pilotless system, the aircraft could be remotely guided from a greater distance. Images transmitted from a camera on the drone to a monitor aboard the control plane would transform its use. Instead of merely serving as a decoy for training, the remotely operated aircraft—no longer limited to line of sight—could be a guided bomb. Reflecting on the proposed weapon, the navy's television review board concluded in 1937 that while they "appreciated the thorough study . . . of television and radio controlled aerial torpedoes, [they] 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."[2]

This early proposal drew together what have become key elements of contemporary unmanned aircraft, indicating how a team of remote operators might use image transmission to carry out a targeted attack from a distance. Television would provide a way for the controller to remotely conduct an aerial bombing.[3] The navy board's initial response, as well as failures associated with the program after the television-guided weapon was developed and tested during World War II, trouble the argument of technological inevitability often used to explain the rise of unmanned aircraft. Today, innovations seen by the U.S. military as providing a strategic advantage—the ability to use real-time imagery as an interface for attack against distant targets—were recalled in the aftermath of World War II as a debacle. This tension speaks to what scholars of science and technology studies describe as interpretative flexibility.

If technological determinism posits that innovation and change are intrinsic to technologies, interpretative flexibility emphasizes how these transformations are multiple, produced through social as well as technical relations. For example, Donald MacKenzie demonstrates in a classic study that nuclear missile guidance did "not simply [mean] different things to the different 'inventors,' but also [was] seen by different groups as a solution to quite different problems."[4] In the case of both drone aircraft and television in the late 1930s and early 1940s, there were diverse understandings about what these technologies were. Interpretative flexibility applies not only to drone and television technologies, though, but also shapes the human operators who remained entangled with, even as they were ostensibly negated from, pilotless planes. In this vein, Charis Thompson analyzes how assistive reproductive technologies "make parents," showing the multiple interpretations MacKenzie describes in missile systems applies to human users as well.[5] I examine interconnections between the remote pilot, television, and aircraft in the navy project to explore how the negated operator and drone emerge in tandem.

Two contradictions emerge in the navy Drone program. The assault weapon undoes the role of human operators who nonetheless remain integral to the pilotless system. On the one hand, unmanned planes were positioned as a technological stand-in for pilots. On the other, American drones were put forth as analogous to Japanese kamikazes. With these ideals, engineers and operators created an "American kamikaze" to mimic and counter the perceived threat of Japanese suicide bombers. The drone was justified

as both superior to and more humane than Japanese tactics by separating human from machine, both framed by the Japanese other. Within this sociotechnical system, the "electric eye" of television comes to stand in for how the operator sees through the drone and, at the same time, is effaced by the network of its parts. This organization also establishes the intrinsic qualities of the Drone that apparently propelled its development, even as it shows these characterizations were also mobilized by the navy's stereotypes of the Japanese enemy. By showing how disjuncture between human and drone were created through this early project, I trouble divisions between human and nonhuman that often frame discussions of unmanned aircraft. Instead, I emphasize how *human and machine are produced in tension with each other and explore the consequences of these relations.* Image transmission technologies, the positive figure of the negated operator, come to be seen as mimicking, standing in for and attacking "the enemy," conceived as a kamikaze. Connections between the wartime context and technical parts show the innovation of the television-guided weapon was not that it was "pilotless," but rather the multiple ways the Drone was figured as such by the U.S. Navy, tied to the wartime context and its failure.

This chapter examines interconnections between operators, television, and drones in four parts. Each focuses on a document tied to the navy Drone project. First, I analyze Zworykin's proposal "Flying Torpedo with an Electric Eye," a 1934 memorandum that explores how television could be used to guide a bomb. The paper was later published in the *RCA Review* in 1946. His account provides an articulation of the two contradictions outlined above. Second, I examine navy engineer Delmar Fahrney's history of the Drone project that he initially led and subsequent efforts to mass-produce a television-guided assault weapon between 1940 and 1944. He explores the project's cancellation in detail, arguing the assault drone's failure was a result of internal struggles within the navy that opposed the drone to the aviator. The third part of this chapter studies a short film made to document a field test with the assault drone in the South Pacific in July 1944. It was used to temporarily override the decision to cancel the project and deploy the television-guided bombs for forty-six missions in the Solomon Islands. The final part examines *American Kamikaze*, a memoir written by James Hall describing his experiences as a drone operator between 1942 and 1944. Through the constellation of these materials, I counter the "invention" of the drone as outlined by the engineers in their papers, as well as

the determinacy associated with unmanned aircraft; rather, the documents show how human and drone are co-constituted, tying their formation to early television systems and suicide bombing.[6]

"Flying Torpedo with an Electric Eye": Integrating, Distancing, and Effacing the Operator through Television

In 1934 Vladimir Zworykin, RCA engineer and innovator of television, sent a memorandum within the company titled "Flying Torpedo with an Electric Eye."[7] He proposed a remotely controlled weapon that would use early versions of television created in Zworykin's laboratory at RCA, the kinescope camera and iconoscope receiver. The memorandum explained that the camera would transmit images from an airborne torpedo to an operator who would control the flying bomb through the image receiver. Accordingly, "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."[8] The memo noted that television provided an "actual view of the target," distinct from other practices of targeting at the time. Zworykin made no mention of the distance enabled by the weapon in this part and instead explained the television system would link the torpedo and operator by relaying "accurate information" from the battlefield and weapon. Television would replace the eye of the pilot aboard the bomber with image and information transmission connecting operator and weapon.

William Uricchio draws on interpretative flexibility to explain that early television "was variously understood as domestic like radio, public like film, or person-to-person like the telephone."[9] Although the concept of television had been explored worldwide since the 1920s, the use of television in assault drones during World War II predated widespread development of commercial broadcast television in the United States. Television was highly anticipated; yet what it was or how it would operate was open to multiple socio-technical frameworks. Uricchio explains that, prior to the 1950s, "television . . . drew upon journalistic, theatrical, and (documentary) filmmaking practices" and argues contemporary transformations in television "are not so much new as reminders of the medium's long-term flexibility."[10] I extend Uricchio's analysis by showing how television in the interwar period was developed for military use. Tying television to drones deployed as

bombers in World War II adds another dimension to the interpretative flexibility of early television and its contemporary resonances, showing how the medium was also conceived as a weapon and in relation to an enemy other.

Zworykin's initial discussion in the memorandum explains how image transmission would give the operator the ability to target and accurately gauge the controls of the weapon. Television would extend how military personnel operated in the battlefield and as such, was linked to the body and vision of the operator. Yet, in the second part of the memorandum, Zworykin focused on how the pilotless plane could exceed human limits, explaining how the eye-like qualities of television distinguished the weapon. 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."[11] Radio control alone, however, relied on the operator's vision to direct the missile to its target, limiting the range of the weapon to how far the operator could see. Having established the 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."[12] This early claim is significant given that systematic attacks by Japanese kamikazes did not occur until 1944.[13] It indicates how American industry and military already conceived suicide bombing as a possible mode of attack by the Japanese, before such an attack happened. Yet, in comparing the television system he proposed to the suicide bomber, Zworykin also emphasized the limitations of the body, including the range of sight that restricted radio-controlled bombs. Contrasting his proposal with tactics attributed to the Japanese, 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.*"[14]

While the first part of "Flying Torpedo with an Electric Eye" indicated that the television-guided torpedo would relay an "actual view" of the battlefield to the operator, the second set of justifications promoted the electric eye as a way to overcome human limitations by analogy to a suicide bomber. Television aboard a radio-controlled plane did not merely extend the role of the American pilot. Rather, Zworykin argued that technical superiority would engineer an aircraft that obtained the same results as a Suicide Corps. The next part of the memorandum focused on relations organized by the

parts of the weapon rather than the human and machine connections established in the first part. After accounting for the weapon as a kamikaze, the radio controller was discursively effaced by the technologies of the torpedo and television image. Describing how the assault weapon would operate, Zworykin used the passive voice. Interactions that would have relied on both image and operator were attributed instead to airplane and camera. For example, he explains: "The carrier airplane receives the picture viewed by the torpedo while remaining at an altitude beyond artillery range."[15] In this passage, the torpedo apparently "sees" the picture, not the operator onboard, although the safe distance of the carrier airplane is emphasized. Throughout his discussion of the torpedo's operation, Zworykin minimized the role of human operators to insist on a "technical" system that made the weapon both "safe" and "superior," even as it would carry out the kind of attacks he attributed to suicide bombers.

"Flying Torpedo with an Electric Eye" elucidates the two contradictions that frame this analysis: First, the television camera onboard the drone ostensibly replaces the pilot, even as a remote operator was connected to the pilotless aircraft and battlefield by image transmission. Although the controller would monitor the target and the drone through the television view, the camera onboard the pilotless system was established as the "electric eye" that "saw" the target. Second, the drone was conceived as more-than-human, disconnected from the operator by emphasizing technical relations between its parts and the camera. The system as such was analogized to kamikaze missions, not piloted flight, underscoring both the possible ruthlessness of the drone as well as the ways the technology stood for the safety of U.S. pilots. Zworykin's memorandum lays out a framework for attack and American superiority through a television and radio-controlled drone, promoting the system as technically superior and foregrounding the image rather than operator as the impetus for a targeted strike.

Project Option: Could a Robot Replace an Aviator?

Zworykin's framework notwithstanding, tensions between manned and drone flight persisted in the development of the assault weapon and were played out in competing goals for the project. As early as 1935, RCA met with representatives from the U.S. Navy about the possibility of using television to control aerial weapons, leading to the review board's assessment two years later. Attitudes toward remotely controlled aircraft shifted as

trials with drone targets expanded and navy personnel increasingly agreed on their usefulness (at first for training anti-aircraft defenses). In 1939 Commander in Chief of the Navy Claude Bloch wrote 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."[16] While Bloch's description accounts for the shift as a technical evolution, the development and cancellation of this project underscores how, in the navy, different groups responded to and shaped the Drone project. The previous section explored how television was envisioned as a military technology, adding to analyses of the flexibility of the medium. I now examine how the "reasonable" shift of drone aircraft from a passive target to an active weapon was debated within the navy through its characterizations as a kamikaze mode of attack or replacement for aviators.

Pilotless aircraft were first tested by the U.S. military in World War I, and early efforts included attempts to build self-propelled vessels as well as radio-controlled aircraft. By the 1920s, however, these projects were cancelled. Interest in remotely operated aircraft reemerged in the 1930s in both military branches. Delmar Fahrney, an aeronautical engineer trained at the Massachusetts Institute of Technology (MIT), was commissioned in 1936 as a navy officer and tasked with leading the Drone program introduced at the beginning of the chapter. Other experiments, including army-led projects, were also pursued at the time. From the earliest days of his involvement, Fahrney saw the possibility that the radio-controlled target might also be a weapon. By 1939 he was informally mobilizing support within the navy to build an assault drone and subsequently recruited key individuals from the earlier experiments with target planes to participate in the project.[17] My analysis of the television-guided drone program from 1939 to 1944 follows Fahrney's history of drone aircraft written in 1953, which was based on an extensive collection of military records that I also consulted. His account highlights how shifts coordinated through television to make the remotely controlled target drone a guided weapon also establish the role of operators through their erasure and by likening them to kamikazes. Yet this is also an account of failure, as the program never achieved the possibilities that Fahrney and others expected: drones at the end of World War II remained mere targets to train anti-aircraft gunners.

In 1939, the same year it demonstrated television transmission at the World's Fair in New York, RCA received a contract from the navy to produce an experimental prototype of television control for remotely guided aircraft. During World War II, RCA produced thousands of television sets. The refinements to the television tube that was used to guide the drone aircraft led to the image orthicon, which made a clearer onscreen image. The innovation became a crucial part of television and was used in commercial sets built through the 1960s.[18] During the same period, the navy officially began its assault drone program when then Chief of the Bureau of Aeronautics Ernest King approved the conversion of a TG-2 aircraft to television and radio control on March 22, 1940. Previously used as a control plane for the operation of pilotless target drones, the transformation of the TG-2 shows how what had been part of the drone target for training air defense might be changed by television to produce an "active weapon."[19] In 1941 a number of tests were made using a TG-2 plane. After being guided by radio control for takeoff by a ground-based crew, the control signal was then transferred to an operator who used a monitor onboard a control aircraft to maneuver the TG-2 via image transmission and commands sent by radio.

Exemplary of these trials were those that took place on August 7, 1941. Walter Webster, manager of the Naval Aircraft Factory who oversaw production of the experimental assault drone, wrote: "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."[20] What Webster emphasized in his report was the distance between the control aircraft and the drone enabled by television, setting out how the aircraft might be a guided weapon that operated beyond the limits of line of sight. In September 1941 two additional TG-2 planes were assigned to the project and converted for operation by radio and television control. By November the Bureau of Aeronautics issued a report that explored production possibilities on a larger scale, looking to obsolete airplanes as possible platforms for the remotely guided weapons as well as cheaply produced plywood airframes.[21]

The attack on Pearl Harbor on December 7, 1941, shifted responses to the experimental program. 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 sea-based warfare as the United States formally entered World War II. Positioned against Japan in the Pacific, the navy was challenged by the unexpected defeat and the fallibility of its sea fleet to aerial attack. Others argued, however, that, beyond mere rebuilding, "technological" advantages must be developed by the navy to counter Japanese forces. Captain Oscar Smith of the Naval Bureau of Ordinance was one such advocate. Unaware of the top-secret developments with radio and television control already underway, he wrote to the Chief of Naval Operations (CNO) on December 15, 1941, and 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."[22] Smith would become the most prominent advocate for the television assault drone program in the U.S. Navy. In his proposal, Smith likened remote control to the tactics of a suicide pilot, linking his description of the radio-controlled aircraft to racialized American stereotypes of the Japanese kamikaze, unflinching and obedient to a higher authority. It is unclear whether Smith knew about Zworykin's 1934 memorandum, although his account mirrors the possibility of remote operation previously outlined. While no organized kamikaze corps existed at the outset of the war, the American military had already characterized Japanese forces as engaging in suicide tactics (as indicated in "Flying Torpedo with an Electric Eye"). This may have been because of Japan's no-surrender policy as well as accounts of a Japanese pilot who was shot down and crashed his plane into the deck of a ship during the Pearl Harbor attacks.[23] The characterizations also tie to how the United States used racial stereotypes to portray and organize its enmity with Japan. Smith uses the attributions associated with kamikazes to frame the radio control technology he envisioned as more-than-human, unfaltering and compliant in its approach to death. He aligned, in this way, the drone with enemy suicide tactics, even as he proposed remote control as a more advanced way to wage war.

After visiting the project led by Fahrney in February 1942, Smith suggested the development of the assault drone be expedited. By May of that year, the navy's first attempt to mass-produce a remotely controlled, television-guided weapon was approved by the Bureau of Aeronautics. Admiral King, who had been Chief of the Bureau of Aeronautics and subsequently assumed the rank of Chief of Naval Operations, 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."[24] 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."[25] As CNO, King fostered the project that he had overseen in its various forms since 1936. Yet the assault drone required a large investment of personnel and budget. The new Chief of the Bureau of Aeronautics, John Towers, a navy pilot and proponent of aviation within the navy since World War I, was more hesitant. He requested that the project develop only 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."[26]

Nevertheless, the navy pursued its plans for a top-secret Fleet Special Air Task Force, which began training in 1942. Smith was given the new rank of Commodore and oversaw the program (although, with his background in the Bureau of Ordnance, he continued to be seen as an interloper within navy aviation). Final proposals called for over 3,000 personnel, 99 control planes, and 891 drones divided into three Special Task Air Groups (STAG). However, by early 1943, only twelve TDN assault drones were built by the Naval Aircraft Factory. Although the pilotless aircraft incorporated television and radio control, the aircraft were low-performance vehicles, built of plywood due to the lack of metal during the war. The assault drones were slow and could only be maneuvered simply. Further, the cost far exceeded the available budget. Interstate Aircraft was contracted to build the next model, also made of plywood, the TDR-1, which was tested in late 1943.[27] Interstate subcontracted a piano manufacturer, Wurlitzer Musical Instrument Company, and a bicycle factory, Schwinn Bicycle Company, to build the body of the drone, which was made of pressed wood over a tubular steel frame. The drone could be ferried to its location by an onboard pilot, so the TDR-1 had a removable cockpit canopy and the remote controls could be disabled. The television-guided air vehicle was thirty-seven feet and eleven inches in length with a wingspan of forty-eight feet and eleven inches. It was designed to carry a two-thousand-pound bomb and had a maximum speed of 140 mph and a range of 426 miles.[28]

When the TDR-1s were built in 1943, the navy still did not deploy them. Towers, now Commander of the Pacific Fleet, resisted efforts to include the television-guided drone in his battle plans. With commanders like Towers satisfied with the tactics and matériel in the South Pacific, the TDR-1s were

declared "untried." Reviewing the project ten years later, Fahrney would offer the following analysis of the tensions between Smith, who came from the Bureau of Ordnance, and Towers, a pioneering aviator within the U.S. 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 skeptically within the Bureau of Aeronautics, which funded the television-guided assault drone project. Describing Towers's reaction, 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. . . . 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.[29]

Tensions between the commanders tied to their positions within the navy, shaped how they saw the 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 believed an aviator could not be replaced by a pilotless plane. Significantly, these competing views were internal to the U.S. Navy. Further, they reflect and transform the two strategies of distance and immersion that I explored in Zworykin's memorandum. Drone aircraft, on the one hand, changed the scope of war, distancing the pilot from the battlefield by possibly replacing him in the aircraft with television. On the other hand, as a technology, drone aircraft allowed for unprecedented immediacy and connection with attack, paralleling a suicide attack in a way that was described as more-than-human and robotic.

In 1944 the conflict between Smith and Towers came to the fore. That year Fahrney was reassigned to serve as Head of the Logistics Section of the Aircraft Command, the only position he would hold that was not related to drones or guided missile development between 1936 and his retirement in 1950. This posting came after he had been directed by Towers in 1943 to "have no further unofficial or official personal contacts with the . . . CNO"[30] regarding the assault drone program. An ally of Towers's, Captain H. B. Temple, was placed in charge of the navy's guided missile program on February 15, 1944. According to Fahrney's manuscript, Temple was instrumental

in changing navy plans. He reduced the scale of the assault drone program significantly, and most of the personnel who had been trained for the television-guided assault drone program were reassigned.[31] Commodore Smith continued to exercise some influence within the CNO's office, however. His argument that the television-guided assault drone should be tested in combat held sway with King and resulted in the deployment of the one remaining STAG unit in June 1944.[32] By the end of the summer, though, King would terminate the program. The CNO transferred the remaining radio and television technologies to the army in an effort to reduce costs. The navy, he proposed, would turn instead to "the latest advances in the science of propulsion, aerodynamics, and electronics,"[33] and future developments would emphasize the strategic advantages of the sea fleet. Even before the drone had been used in war, the television-guided weapon the navy had built was finished. The project's cancellation is a potent reminder that the inevitability of a television-controlled weapon was not a foregone conclusion and thousands of RCA television sets remained unused at the end of the war.

Service Test of Assault Drone: Enacting Drone and Operator through Television

The temporary deployment of the TDR-1 further instantiated contradictions and connections between aircraft, television, operator, and kamikaze. A film made on July 31, 1944, in a final effort to secure support for the navy's television guided drones, *Service Test of Assault Drone* offers a record of how the aircraft operated, staging both an experimental test and an idealized view of the system.[34] The film recorded tests carried out by STAG-1 personnel using four drones. It demonstrated how the television-controlled systems could dive-bomb a ship by targeting a beached Japanese freighter, the *Yamazuki Maru*, the wreckage of which remained in the area from a navy campaign the previous year. In the film, orders to the STAG-1 unit are relayed through title cards, providing a text for the images. A count down the narrative. An intertitle early on indicated the strike would occur at "fourteen-hundred hours," structuring the grainy, television images in the film as an "actual view" of the attack. The goal of hitting the target on time functioned as a marker of the success for the experiment as well as a cinematic climax for the sequence of images leading to the test strike.

The staged mission against the *Yamazuki Maru* presented the assault drone as a set of technological parts. In so doing, the television-guided

weapon effaced the role of the human operator, and its attack seemed to replicate a kamikaze strike. The document can be read as a filmic enactment of Zworykin's "Flying Torpedo with an Electric Eye": it attempted to produce a technological counterpart to piloted flight even as the film emphasized the immersive connection between the operator and television through the transmitted image. The footage from the test begins with a title card indicating there is no onboard pilot: "the drone in NOLO [no live operator] condition ready for take-off."[35] The TDR-1 drone is then pictured in the center of the frame on an empty runway, palm trees in the distance. None of the personnel involved in the TDR-1's takeoff are in the picture. The next intertitle states each TDR-1 holds a two-thousand-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. 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 offscreen as no human appears. Only in the shot that follows, after the second TDR-1 fails during takeoff, does one glimpse the personnel involved, who rush onscreen to attend to the drone's nose over. Due to technical difficulties, the viewer sees the personnel.

Once airborne, a title card states, "During attacks, control planes remain seven miles from the target." The next image shows the exterior of the aircraft against the open sky with no sign of the television controller who is onboard. This shot is like the "carrier plane" that Zworykin described in his proposal, ostensibly networking the operations of the drone between the television and the plane, as though the weapon had no operator. 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, Guadalcanal, in succession, commencing at 14:00." The following shot is a close-up of the beached freighter deck, panning across the point of aim described in the previous intertitle. More than half of the film is devoted to showing the drones, control plane, and target in succession. The images organize how the drone operates and how it will target, proposing a technological system that leaves out navy personnel integral to the assault drone's functioning (who only are seen during the nose over).

The second part of the film shifts the focus to television transmission by featuring images from the monitor in the control plane. While the drone's operator never appears onscreen, the film viewer watches the drone strikes from his perspective, seeing through the camera on the weapon, as it dive

bombs toward the beached freighter. The title card at the beginning of this sequence states, "At 13:58 control pilot sights target on television screen," using time to indicate how the filmed images on the monitor are the "actual view" of the strike. A grainy television transmission follows the intertitle, showing an almost unintelligible island landscape with the freighter in the foreground. The target might not be recognizable if a prior sequence had not shown a close-up of the deck line. Onscreen, for both the pilot watching the television screen and the viewer watching the film, crosshairs indicate the point of attack. As the drone dives downward, the freighter becomes more prominent in the operator's and viewer'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, relaying 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." The next shot is from the point of view of another camera filming the test against the freighter. The assault drone dives into the *Yamazuki Maru*, followed by a large explosion. The two shots establish the impact of the TDR #860 as it is destroyed when it hits the deck of the ship. The image disappears with the explosion. The second view, however, shows what has happened through a landscape shot: Billowing clouds of smoke from the ship contrast with the tropical island in the background. The explosion has obliterated the aircraft and camera and damaged the target, a mirror of the kamikaze flights that would attack U.S. Navy ships in the coming months. In the sequence, the viewer is aligned with the perspective of the drone and operator through the image, while the second shot disconnects him from this point of view, showing the strike as a technical sequence.

Two of the four planes hit the ship and a final bomb strike closes the film, after which a title card appears: "The End." This film documents and enacts an account of a television-guided missile strike, directing the viewer how to watch the drone and creating a particular, contradictory role for the human operator with whom he is aligned. The viewer sees through the television lens and watches the bombing from a "neutral" camera recording 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 and his effacement, particularly the second shot of the strike, which distances the operator from the view of the television camera, showing the drone diving into the ship from the perspective of an onlooker as if he played no role in its kamikaze mission.

Talal Asad's analysis of the contemporary suicide bomber troubles the clear separation between legally sanctioned war carried out by states and the vulnerability introduced by acts of terror. He underscores the "moral advantage" these distinctions provide and the "civilizational status" accorded to state-sanctioned militaries and the legal justifications they use.[36] World War II assault drones follow a parallel logic, albeit in the context of a sanctioned war, proposing the television-guided weapon as a "superior" stand-in to the kamikaze, even as it mimics its tactics. Its moral advantage, however, is justified by the "technology" of image transmission rather than through the legal frameworks emphasized by Asad. Socio-technical relations enacted by television were key to creating interpretations that framed the drone's analogy with and distinction from suicide flights, resulting in the contradiction of image immersion in the battlefield and the simultaneous erasure of the human operator. Emiko Ohnuki-Tierney problematizes any linking of *tokkotai* pilots, the term used by the Japanese for the soldiers who flew aerial missions between 1944 and 1945 with no chance of return, to contemporary suicide bombers. Her point is well taken, given that Japanese pilots carried out their missions under the auspices of a state-sanctioned military.[37] Yet U.S. Navy comparisons between the assault drone and suicide missions had little to do with the actual attacks carried out by the Japanese tokkotai beginning in October 1944. Rather, the discursive distinction reflected socio-technical relations created by the American military and its industrial counterparts to establish the "superiority" of the drone. Resonance between suicide missions from World War II and contemporary suicide bombings might be read as marking the similarities of socio-technical frameworks developed by the United States to use technological superiority to construct and counter an enemy "other," while minimizing the role of its personnel. Justifications based on morality and "technological" advantage that the United States uses to defend unmanned warfare today can be linked to arguments for the "technological superiority" of assault drones in World War II and how television transmission was part of this portrayal. Thinking

about the drone not as "technology" but, instead, as a flexible system of human and nonhuman parts, the final section examines similarities between the suicide bomber and the assault drone to trouble the advantage that is claimed this way.

American Kamikaze: Recalling the Socio-Technical Relations

The STAG-1 unit based in the Russell Islands campaigned for the chance to use the television assault drones in the Pacific even though Chief Naval Officer Admiral King had canceled the project during the summer of 1944. Instrumental in securing the monthlong combat test mission for the TDR-1 was Robert F. Jones, who, like others in this account, had been involved with the project from its initial stages. After commanding a target drone utility wing 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 film *Service Test of Assault Drone* to convince commanders to use the weapon: "Jones made a flight to the headquarters of Commander Aircraft in the Northern Solomons [*sic*] 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 . . . for a thirty day trial."[38] STAG-1 carried out bombing missions between September 27, 1944, and October 26, 1944, in the Japanese-held parts of the Bougainville Islands. The team was split into two groups and the drones were flown in configurations of four. Forty-six TDR-1 drones were launched during this month. Of these, twenty-nine assault drones were detonated by their operators, while the others failed due to mechanical or weather conditions as well as succumbing to anti-aircraft fire. Jones and Larkin construed the project as an overall success in their final reports. Two TDR-1s struck a lighthouse and six hit a beached ship used by the Japanese as an anti-aircraft emplacement. Of the twenty or so remaining drone strikes, the officials note, "[these] 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."[39] Nonetheless, these missions are registered as hits in the navy reports and the final analysis of the experiment claims an over fifty percent success rate.

For the personnel, failed missions were just as memorable as the strikes. While the argument that pilotless planes saved soldiers' lives was mostly

absent in the official discussions of the drone, which focused instead on its analogy with the kamikaze or how it would replace pilots, this aspect was salient for the squadron. Indeed, their safety was also understood by disjoining their role as operator from the technical parts of the drone. Billy Joe Thomas, a control pilot in STAG-1, later recalled his experiences flying a TDR-1: "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."[40] As the remote pilot of the aircraft, Thomas remembers being "shot down." Of course, he was not shot down; rather, the assault drone he controlled was hit. The statement insists upon this separation in the next part of the sentence, recalling how anti-aircraft fire brought *it* down. A different movement between operator and technology happens in the next sentence. Thomas explains that the picture was out of his control, an image "he couldn't do anything about." Yet he also saw himself through "its" perspective, looking straight down as though he saw what the camera saw. By the end of his statement, the point of view from the camera onboard the aircraft becomes his hypothetical position. In the final sentence, however, he erases his role as the operator, noting that "if" the drone had been a piloted plane, it would be a funeral. This ambiguity—seeing himself on the one hand as part of the television-guided weapon and separate from the socio-technical relations on the other—shows the contradiction between human and technology he experienced.

James J. Hall, another remote pilot who participated in the STAG-1 missions, published *American Kamikaze* in 1984.[41] The book is a memoir based on his experiences, although it is written in the third person. *American Kamikaze* offers a corollary to the elision between self and object analyzed in Thomas's statement, as it recounts Hall's involvement in STAG-1 as if these were not his own memories. Overall, *American Kamikaze* devotes little attention to the missions and the new technologies on which they relied, emphasizing instead unit members' camaraderie and their pursuits on leave. The title of the book is left unexplained, though the assault drone squadron's month-long deployment in the South Pacific coincided with the first organized kamikaze missions flown by Japan. In what might be another layer of separation between himself and the actions he participated in, Hall reprinted the unit's official correspondence to the navy's Pacific Command in lieu of his own remembrances of the military operations between September 27 and October 26, 1944.

Although the book is laudatory of STAG-1 and the experimental technologies tested by the unit, Hall briefly expresses doubt about his role as a drone operator. According to reports submitted to the Pacific Command, the formal cause of an unsuccessful mission on October 15, 1944, was television failure. Hall explained that, as operator of the aircraft, he knew the drone actually crashed 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."[42] In the navy report, the strike is recorded "at the south end of Hospital Ridge" and makes no mention of a building.[43] Describing the experience in the memoir, the images transmitted through the television persist in Hall's memory forty years later, although they are accounted for in the third person. His memory shows how he was tied to the operation of the aircraft and how he disconnected himself from the television-guided weapon. "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."[44] Hall remembers 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."[45] While only momentary, Hall's recollection pictured himself in relation to the Japanese; his actions were paralyzed and he watched the drone aircraft explode onscreen. The image on the television was one he could not "blot out," even as his position at a distance allowed him to ask "what if" it was a hospital that he struck: he was both part of and undone by "the drone."

Examination of the socio-technical relations that led to the television-guided assault drone complicates the straightforward opposition between the drone and kamikaze made by Grégoire Chamayou. Based on a brief analysis of Zworykin's memo, Chamayou contrasts "the suicide bomber who crashes once and for all in a single explosion; . . . [and] the drone which fires its missiles repeatedly, as if nothing happened."[46] This characterization leads Chamayou to theorize the "twin" tactics of the drone and the kamikaze, a ghostly machine versus a courageous combatant, both conceived as methods for solving the problem of targeting. This formulation overlooks how missions undertaken by the "American kamikaze" interconnected operators like Hall and the television screens they watched as dissociated parts. Between the suicide pilot and the drone are a set of contradictory contexts established through the development of the navy project. Further, the comparison offered by Chamayou equivocates between the first television-guided weapons and contemporary unmanned aircraft, as the weapons built by the navy in World War II were also consumed in a single explosion. While the fact that Hall is alive forty years after the drone he flew crashed into a hospital roof underscores the stark difference between the death of the kamikaze pilot and the technological assault carried out through the television-guided system, Chamayou's contrast is nonetheless misplaced. He simply reverses the role of drone and kamikaze proposed by the Drone program's advocates and engineers. My analysis of the navy's television-guided assault drone undoes the polarity between human, drone, and kamikaze, showing instead how each is co-constituted. In this way, there is no "drone" that can be separated from the human operator, even if this disassociation was integral to the development of the weapon, as was its difference from the suicide mission. The drone is a kamikaze not because of its technical interface but because the project development was organized on creating and mimicking the enemy.

Jones's final report highlighted how drones could "attack with minimal risk to the pilot and crew."[47] Yet these arguments were not enough to continue the project, further complicating Chamayou's evaluation of the risks implied by the early project and the versions of life and death they supposedly avow. Between 1944 and 1945, over 1,500 U.S. Navy personnel were killed in air combat alone.[48] During the ten months of kamikaze attacks, over 3,500 tokkotai died in Japanese missions.[49] Yet the total number of lives lost during this period by both militaries was far greater. Japan was systematically bombed by Allied powers beginning in 1944, and at least half a million civilians died. These death tolls emphasize the incompleteness of any single perspective on aerial bombing and the destruction wrought by targeting from the air.[50] The protection provided by the assault drone was limited and, in World War II, insignificant. Following the monthlong test of the TDR-1s, new assignments were issued for the remaining personnel in STAG-1 and "all 30 Avenger [TBM] control planes were placed aboard a barge, taken out to Reynard Sound, and dumped into the lagoon."[51] Regardless of its potential, the assault drone was scrapped, and its use in World War II has until recently been mostly ignored.

Writing to Jones shortly after the unit was disbanded, Commodore Smith expressed bitterness following the termination of the project. Its failure is explained in terms that emphasize the challenges internal to the navy

and the inevitability of the technology: "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."[52] The exchange reflects the determinism that Smith thought drove the weapons project that he spearheaded, undermined in his assessment by internal resistance to unmanned aircraft within the navy hierarchy. Opposition to the project was exemplified by comments made by Vannevar Bush, director of the Office of Scientific Research and Development in World War II. In a 1947 letter evaluating the TDR-1, he dismissed the project, writing, "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."[53] As I have argued, what the drone was or could be, along with evaluations of its performance, do not reflect the technology itself but rather, emerge out of its socio-technical context. Importantly, in both Bush's and Smith's evaluations, no mention is made of the lives that might be saved or taken by the "robot"; rather, its technical merits were debated and it was the life and death of the weapon that Smith lamented. Operator and aircraft are intimately entangled.

Conclusion

The failure of the television-guided assault drone is important not only to debate the legacy of the project but also to question the inevitability associated with unmanned aircraft and the logics that apparently underwrite concerns about replacing humans with drones. Drones are tied to socio-technical frameworks that organize the terms for their development, use, and evaluation. They link together human and machine. Between 1934 and 1944, the television-guided assault drone emerged as an analog to the kamikaze and a replacement for pilots in debates internal to the U.S. Navy. By effacing the role of the operator and dissociating human action from the drone system, advocates of the television-guided assault drone lauded its "technological" superiority. This view was promoted by the use of television, which transmitted an "actual view" to an operator, and, in so doing, depicted the technical parts described this exchange. The 1944 film *Service Test of Assault Drone* shows how this perspective was enacted and documented by the STAG-1 commanders, minimizing the role of humans in the

operation of the assault drone and emphasizing the television image. Yet confusion expressed by STAG-1 pilots underscores how the television-guided drone never became a robotic analog to the kamikaze. Rather, the images onscreen captured a new synthesis between what is human and what is not, emphasizing the former to dissociate the operator from the destructive view in which he was immersed, while the assault drone, like the kamikaze, exploded in battle. The results of the Drone program were forgotten as unremembered bombings in the South Pacific and a discarded project that would reemerge in another, flexible iteration years later.

Notes

This chapter has benefited from comments provided by Caren Kaplan, Lisa Parks, Andrea Miller, anonymous reviewe, as well as discussions with the America's Initiative Working Group at Georgetown University. All errors and omissions are my own.

1. Fahrney, "The Genesis of the Cruise Missile."
2. Navy Television Review Board, 1937, Assault Drones, Collected Records of D. S. Fahrney, Records of the Bureau of Aeronautics, Record Group 72 (RG 72), National Archives II, Washington, DC (NARA II).
3. See Gregory, "From a View to a Kill"; and Mirzoeff, *The Right to Look*, for analysis of the connection between image transmission and drone warfare in the contemporary context.
4. MacKenzie, *Inventing Accuracy*, 214.
5. C. Thompson, *Making Parents*, 8.
6. See Haraway, *Simians, Cyborgs, and Women*; Latour, *Pandora's Hope*; and Jasanoff, *States of Knowledge*, for background on the coproduction of humans and nonhumans.
7. For a biography of Zworykin, see Abramson, *Zworykin, Pioneer of Television*; and Edgerton, *Columbia History of Television*.
8. Zworykin, "Flying Torpedo with an Electric Eye," 359, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II. See also the original document available in the RCA Collection, Hagley Library Manuscripts Collection, Wilmington, DE.
9. Uricchio, "Television's First Seventy-Five Years," 289.
10. Uricchio, "Television's First Seventy-Five Years," 289.
11. Zworykin, "Flying Torpedo with an Electric Eye," 1.
12. Zworykin, "Flying Torpedo with an Electric Eye,"1.
13. See Ohnuki-Tierney, *Kamikaze, Cherry Blossoms, and Nationalisms*; and Ohnuki-Tierney, *Kamikaze Diaries*, for analysis of the racism against the Japanese reflected in these discussions. Due to limits in the length of this chapter, the ways race is part of the tension between human and technology were not developed further.
14. Zworykin, "Flying Torpedo with an Electric Eye," 1–2, emphasis added.

15. Zworykin, "Flying Torpedo with an Electric Eye," 2.
16. Claude Bloch, Navy CNO, to Chief of the BuAer [Bureau of Aeronautics], 1939, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.
17. Fahrney, "The History of Pilotless Aircraft and Guided Missiles."
18. Edgerton, *Columbia History of Television*, 70–71.
19. Ernest King, Chief of the BuAer, to Navy CNO, August 22, 1940, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.
20. Walter Webster, Manager of NAF, to Chief of the BuAer, Philadelphia, PA, August 22, 1941, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II. In the report, *Drone* is capitalized to indicate that it is a code name.
21. Fahrney, "The History of Pilotless Aircraft," 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."
22. Fahrney, "The History of Pilotless Aircraft," 339.
23. For example, Axell and Kase, in *Kamikaze*, 40–44, discuss a Japanese pilot who, after being shot down, crashed his aircraft into an American ship during Pearl Harbor. There were, however, no organized suicide missions by Japanese pilots until 1944, and the tactics recounted by Axell and Kase were not exclusive to Japan; rather, they were used more widely by pilots of various nationalities who had already been hit by anti-aircraft fire.
24. Fahrney, "The History of Pilotless Aircraft," 371.
25. Fahrney, "The History of Pilotless Aircraft," 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."
26. Fahrney, "The History of Pilotless Aircraft," 372.
27. Fahrney, "The History of Pilotless Aircraft," 373.
28. National Naval Aviation Museum, "TDR-1 Edna III."
29. Fahrney, "The History of Pilotless Aircraft," 394.
30. Fahrney, "The History of Pilotless Aircraft," 386.
31. Fahrney, "The History of Pilotless Aircraft," 396–99.
32. Fahrney, "The History of Pilotless Aircraft," 401.
33. Fahrney, "The History of Pilotless Aircraft," 424.
34. *Service Test of Assault Drone*. 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 it to the National Air and Space Museum archives, rather than the Smithsonian archives. Part of the film is available at "Service Test In Field of TDR-1—WWII, Torpedo Drone," YouTube, www.youtube.com/watch?v=8RQcUtzAe98.
35. On NOLO, see Fahrney, "The History of Pilotless Aircraft," 211–14.
36. Asad, *On Suicide Bombing*, 37.
37. Ohnuki-Tierney, *Kamikaze Diaries*, xvi–xvii.
38. Jones, quoted in Fahrney, "The History of Pilotless Aircraft," 404.

39. Fahrney, "The History of Pilotless Aircraft," 419.
40. Spark, "Command Break."
41. J. Hall, *American Kamikaze*.
42. J. Hall, *American Kamikaze*, 214.
43. J. Hall, *American Kamikaze*, 203.
44. J. Hall, *American Kamikaze*, 214.
45. J. Hall, *American Kamikaze*, 214.
46. Chamayou, *A Theory of the Drone*, 84.
47. Jones, quoted in Fahrney, "The History of Pilotless Aircraft," 421.
48. Naval History and Heritage Command, "U.S. Navy Personnel."
49. See Ohnuki-Tierney, *Kamikaze, Cherry Blossoms, and Nationalisms*, 167.
50. See Tanaka and Young, *Bombing Civilians*.
51. Fahrney, "The History of Pilotless Aircraft," 427.
52. Oscar Smith, Commodore of United States Navy, to Lieutenant Robert Jones, Washington, DC, November 26, 1944, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.
53. Vannevar Bush, Guided Missile Review, Washington, DC, 1947, Assault Drones, Collected Records of D. S. Fahrney, RG 72, NARA II.