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Project Pigeon

Rendering the War Animal through Optical Technology

In his 1979 autobiography, *The Shaping of a Behaviorist*, B. F. Skinner recounted a fateful train ride to Chicago in 1940, just after the Nazis had invaded Denmark.[1] Gazing out the train window, the renowned behaviorist was ruminating on the destructive power of aerial warfare when his eye unexpectedly caught a "flock of birds lifting and wheeling in formation as they flew alongside the train." Skinner recounts: "Suddenly I saw them as 'devices' with excellent vision and extraordinary maneuverability. Could they not guide a missile?"[2] Observing the coordination of the flock, its "lifting and wheeling," inspired in Skinner a new vision of aerial warfare, one that yoked the senses and movements of living animals to the destructive power of modern ballistics. This momentary inspiration began a three-year project to weaponize pigeons, code-named "Project Pigeon," by having them guide the flight of a bomb from inside its nose (fig. 11), a project that tied together laboratory research, military technology, and private industry.

This strange story is popularly discussed as a historical fluke of sorts, a wacky one-off in military research and development. As Skinner himself described it, one of the main obstacles to Project Pigeon even at the time was the perception of a pigeon guided missile as a "crackpot idea."[3] But in this section I will argue that it is, in fact, a telling example of the weaponization of animals in a modern technological setting where optical media was increasingly deployed on the battlefield, a transformation with increasing strategic and ethical implications for the way war is fought today. I demonstrate that Project Pigeon was historically placed at the intersection of a crucial shift in warfare away from the model of an elaborate chess game played out by generals and their armies and toward an ecological framework in which a wide array of nonhuman agents play crucial roles. As Jussi Parikka recently described a similar shift in artificial intelligence, this was a movement toward "agents that expressed complex behavior, not through preprogramming

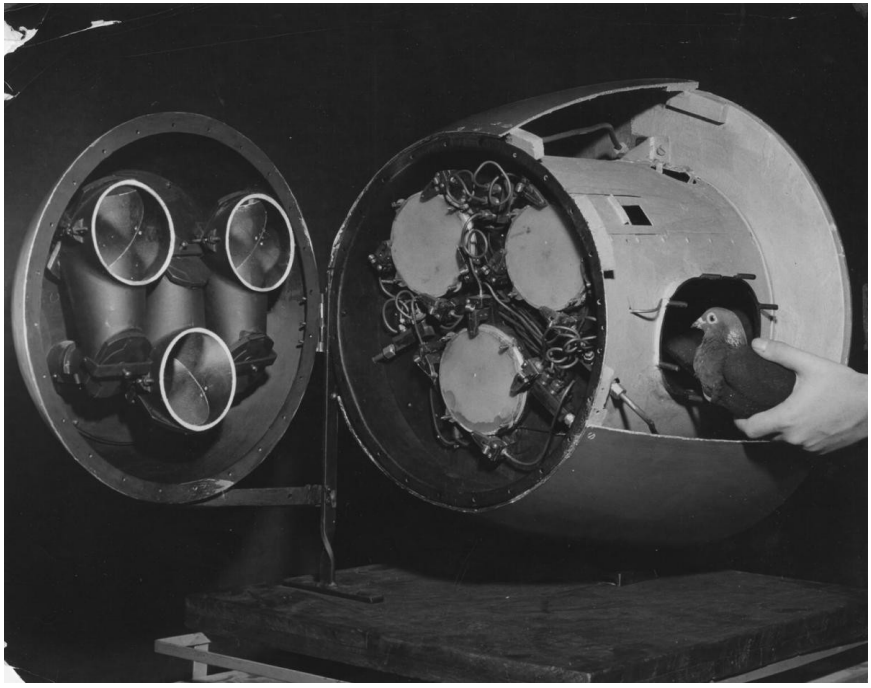

FIGURE 11. Photograph of Project Pigeon from the Burrhus Frederic Skinner Papers at Harvard University Archives. Courtesy of the B. F. Skinner Foundation.

and centralization, but through autonomy, emergence, and distributed functioning."[4] The missile developed and marketed by Project Pigeon was premised on a conversion of the pigeon from an individual consciousness to a living machine, emptied of intentionality in order to leave behind only a controllable, yet dynamic and complex, behavior that could be designed and trusted to operate without the oversight of a human commander. Here is a reimaging of what a combatant can be, no longer dependent on a decision-making human actor but rather on a complex array of interactions among an organism, device, and environment. As we will see, the vision of a pigeon-guided bomb presaged the nonhuman sight of the smart bomb, drone, and military robot, where artificial intelligence and computer algorithms replace the operations of its animal counterpart.

Media and cinema scholars have written extensively about the transforming visual landscape of the battlefield and film's place within this shifting history. Militaries from across the globe have pushed film to be used in dramatically unorthodox ways. Lee Grieveson and Haidee Wasson argue that the US military historically used film as "an iterative apparatus with multiple capacities and functions," experimenting with the design of the camera, projector, and screen to fit new strategic interests as they arose.[5] As Wasson argues in her chapter dedicated

to experimental projection practices, the US Army "boldly dissembled cinema's settled routines and structures, rearticulating film projection as but one integral element of a growing institution with highly complex needs."[6] As propaganda, film was used to portray the military to civilians at home and abroad; as training films, it was used to consistently instruct large numbers of recruits; as industrial and advertising films, different branches of the military used it to speak to each other. Like these examples, Project Pigeon relied on a radically unorthodox use of film that directed it into new terrains, intervening in the long-standing relationship between the moving image and its spectators to marshal its influence on nonhuman viewers, as well as humans. Here, we will see a hitherto unstudied use of the optical media, in which film was a catalyst for transforming animals into weapons and combatants.

Project Pigeon was one of the earliest projects to come out of an illustrious and influential career. Skinner would go on to become one of the most well-known voices in American psychology, introducing the "Skinner box" to the study of animal behavior and the vastly influential theory of "operant conditioning."[7] His influence was not limited to the sciences but was broadly felt across conversations in political theory, linguistics, and philosophy as well. As James Capshew has shown, much of Skinner's later, more well-known research originated in this military research into pigeon-guided ballistics.[8] Growing from initial independent trials in 1940, Project Pigeon secured funding from the US Army's Office of Scientific Research and Development in 1943.[9] The culmination of this work placed three pigeons in the head of a missile; the birds had been trained to peck at a screen showing incoming targets. These pecks were then translated into instructions for the missile's guidance system. The goal was a 1940s version of a smart bomb, which was capable of course correcting midflight in response to the movement of a target. Although Project Pigeon developed relatively rapidly, the US Army was ultimately denied further funds in December of 1943, effectively ending Skinner's brief oversight of the project. In 1948, however, the US Naval Research Laboratory picked up Skinner's research and renamed it "Project ORCON"—a contraction of "organic" and "control." Here, with Skinner's consultation, the pigeons' tracking capacity for guiding missiles to their intended targets was methodically tested, demonstrating a wide variance in reliability.[10] In the end, the pigeons' performance and accuracy relied on so many uncontrollable factors that Project ORCON, like Project Pigeon before it, was discontinued.

Moving images played two central roles in Project Pigeon: first, as a means of orienting the pigeons in space and testing the accuracy of their responses, examples of what Harun Farocki calls "operational images," and, second, as a tool for convincing potential sponsors of the pigeon's capacity to act as a weapon.[11] The first use of moving image technology shows up in the final design of Project Pigeon, where each of the three pigeons was constantly responding to camera obscuras that were installed in the front of the bomb. The pigeons were trained to pinpoint

the shape of incoming targets on individual screens (or "plates") by pecking them as the bomb dropped, which would then cause it to change course. This screen was connected to the bomb's guidance through four small rubber pneumatic tubes that were attached to each of side of the frame, which directed a constant airflow to a pneumatic pickup system that controlled the thrusters of the bomb. As Skinner explained: "When the missile was on target, the pigeon pecked the center of the plate, all valves admitted equal amounts of air, and the tambours remained in neutral positions. But if the image moved as little as a quarter of an inch off-center, corresponding to a very small angular displacement of the target, more air was admitted by the valves on one side, and the resulting displacement of the tambours sent appropriate correcting orders directly to the servosystem."[12]

In the later iteration of Project ORCON, the pigeons were tested and trained with color films taken from footage recorded on a jet making diving runs on a destroyer and a freighter, and the pneumatic relays between the servosystem and the screen were replaced with electric currents. Here, the camera obscura and the training films were used to integrate the living behavior of the pigeon into the mechanism of the bomb itself and to produce immersive simulations for these nonhuman pilots in order to fully operationalize their behavior.

The second use of moving images for this research was realized in a set of promotional films for Project Pigeon, which Skinner largely credited for procuring its initial funding from General Mills Inc. and the navy's later renewal of the research as Project ORCON. Skinner's letters indicate that there were multiple films made for this purpose, which were often recut in order to incorporate new footage.[13] Currently, I have been able to locate only a single version of the multiple films produced by Skinner, the latest iteration that was made to promote Project ORCON. Whether previous versions exist and have yet to be found or whether they were taken apart to create each new version is unclear. Based on the surviving example, it appears that these promotional films were used to dramatically depict the pigeons as reliable and controllable tools. Their imagery presents the birds surrounded by cutting-edge technology, rapidly and competently responding to a dynamic array of changing stimuli. These promotional films played a pivotal rhetorical role in convincing government and private sponsors to back the project. Skinner wrote that one demonstration film was shown "so often that it was completely worn out—but to good effect for support was eventually found for a thorough investigation."[14] This contrasted starkly with the live presentation of the pigeons' work, of which Skinner wrote: "the spectacle of a living pigeon carrying out its assignment, no matter how beautifully, simply reminded the committee of how utterly fantastic our proposal was."[15] Here, the moving image performed an essentially symbolic function, concerned primarily with shaping the *image* of the weaponized animal bodies.

Film was therefore used to transform the pigeon's behavior both materially and symbolically. Nicole Shukin's concept of "rendering," and its deployment in

producing what she calls "animal capital," provides a useful theoretical framework for connecting the rhetorical and functional aspects of the moving image in Project Pigeon. Broadly speaking, animal capital refers to the incorporation of animal life into capitalist systems of currency and exchange. As Shukin writes: "'Animal capital' simultaneously notates the semiotic currency of animal signs *and* the carnal traffic in animal substances."[16] Within the history of this processing of animal life, "rendering" takes on a double meaning. On the one hand, it connects to a history of animal recycling, the process of breaking down animal bodies for the production of a vast array of products, from meat to glue to leather.[17] On the other hand, rendering, especially recently, often refers to the process of producing a rendition, to the making of an image. Animal capital is the product of this double rendition, where animal bodies are processed into products and consumer goods, while their imagery is simultaneously consumed as symbols.

Shukin tracks this history of rendition through the interlocking development of the slaughterhouse and motion studies. Within her account, the slaughterhouse is an originary site for the systematic breakdown of bodies in industrial capitalism. Henry Ford's infamous inspiration for the assembly line—flipping the process from disassembly to construction—the slaughterhouse floor literally transformed bodies into an assemblage of component parts. Here, human labor and animal bodies were both integrated into industrial machinery for the purposes of producing goods. Shukin, along with others, traces the desire to further this process of integrating living bodies into mechanical systems to the initial motion studies of Etienne Jules Marey and Eadweard Muybridge.[18] Here, the *movements*, rather than the corpses, of animals were disassembled and mechanized. The images produced by chronophotography were a new kind of product. They were useful technologies, way stations in the optimization of the animal machine. As Marey wrote in the 1874 monograph that would inspire Muybridge's chronophotographs, *Animal Mechanism: A Treatise on Terrestrial and Aërial Locomotion:* "The comparison of animals with machines is not only legitimate, it is also extremely useful from different points of view. It furnishes a valuable means of making the mechanical phenomena which occur in living beings understood."[19] The mechanics of flight were contained in the images of a bird's wings, the physics of exertion in the leap of a cat, the dynamics of locomotion in the gait of a horse. With the integration of chronophotography into the management of the production line through Taylorism, the circuit of the industrial factory and motion studies was completed, as workers were filmed to more efficiently integrate their movements with the demands of the assembly line.[20] Within the posthuman logics of animal capital, it was only a matter of time before what was done to animals spread to the treatment of humans.[21]

The corresponding sites offered by Shukin, as we have seen, are the slaughterhouse and chronophotography out of which arose a particular brand of biopolitics and biomechanics in industrial production in the late nineteenth century. But to understand Project Pigeon, we need to study a different history of rendering, one

that was produced by an alternate circuit focusing on the science of perception. Skinner's research emerged at the intersection of two different genealogies: that of the camera obscura and that of the battlefield. The correspondence between histories of optics and warfare renders animals differently than do those of the factory. The animal-as-weapon that is produced from this knotted history is mindless, yet complex, and fundamentally rational in its operations. Like Marey's chronophotographs, this was a history of harnessing nature as technology, which in this context would be aimed at military rather than industry goals.

Well before the advent of capitalism, or Project Pigeon, humans and animals were being rendered into useful bodies on the battlefield, consumed not by the industrial factory but by the war machine.[22] Animals offered fantastic, nonhuman powers for waging war. For centuries, horses, elephants, dogs, and other animals fought alongside human soldiers under almost every conceivable circumstance. These battles often required a deep synchronicity and companionship between humans and animals, creating what David Gary Shaw calls "a unity, a temporary but socially significant fusion of sensible things."[23] At times, these assemblages of human and animal produced deep emotional bonds, with war animals depicted as heroic companions and fellow soldiers. Animals were awarded medals and given funerals, recognized as essential players in the theater of war.[24] They were a means to an end—heightening human senses, providing speed and endurance, elevating commanders above the fray, and so forth—but often were not described as disposable tools in the way that a rifle or a cannon was. These charismatic companions ranked as members of the troop or battalion, worthy of recognition and praise.[25] Pigeons participated in this history, especially during World War I, when they were used extensively to coordinate attacks and relay crucial information.[26] As small, speedy, and agile messengers, pigeons allowed commanders to communicate across enemy lines. Additionally, they were known to persist in their missions even when injured, leading to heroic, popular stories of individual pigeons that delivered multiple messages even after being wounded. One particularly heroic pigeon, Cher Ami, was stuffed and preserved in the United States National Museum, commemorated by one author as "A Feathered Hero of the World War."[27]

At the same time, a very different strain of animal warfare existed alongside these companion species. Animals were just as often used as a kind of expendable technology, capable of killing and being killed in ways that did not risk human soldiers and were often more effective than traditional weaponry. Stretching back to the middle ages, practitioners of biowarfare developed a cruelly efficient use of nonhuman life as killing machines, terraforming, infecting, and infesting massive swaths of land.[28] The germ, the virus, and the swarm were staples in the arsenal of colonialism, where agricultural, ecological, and medical systems were all upended.[29] Here, too, pigeons were present. Donna Haraway describes the pigeon as a "creature of empire," animals "who went with European colonists and conquerors all over the world," and who were "infamous for ecological damage and

biosocial upheaval."[30] Like rats and crows, pigeons thrived in urban settings, proliferating along with industrialization as a sign of the transformation of territory and landscape. By the 1940s, pigeons had also become disposable in a new way as vermin. They were "rats with wings," symbols of urban blight and decay.[31] In this context, pigeons were occasionally associated with other perceived social threats, such as immigrants and the homeless.[32] They were a scourge to be eradicated. In popular news and magazines, pigeons were connected to disease and infestation and often were exterminated in large numbers. These pigeons were not individualized but rather perceived as a swarm or pestilence, a threat to public health and sanitation.

Skinner's Project Pigeon emerges from this history but was also unique to its scientific and cultural context. Skinner connected his project to the history of deploying animals' sensory capacities, such as the bomb-sniffing dog, to extend human awareness of the battlefield. Like the dog's sense of smell, the pigeon's capacity for sight was weaponized for the purposes of seeing from the air. But, Skinner also crucially recognized that Project Pigeon was not about expanding human sensory capability, as pigeon senses do not surpass our own. What made the pigeon so valuable was that it was "readily expendable."[33] The pigeon's disposability allowed it to function as a component within a self-destructing system, seeing and responding up until the last explosive moment, connecting its sensory input to the movements of the bomb throughout the entire flight. The disposability and availability of pigeons made them ideal artillery, while their capacity to learn complex behavior allowed them to be installed into the complicated machinery of the bomb. These birds allowed Project Pigeon to create a bomb that could respond to its environment in real time like a living thing but also be indiscriminately destroyed as an object.

Paired with the disposable pigeon agents, the camera obscura was a crucial integrating device in the development of this project. It tied the behavior of the pigeon-as-subject to the movements of the living bomb. Thus, the ways that the camera obscuras installed in the "pelican bomb" (named for its beak-like nose) conditioned (or rendered) the behavior of the pigeon are essential for understanding the weapon's function. As Jonathan Crary outlines in *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century*, camera obscuras have a long philosophical history of envisioning, materializing, and conditioning forms of (primarily human) consciousness.[34] Skinner's radical repurposing of this optical tool illustrates his broader vision of warfare fought by distributed autonomous organisms rather than a centralized strategic intelligence. A camera obscura is constructed by installing a convex lens into a pinpoint hole in one wall of a darkened room, causing the light and images hitting the lens to be projected on the opposite wall. Crary argues that, like the bomb in Project Pigeon, the camera obscura was long used as a means of reconciling observers with the world around them, by modeling the interiority of the subject as both an actual space and a

potent metaphor. The material and symbolic rhetoric of Cartesian dualism was rendered real by the camera obscura, exemplifying humanity's exceptional capacity for reason in its architecture.[35] Within the darkened enclosure created by the camera obscura's walls was the deliberating, rational human who was given space to reflect, organize, and order the forms and functions of the world outside.[36] The camera obscura offered its users the power to observe, apprehend, and define at a distance.

In many ways, the aerial perspective produced by the pigeon bomb and other instances of aerial warfare was born out of precisely this humanist logic. As Caren Kaplan describes, scholars studying the history of aerial views have created a "now-established narrative" in which views from above are seen as increasingly compounding Cartesian dualism's split between mind and body by further separating humans from their environment, expanding the reach of their vision and providing a space for interpretive analysis and reflection.[37] Paired with colonial and military projects, the aerial perspectives created by such diverse phenomena as hot-air balloons, spy planes, satellites, and drones have all been tied to the growing expansion of imperial power by bringing the entire globe into the line of sight of a controlling Western "magisterial vision."[38] As T. J. Demos argues, these remote sensing technologies promise "viewers a sense of control over the represented object of their gaze," in which "the dual colonization of nature and representation appear inextricably intertwined."[39] But Kaplan also takes pains to point out that this narrative leaves out crucial breaks and nuances, moments in which "the relationship between the material and the immaterial is never fully resolved and is therefore productive of ways of knowing and being that do not always square, literally and figuratively, with the Cartesian, bounded subject."[40] Poor images, tactile or haptic dissonances, engineering restrictions, realities on the ground, and unexpected affective intensities always threaten to intervene in the narrative of a smooth and seamless increase in human perception and power.

Following Kaplan, we can read Skinners' Project Pigeon as one of these moments, in which the power promised by the pigeon bomb was predicated on handing over the deadly capacity to perceive and master to a nonhuman consciousness rather than the expansion of human vision. By placing pigeons within the darkened enclosure of the camera obscura, Skinner hopelessly scrambled the binaries of human and nature, mind and matter, reflection and action that were represented in the camera obscura and amplified by the technologies of aerial surveillance. Suggesting an alternative historical narrative, Project Pigeon was the product of several major shifts in thinking and technology from the end of the eighteenth century to the Second World War. As Crary argues, later optical devices, such as the thaumatrope and the zoetrope, effectively located the operations of vision into the physiological processes of the body. For instance, the zoetrope—a cylindrical drum whose inside was lined with successive images that seem to move when spun and viewed through a series of open slots on the side—clearly displayed the

imperfect functioning of the eye, as the viewer could switch back and forth from moving illusion when looking through the slats to incoherent blur when looking over the top of the zoetrope. The marvelous illusions that nineteenth-century media created were premised on a precise manipulation of the senses rather than the relay of a real world of material objects, effectively disengaging sight from a direct access to truth.[41] Optical media became more and more corporeal, associated with the arrangement and functioning of the human sensory apparatus.

At the same time, the particularly *nonhuman* functions of optical media were also being extolled. The transportive effects of these devices suggested an accumulation and access to other sensoria beyond the human, other optical truths that might be just as revealing as our own. A parallel interest in the perceptions of animals coming out of ethology in the late nineteenth and early twentieth centuries was also leading to the conclusion that the world experienced by humans was only one of many possibilities. The German ethologist Jakob von Uexküll developed the concept of the *umwelt* (environment) to describe the differing perceptual worlds inhabited by human and nonhuman animals with different sensory capacities. As Jussi Parikka describes, Uexküll "can be thought to show the crumbling of human apperception via the potentially infinite number of perceptual worlds existing in animals—with the world of perceptions too small or too large to comprehend from the human perspective."[42] Uexküll himself described this work as an outgrowth of animal research on film. He recounted the experiments of one German researcher who found that certain strains of fish only respond to images projected at thirty frames per second, leading Uexküll to conclude that "all processes of motion appear more slowly in their environment, as in slow motion."[43] The study of animal perceptions and of moving image technology seemed to demonstrate the ways that life could inhabit the world in radically different ways. Unlike the pairing of the Cartesian subject with the camera obscura, the coupling of animals and cinema, with their capacity to project startlingly different perspectival positions, was associated with the exploration of nonhuman *umwelts* by gesturing to alien perspectives outside the human.

And finally, by the 1940s, optical media had also dramatically altered the epistemology of warfare. As Paul Virilio tracks in *War and Cinema: The Logistics of Perception*, in the early decades of the twentieth century, combat was increasingly fought through the aid of photographic and moving image technology. Beginning especially with World War I, as Virilio writes, battles "depended upon the *regulation of points of view*—that is, on a definition of the battle image in which the cavalry's perspective suddenly lost out to the perpendicular vision of the reconnaissance aircraft."[44] As with the shift in approach from the camera obscura to the optical toy, less and less emphasis was placed on the revelatory capacities of "seeing with one's own eyes" and more and more battles were conceived as a panoptic assemblage of nonhuman points of view in combat. The expansive application of surveillance in war was paired with evermore powerful artillery, creating a scenario in which

one needed only to see the enemy to kill them: "The idea of war as fundamentally a game of hide-and-seek with the enemy was proved to the point of absurdity in those First World War earthworks where millions of men were entrenched and interred for four long years."[45] Just as science had increasingly off-loaded the act of observation onto mechanical means, so, too, the military developed its own "mechanical objectivity," except with the twist that observation and attack were densely intertwined.[46] To see, to identify, to visualize became increasingly synonymous with monitoring, targeting, and killing, a process that was abetted by operationalizing modes of vision beyond the individual human combatant.

Therefore, by the time Skinner began his project, optical media and nonhuman perspectives had been largely intertwined and operationalized for combat. Even in World War I, pigeons were well integrated into this new framework. A conspicuous example was Dr. Julius Neubronner's miniature pigeon camera.[47] Created in 1903, the pigeon camera was light enough to be carried by a flying pigeon and would automatically snap photographs through a time-released shutter. The German military adopted the pigeon camera as a means of surveillance, and a 1916 article in *Popular Science Monthly* reported several such pigeons being shot down by Allied forces. This article, "The Pigeon Spy and His Work in War," begins with an eloquent appraisal of the bizarre mixture of old and new in these pigeon cameras: "It is a strange medley, the air-ship, the last and most daring invention of man's brain, rising in the early dawn to search out and photograph the foe's movements, and the graceful pigeon, so frequently mentioned in the stories of early days, soaring, perhaps at the same moment, to act as an aerial scout."[48]

While Neubronner's pigeon camera stimulated popular imagination, it was hardly the most pervasive use of pigeons at the time. During World War I, pigeons were part of a loose network connecting intelligence gathering with battalions on the ground, stringing together observation and attack. In particular, pigeons were used to coordinate aerial spy crafts. Susan Bulanda notes that "pigeons could be released from aircraft going 100 miles per hour and from heights of up to 6,000 feet."[49] Pigeons were used extensively to communicate coordinates to headquarters, an important channel of communication for directing the various points of view that were beginning to define the war.[50]

By the Second World War, many of the functions previously performed by pigeons were thought to have largely been taken over by electronic means of communication. The expanding use of radio and the advent of radar in the 1940s were ideally meant to rapidly connect bombers to a centralized headquarters and allow pilots to "fly blind" regardless of the time of day or weather conditions. As Virilio describes aerial warfare during World War II, it was a cinema or phantasmagoria of war.[51] The victims of both German and Allied bombing raids were spectators of these horrific lightshows in the sky, which were orchestrated by far-off commanders who designed and guided the deadly displays. Electronic sensors and communication created a vision of war as a grand performance in which all the various

actors were coordinated and guided by orders from remote headquarters. This lightning-fast communication seemed to make the homing pigeon largely obsolete. Despite this, there were in fact more pigeons deployed during World War II than during World War I. Pigeons were used to communicate among those who could not bring the rather bulky equipment necessary for radio and radar communication with them. This points to an essential difference between the techno-utopian rhetoric and vision for warfare and the realities on the ground, where pilots often flew blind.[52]

But Skinner transformed the pigeon's role into that of a possible guidance system for deployed missiles. The threads of embodied media, animal ethology, and optical warfare were all present in this repurposing of the pigeon combatant. Skinner explicitly envisioned Project Pigeon as an alternative operating system to the networks of command and control created by radar and radio. He acknowledged that homing missiles that could be guided through radio had already been created in the 1940s, but their existence within the recognized field of electronic warfare also made them susceptible to interception and jamming.[53] No matter how instantaneous the speed of communication between bomb and headquarters, there was always the chance of the enemy intercepting or disabling these communications, of severing the connection between the bomb and its controller. Reacting to these flaws, Skinner posited the pigeon as a system of response that was incorruptible in its proximity to the facts on the ground. An alternative to the grand maneuvers of a centralized orchestration of war, Project Pigeon envisioned a flock of bird-brained bombs, alive and responding to their environment, with a clear goal of defeating a clear enemy yet devoid of any master plan. Theoretically, the pigeons would self-organize, just as they did in their flocks, and therefore create their own patterns of attack to fit each circumstance. It was this alternative form of warfare that Skinner had suddenly seen on that fateful train ride in 1940—one that was dramatically opposed to the vision of war as a massive centralized organization of many dispersed pieces.

Skinner's pigeon bomb was designed as a kind of animal, given a sensorium by harnessing optical media and the ability to respond through the behavior of the pigeon. The falling bomb sensed the space around it through its three camera obscuras, which functioned as eyes. The pigeons inside the bomb operated as a kind of nervous system, rerouting outside stimuli to the thrusters, allowing it to respond to shifts in position due to drift, air currents, and moving targets. The pigeon bomb was deeply embedded with its environment through a feedback loop produced by sensing and reacting to shifts in perspective. The majority of the training of the pigeons themselves was dedicated to wedding the nature of the birds to the spectacle produced by the camera obscura, thereby producing an image that would elicit action. The *umwelt* of the pigeon was interfaced by the design of the bomb. Unlike the camera obscuras of the seventeenth century, which promoted a sense of separation from the world by walling off the observer inside a space of

repose, the images produced within the Project Pigeon bomb were connected to the needs of its animal inhabitants. The hungry pigeons were conditioned through days of training to constantly peck certain shapes on the screens in front of them. By rewarding the pigeons with food, Skinner and his peers created an image that required action on the part of the observing animal in order to satisfy its basic demands for survival. By hacking into the *umwelts* of the pigeons, Skinner and his research associates could control their responses and tie them to the operational objectives of the bomb.

Toward these ends, the researchers at Project Pigeon, and later at Project ORCON, labored to produce precise simulations of the suicide bombing missions that the pigeons would be expected to run. While Project ORCON was being conducted, Skinner was researching visual acuity in the pigeon and relaying his research to the ORCON crew, testing pigeons' responses as they rapidly moved toward photographs. He consistently pushed the navy's photography division for more clarity and contrast in its images, asking for photographs that one correspondent claimed were "physically impossible."[54] Attempting to fulfill his request, the photographers had to experiment with new fine-grain lenses and large-format cameras. Skinner tested the pigeons' visual acuity in close-up, reproducing the views just before impact. He also simulated the extreme duress that the pigeons would experience in battle by having them practice in different air pressures and by firing a pistol during test runs.[55]

Meanwhile, the staff of Project ORCON created their own elaborate devices for connecting the pecks of the pigeons with their filmed simulations of bombing runs (fig. 12). They invented a relay system whereby each peck created a circuit between a metal headpiece worn by the pigeon and the electrical conducting glass placed in front of the image. The location of each peck was translated as an electrical current registering the distance of that point from the center of the frame. This device was then coupled with a film projector whose projected image would swivel in response to the pigeon's pecks, thereby creating a realistic simulation of what would occur when the pigeons controlled the movement of the bomb. As one report described: "The key apparatus here was a small mirror that could be turned right-left and up-down by a servo motor. The motion picture projector beamed the target pictures onto the mirror, which then reflected the images onto the tracking screen. The control loop, embracing the pigeon's beak contact and the conducting glass, provided the signals which determined which way the servo motor would turn the mirror, and thus where the image would appear on the screen."[56]

The result was a film image that changed position in response to where the pigeon struck the screen. The tight feedback loop between organism and environment was simulated by these optical devices, allowing for the use and design of the pigeon's responses as a tool. Ultimately, by pairing the onscreen image with the needs of the pigeon's body, and by creating a media device that could respond to its movements, Skinner and his peers reimagined the bomb as an optical device

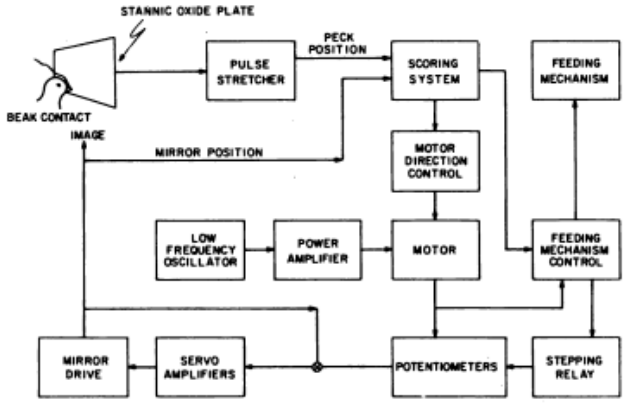

FIGURE 12. Diagram of Project ORCON's analogue touchscreen. Reproduced from US Naval Research Laboratory's "Project ORCON: The Use of Pigeons to Guide Missiles." Courtesy of the B. F. Skinner Foundation.

that could—with precision—correspond to the animal's sensory system, a cyborg apparatus that tethered the life of the pigeon to the working of the bomb.

According to Skinner, the eventual failure of Project Pigeon was not due to a design flaw or incapacity on the part of the pigeons. Instead, it was his inability to convince the army generals of his dramatically different vision for how war might be fought. Skinner interpreted the final written rejection of Project Pigeon as alluding to the invention of the atomic bomb, a weapon whose sheer power would make the precision of Skinner's missile superfluous.[57] The world of warfare envisioned with the advent of the A-bomb, with its emphasis on the most troubling of human decision-making and operational chains of command, was diametrically opposed to Skinner's vision. He had been fundamentally *inspired* by watching the coordination of the flock of birds, seeing in their movement a new metaphor for the battlefield. Even though the pigeons' ability to fly ultimately had very little to do with their actual function within the bomb, as their wings were strapped to their sides inside the bomb, the bird's flight was replaced by the bomb's flight, guided now by the perceptual apparatus of a hungry pigeon, creating a kind of self-synchronizing arsenal of bombs. Skinner's "rendering" (in Shukin's use of the term) was not only the transformation of the pigeon's body into a guidance system but also the reimagining of the visage of a flock of birds as a novel form of war strategy in which weapons guided themselves and were responsive to their immediate surroundings.

Such a strategy meant relying on the behavior of birds as consistent weapons, as well as relying on the work of laboratory psychology to generate replicable scientific findings that could be applied in circumstances of life and death. Orienting animal laboratory research toward the production of weapons based on avian behavior required adapting the terms of psychology to the language of the military-industrial complex. As James Capshew writes in his account of the scientific history of Project Pigeon, Skinner and his researchers were initially unable to

FIGURE 13. Panel depicting Project Pigeon from a comic strip. *Toledo Blade*, Oct. 11, 1959. Copyright The Blade 1959. Used by permission.

convince even other scientific divisions of the validity of their findings, "eventually learning to articulate their work in engineering terms, as seen in the use of the metaphor of the bird as a machine." Both the success and the failure of Project Pigeon hinged on this "rhetorical ploy," as Capshew calls it, which described the pigeon as a dependable piece of equipment that could be trusted to operate on its own without oversight from a human commander.[58] As Skinner wrote: "We had begun to realize that a pigeon was more easily controlled than a physical scientist serving on a committee."[59]

Here, again, film was crucial—not in the actual implementation of Skinner's model of war but in its promotion, in Skinner's ability to sell the idea to the military brass. Skinner struggled to have Project Pigeon taken seriously. He described being all but laughed out of conference meetings on several occasions. Indeed, when the project was eventually declassified, it was the butt of many jokes by popular commentators. An example of this scorn can be seen in a 1959 cartoon for the *Toledo Blade* (fig. 13) in which a pigeon was depicted dressed as a pilot boasting to another pigeon in a black cocktail dress that "I'm a big missile man from U. of M." The humor is premised on the absurdity of the pigeon replacing the human pilot, the incongruity between the prestige and authority of the pilot's role and the animal body of the pigeon, the ludicrousness of a pigeon who would boast of his flights over a cocktail. Project Pigeon seemed laughable as long as the pigeons were seen as living substitutes for the decisions made by pilots, as we see in a different panel of the comic that depicts two pigeons inside the bomb debating whether or not they are heading in the right direction (fig. 14). As a device that was designed and installed into a machine, the pigeons could be seen as an efficient and cheap means to an end, but as decision-making actors, they became anthropomorphic caricatures of war strategists and bombardiers, placing the power of the US military into the hands of animals.

The frequent dismissive responses to Project Pigeon, crystallized by these comic strips, stand in utter contrast to the stark and brutal efficiency depicted

FIGURE 14. Panel depicting Project Pigeon from a comic strip. *Toledo Blade*, Oct. 11, 1959. Copyright The Blade 1959. Used by permission.

in the project's promotional films. Skinner's film had "good effect," as he repeatedly put it, helping to procure funding at several steps in the research's development.[60] Within the competitive field of military contracting, General Mills (which had initially sponsored Skinner's experiments) and Franklin Taylor (who took over the running of Project ORCON) used the footage of Skinner's research to market the weapon to possible investors. Heidi Holmstrom's blog entry "From War Dogs to Remote Controlled Monkeys" exemplifies one entry into the small subgenre of nontheatrical movies made to promote animal weaponry within the military.[61] Such films generally depict nonhuman organisms as integral parts of a modern military arsenal, a biodiversity of weapons, each contributing a unique body and behavior ready and available for every circumstance. Humans are shown on the periphery, installing and operating tech that will direct the movements of the war animal. Within this weaponized menagerie, the human viewers are instructed on the use of their animals, appraised of the development of new biotechnology, and encouraged to imagine a battlefield in which animal combatants swim, swarm, and scamper into the fray as proxies for human soldiers.

The scenes shot to promote Project ORCON picture the bodies of the pigeons as being capable of full integration into machine technology. Viewers are embedded in the highly technical space of the behavioral lab where the pigeon is conditioned to follow and peck certain shapes. The film begins with the installation of a headpiece on a pigeon in extreme close-up, its beak becoming a part of the instrument. The hands of the scientist cup and frame the head of the pigeon as a small metal prong is stuck to its forehead. Held between what appear to be two giant fingers, the pigeon's head is turned side to side, providing both a more complete image of the installed headpiece and a demonstration of the bird's malleability and compliance. The pigeon is subsequently shown performing in a series of simulations in which it displays its ability to target metallic objects that slide on rails behind an open screen. Viewed from behind, the construction of the film emphasizes the typewriter-like rapidity of the pigeon's head as it matches its movements

VIDEO 10. Film made to promote Project ORCON. Courtesy of the B. F. Skinner Foundation.
DOI: https://doi.org/10.1525/luminos.145.10

to the automated back-and-forth of the target. Here, the pigeon's animality is depicted as a powerful rapid-response system capable of keeping time with the other moving mechanisms surrounding it.

The final two shots depict the training of the pigeons responding to Project ORCON's filmed simulations. These scenes repeatedly show the pigeon guiding the missile to a series of ships in silhouette. Each time a battleship veers from the center, the pigeon reorients the image by accurately pecking on the ship, shifting the picture's position on the circular screen to reframe the target. Shown in a magnified close-up, the film constructs a bomb's-eye view. This is a triumphant image for the power of merging animal with machine, placing viewers with the pigeon inside the bomb as we move closer and closer to the oncoming ship. Each shot cuts off just before impact, suggesting the final destruction of pigeon, bomb, and boat. The effect of these shots is one of brutal efficiency, in which the compliant, nearly automatic, responses of the pigeon continue to perform up until the last moment, at which point the image and the bird both disappear. And then, after briefly cutting to black, the next shot repeats the dive again. Here, the multiplication of similar shots evokes a flock of similar bombs, each inhabited by a small disposable kamikaze pilot who can dispassionately destroy itself and the enemy with expert accuracy. Revealing fairly little detail of the actual workings of the bomb, these final shots are more iconic than informative, prompting the audience to imagine a new form of bioweaponry and war.

While Project Pigeon was never realized as a military technology, we now inhabit a future where Skinner's living weapons are no longer entirely a "crackpot idea," a world in which the nature-culture of the battlefield is increasingly recognized and put to lethal use.[62] As we grapple to understand this present moment, it is instructive to look back at Skinner's failed project, envisioned while gazing out a train window, to transform a flock of birds into an arsenal. The two-pronged rendering of bodies and images of war animals continues today, as ecological models and animal physiologies are adopted to military means. Body armor made from spider silk, remote-controlled insect drones, bomb-detecting harbor seals, and mine-detecting dogs now populate our military armory.[63] Additionally, progress in artificial intelligence, robotics, and genetic engineering have accelerated the use of animal weaponry far beyond anything Skinner could have imagined. Even products of purely mechanical engineering now seem possessed by the ghosts of animal combatants, as the military depends increasingly on nonhuman proxies such as the BigDog and WildCat systems. And, again, optical technology has been essential for the creation of such weapons. By integrating the moving image with nonhuman response systems, we have become accustomed to thinking about our weapons as having a perspective, a point of view, and of being capable of responding to changing events on the ground as they occur. Caren Kaplan describes how military intelligence's conception of surveillance technology has recently shifted from "identifying fixed, precise locations to 'situational awareness' in relation to a 'field of motion.'"[64] Here, flexible, even lifelike, weaponry is being developed to respond to the movements of individual combatants as they populate urban and civilian areas rather than surveying the movements of armies. As the chief of the Network Science Division of the Army Research Laboratory, Alexander Kott, recently observed: "A variety of networked intelligent systems—things—will continue to proliferate on the battlefield, where they will operate with varying degrees of autonomy. Intelligent things will not be a rarity but a ubiquitous presence on the future battlefield."[65] These new developments realize Skinner's radical vision of warfare not as a contest of solely human soldiers but as an elaborate network of animals and machines that mobilize nonhuman bodies, movements, and perceptions.

The ethics of this shift have always been questionable. Skinner, for his part, wrote: "The ethical question of our right to convert a lower creature into an unwitting hero is a peacetime luxury. There were bigger questions to be answered in the late thirties."[66] In the face of the horrors of World War II, Skinner believed that the loss of pigeon lives was a small price to pay in a battle against enemies that had "promised, and eventually accomplished, the greatest mass murder in history."[67] But, in many respects, the distributed agencies of the battlefield precipitated by Project Pigeon, with their capacity for pinpoint accuracy and a low risk in human lives (for our side), have effectively erased the distinction between peacetime and wartime, creating an endless sense of urgency about the events of an increasingly

remote battlefield. As Brian Massumi describes it, the preemptive logic of the "war on terror" no longer relies on calls for direct intervention but rather rests "on the wings of a drone."[68] Realizing the promise of the pigeon bomb, drone warfare has allowed America to conduct a never-ending war of extrajudicial killings, without either a declaration of war by Congress or any real reckoning of American intervention abroad, fought by what Massumi calls the "Obama generation of high-tech, low-footprint pollinators of preemption."[69] The lingering ethical questions of who is responsible for these remote killings and what the effects are of such asymmetrical risk to human life stay with us today. The distributed agency of the pigeon bomb that so startled the US commanders during World War II has now become a reliable political and strategic tool in contemporary warfare, where the accountability and costs of war have been dispersed to swarming flocks of nonhuman actors. As we come to grips with the fact that there is no "peacetime" to look forward to, no respite when we can pause and debate these approaches, the ethical questions about our newly accepted nonhuman combatants cannot wait.