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Book Author(s): MICHAEL RICHARDSON
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CHAPTER
ONE

witnessing violence

TWO MQ-9 REAPERS confront each other nose to nose, simulated aerial vehicles floating above simulated mountainous country. Light bends across the mirrored surface of one; the other is gray and black, a digital replica of its physical counterpart. Interspersed by spinning reflective planes and suspended in inscrutable contemplation, the two machines seem possessed of their own needs and desires. What takes place in this communion of militarized drones? While the drone skinned in military tones and textures is disconcerting if familiar, the mirrored drone is both alluringly beautiful and horrifyingly alien, an other-than-human object across which the gaze slides and fails to stick. Its mirroring offers no clear reflections, but rather refracts its surroundings into distorted fragments—a nonhuman resurfacing, the world rendered into the materiality of the drone as it seeks to become imperceptible. This moment in Australian artist Baden Pailthorpe's *MQ-9 Reaper I–III* (2014–16) captures something of what makes military drones fascinating, disturbing, and urgently in need of critical attention. At once threatening and seductive, the Reaper drone promises an omniscient and yet nonhuman capacity to perceive, know, and kill, one that sanitizes war by making it datalogical, computational, and spatially and affectively remote.

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For the militarized drone of the last two decades—exemplified by (but far from limited to) the Predators, Reapers, and Global Hawks operated by the United States, or the Turkish Bayraktar TB2 used by Ukraine—this capacity has depended on its near invisibility, its ability to operate untouched from the atmosphere. As war becomes increasingly autonomous and more centered on great power conflict, the forms and applications of drones are becoming far more varied, ubiquitous, and dependent upon artificial intelligence.

Exhibited at Centre Pompidou, Art Basel Hong Kong, and numerous festivals and galleries, *MQ-9 Reaper I–III* presents drone warfare as violence enacted through the computational simulation of reality (figure 1.1). Built in the modeling program Autodesk 3Ds Max, Pailthorpe's project reimagines key locations within the drone apparatus into the air above an environment that references the mountainous terrain of Afghanistan, over which drone warfare took its contemporary form. Shipping containers rotate slowly in the clouds, walls cantilevering open on hydraulics to reveal ground control station cockpits loaded with the screens, controllers, and interfaces needed to crew the Reaper and its siblings. Or they open to expose spare living rooms in which uniformed men perch on beige couches or do jumping jacks, transplanting the suburban life that bookends on-base shifts operating drones from the domestic United States to the atmospheric zone of war. Graphics are realistic but heightened, surreal simulacra of the computational space of war and an aesthetic familiar to both video games and the promotional videos produced by arms manufacturers. Their sterility mimics the rhetoric of precision and hygiene that accumulates around remote warfare and infuses the technocratic and corporate discourses that elide the violence inflicted by lethal strikes.

More than this, the computational materiality of *MQ-9 Reaper* is a stark reminder of the layers of simulation, data, modeling, and algorithms connected by distinct logics and processes that constitute the martial contemporary. Estranging relations between elements within the drone apparatus while insisting on the distortions and reflections produced by its operations, Pailthorpe lays bare the circulatory, diagrammatic flows of the system by shifting the locus of agency away from the human and to networked relations. When soldiers appear on screen to shadowbox and sit at their control stations, they have also entered the space of the drone and become its subject. Yet in taking up the toolkit of modeling, computation, and simulation, Pailthorpe knowingly enters the epistemic regime of contemporary war and so is bound to its informational logics and representational modalities even as they come under scrutiny. How, then, to witness this increasingly autonomous form of

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FIGURE 1.1. Still from *MQ-9 Reaper (III)*, Baden Pailthorpe, 2016. Courtesy of the artist.

war? How to grasp the violence its witnessing might do? While Pailthorpe's aesthetic intervention makes for an instructive entry point into the entanglement of aesthetics, war, and computation, this chapter is not about drone art per se.[1] Rather, it pursues these questions of witnessing violence by tracing the violent mediation that is essential to perception, knowledge-making, and communication in contemporary war.

DRONE WAR'S VIOLENT MEDIATION

Violent mediation names those material processes that are constitutively harmful, whether because they cut, target, exclude, define, categorize, or classify in ways that are injurious to human or nonhuman entities and environments. Weapons targeting systems are one such violent mediation in which the flux of light, molecules, and energy captured by computer vision systems are directed through interfaces that enable the selection of entities for lethal assault. But so too are mugshots, colonial land registers, and pesticides. Mediation itself is ambivalent, as Sean Cubitt notes, its flux preceding "all separations, all distinctions, all thingliness, objects, and objectivity."[2] In this sense, "mediation as the very fabric of change, of mutation, is a builder of

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differences, but as bearer of communication, it also establishes organizational forms with varying degrees of longevity."[3] While mediation can be transformative and generative, enabling deep communication and the flourishing of rich ecologies, it is not bound by moral standards nor intrinsically ethical. Mediation is thus not a normative process. With this concept of violent mediation, I want to distinguish between mediation in general and those instances in which it animates human desires to control, extract, dominate, oppress, and kill. Violent mediation is often most evident through technical systems that subjugate life and nonlife to their ends, but it is also at work in datafication and computation, and in a host of biogeophysical interactions instigated by humans to bring ecologies to heel or direct them to human ends. In this chapter, my focus is on the violent mediations of drone warfare, enacted through its sociotechnical apparatus. Violent mediation is not ancillary to drone warfare, but constitutive of it.

In this, drone warfare is not an outlier within war more generally but rather symptomatic of its media saturation. Martial operations are intensely mediated, bound together through recursive informational flows structured and organized by media technics. "Military knowledge," as Packer and Reeves put it, is primarily "a media problem, as warfare is organized, studied, prepared for, and conducted according to communicative capacities."[4] Military strategy, logistics, and operations are all determined by media technological capacity, but also shape those technologies in turn. The necessity of communication across distance produces semaphore, the telegram, satellites, and the internet, and these then enable naval formations, the coordination of mass armies, the deployment of missile batteries, and the networking of the battlefield via tactical drones, wearables, and mapping systems. This coconstitution of war and media means that human soldiers, pilots, analysts, and even commanders are increasingly ancillary to the workings of the systems themselves. If this was already true in the logistics or command-and-control infrastructures of earlier wars, the intensification and proliferation of automation marks an acceleration of the removal of human agency. No longer the essential component in waging war, the human is increasingly seen as either its most fallible element or its datalogical target. The ballistics revolution reorganized battlefield perception around wider geographies and enabled the infliction of violence at considerable distance, while the nuclear revolution introduced a planetary perception coupled with the potential for violence at a planetary scale. But the emergent AI revolution is reconfiguring perception to be everywhere and nowhere, with the capacity for violence so tightly bound to perception that it too can take place anywhere at any time.

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Warfare transforms not only in connection with technological, strategic, or even political change, but also in concert with epistemic shifts in the foundational frameworks, assumptions, and metaphors of scientific knowledge.[5]

From its inception, artillery targeting entailed mediation: the selection of targets, measuring of distances, the translation to maps, the adjustment of machinery, the firing of the gun. But with the emergence of autonomous systems of war—exemplified by the adoption, development, augmentation, and transformation of remotely piloted systems such as drones—mediation takes on a new complexity founded on the imagined and presumed exclusion of the human from its workings. Wide area motion imagery systems track areas as large as small cities at high resolution, identifying and following targets of potential interest that would be difficult if not impossible for human analysts to comprehensively account for. As such systems develop in capacity and autonomy, automated processes of mediation will locate, select, track, and even execute threats that only exist within the framework of the system. Military media are thus "constantly producing new enemies, and new methods of enemy identification stimulate the development of new weapons technologies designed to kill those newly identified enemies."[6] This interconnection between media and what Packer and Reeves call "enemy epistemology" and "enemy production" is not only a question of stabilized media technologies intersecting with military strategic imperatives. It also occurs through material processes of mediation, bounded by instrumental technologies but let loose on the complex terrain of life.

As I theorize it, violent mediation is embedded in a material-ecological understanding of war and the role of technologies of perception within it. In this, it shares much with what Antoine Bousquet terms the "martial gaze," which aligns "perception and destruction" through "sensing, imaging and mapping" that encompasses not just the visual but "the entire range of sensorial capabilities relevant to the conduct of war."[7] As perception and violence are increasingly twinned, mediation functions within those apparatuses to produce violence. Violent mediation is thus intrinsic to the martial gaze. We might think of violent mediation as the connective tissue of such systems, constituting sensing at the material level of technical operation but also stitching sensing into the larger apparatus: the thermal camera of the drone sensing its environment entails violence within its mediating processes, but also in the translation from sensing (thermographic camera) to imaging (decoding for optical display) to targeting (fixing of the reticule on an agglomeration of pixels). Processes of mediation occur within each stage, but also across them and throughout the kill chain. Attending to violent mediation

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thus means focusing on the movement, use, and structuring of information within the military apparatus, as well as within the elements that compose it. As with the martial gaze, much of this mediation is not visual—or only presented visually for the benefit of human actors within the system. Much of what is violent in such mediation is bound up with the technical processes of datafication, abstraction, analysis, and instrumentalization that increasingly animate military technologies of perception.

This chapter asks how witnessing might take place through the violent mediations of the martial gaze, and how those mediations—and the corporeal, ecological, and affective violence they engender—might be witnessed. It locates remote and increasingly autonomous warfare as both a driver and beneficiary of algorithmic enclosure, while recognizing that it simultaneously responds to and produces ecological crises.[8] Nonhuman witnessing provides an analytic framework for conceiving and excavating the witnessing that takes place in, by, through and, crucially, *of* the drone assemblage. War has always been a form of life, as Grove maintains, but its emergent contemporary forms possess a ubiquity, complexity, variability, autonomy, and technicity unprecedented in human experience. Reckoning with this becoming-war will require a refiguring of the human relation to it, but also a transformative shift in what counts as ethical and political claims to knowledge. This chapter thus lays conceptual foundations for the examinations of algorithms, ecologies, and absences that follow by showing how violent mediation is constitutively imbricated with war.

By attending to the nonhuman of witnessing, I am not dismissing or marginalizing the Afghans, Yemenis, Somalis, Palestinians, Pakistanis, Syrians, Iraqis and others who have given and will continue to give testimonies to reporters and human rights organizations.[9] As Madiha Tahir forcefully points out, "every thing is speaking and talking and witnessing and testifying these days, it seems, except the people whose family members and neighbors have been blown to bits in this war."[10] Hearing those voices louder and in more forums is unquestionably a vital task. Factual in orientation and presented as narrative, many of these testimonies are shaped by the expectations of human rights convent and the norms of tribunals and courts.[11] Their very familiarity, their echoing of testimonies of torture or rape or migration, speaks to the "becoming witness" of international humanitarian politics in the latter half of the twentieth century.[12] Such testimonies intentionally reinforce the humanist, rights-bearing subject because their very efficacy and legitimacy depends on recognition by the institutions and conventions of international humanitarian law, which are themselves interwoven with

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neoliberal attempts to develop a moral framework for capitalist relations in the wake of World War II.[13] Yet in doing so they seek to make recognizable encounters with nonhuman systems of violence—networked, autonomous, highly technical, and massively distributed in space—that resist the forms of knowing and speaking available to the eyewitness. There is a tension, then, between the necessity and possibility of making drone violence legible within the conventions of human-centered forums, whether international humanitarian law or rights discourses more generally. Within such a framework, drones and their data can only be made evidence, rather than recognized as witnessing in themselves. That is, human witnessing takes precedence and priority, relegating the nonhuman to the status of evidence that must be interpreted. While Pugliese provides a powerful case for a counterforensics that reckons with the more-than-human and Schuppli shows how material witnesses can obtain standing within public and legal fora, this chapter adopts a strategic agnosticism toward the agencies that animate the drone apparatus *and* to the potential for any instance of witnessing taking future shape as testimony. It refuses to deny potential standing as witness to the system (the entire military drone network, for example) nor any given elements of such systems (automated image analysis software, for example), even if they will be hostile witnesses. And it understands nonhuman witnessing as *preceding* the existence of fora for testimony, and so sees witnessing as independent from such fora. This chapter thus attends to the constitutive entanglement of human and nonhuman witnessing as a relational process of mediation through which violence is both registered and enacted on people, places, and ecologies, no matter whether testimony is ever called for.

In the remainder of this chapter, I examine nonhuman witnessing within the widening frame of increasingly autonomous martial systems. First, I consider the multiplying aftermaths of drone violence, attending to the interplay of the survivor testimony, war's material and cultural traces, and the way drone sensors and computational systems perform their own nonhuman witnessing. As a counterpoint to this bleak vision, I then turn to look at drone and remote sensor witnessing of Aleppo, Syria, in the aftermath of war. Moving from the drone war of recent decades to more autonomous futures, I then examine the violent mediations of augmented sensor systems in the case of the Agile Condor targeting system, which I read as an instance of automated media that displaces and disperses witnessing across military architectures and into the preemptive technics of edge-computing targeting systems. Finally, the chapter closes with an extended discussion of witnessing, autonomy, and the martial future of violent mediation.

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Drone is the colloquial term for an unmanned or remotely piloted aerial vehicle or—more properly—an unmanned or remotely piloted aerial system. At a minimum, the vehicle requires a controller, network, and signal to operate. Hobby drones typically form a wifi network with a smartphone as controller. Small military drones such as the AeroVironment RQ-11 Raven, a fixed-wing drone designed for tactical battlefield awareness, are launched by hand, and networked to a hardened laptop. The Predator and Reaper commonly associated with drone warfare are more complex, employing a "remote split" system in which the drone is launched from one location before control is handed off via satellite link to an operations crew, typically located in the continental United States. Data feeds from those systems can flow across an array of military institutions and actors, with communications inputs streamed back into the control station via voice and IRC-style text chat. Swarming drones are more complicated still, communicating with one another in the service of a predefined mission and thus even more dependent on software and sensors.

Drone systems are complex media architectures subject to continual transformation, which means they are best understood as hybrid collections of human and nonhuman agents and the relations that bind them.[14] As Anthony McCosker and Rowan Wilken observe, "Drones have emerged as a set of technologies that throw orbital power off its axis through their unfixed, unruly trajectories, their accessibility to ordinary users and their multidirectional motility."[15] Whatever their form, as Lisa Parks and Caren Kaplan write, drones "are loaded with certain assumptions and ideologies."[16] Yet while it is tempting to think of drones as radical departures—as exceptional technologies—undue focus on their newness obscures their debt to histories of airpower, racializing surveillance, and colonial-imperial practices of classification and control.[17]

Figured within the long history of airpower and its relations to visual culture, drones don't so much mark a radical break in the evolution of the martial gaze as coalesce a set of tendencies residing within the technics, imaginaries, and conduct of modern war.[18] This coalescence is particularly evident in their operational combination with the "kill box," the US military term for a temporally limited, geographically specific, and volumetrically defined zone in which deadly force is preauthorized.[19] Defined by a grid reference system and managed computationally through militarized communications systems, the kill box neatly encapsulates the violent mediation constitutive of con-

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temporary war in general and of drone war in particular. The kill box itself is a mediation: an operative transfiguration of world into media. In taking up life and refiguring its relation to death, this mediation is constitutively violent even before it kills, reworking the ontoepistemological status of those within its ambit from life to not-yet-death. Whether in concert with the kill box or operating in a less preauthorized context, the kill chain of the drone is distributed, dispersed, and mobile, producing and responding to emergent threats actualized within and through the network.

In this chapter, I approach the problem of witnessing (drone) violence by understanding it in relation and response to the becoming of war, rather than beginning with an imagined fixity or boundedness to war. Against the idea that the nature of war is given or known in advance, Antoine Bousquet, Jairus Grove, and Nisha Shah propose embracing "war's incessant becoming" such that "its creativity, mutability and polyvalence" are as central to analysis as its destruction.[20] Their "martial empiricism" references philosophies of radical empiricism—particularly Whitehead, James, and Deleuze—that resist any preferential focus on either ontology or epistemology in favor of an open-ended embrace of experience in all its generative mutability. Martial empiricism orients critique toward the processes, relations, affects, sensations, and technicities through which war autopoetically emerges. Such an approach necessarily involves an openness to the incapacity to provide ultimate or definitive answers and demands instead that martial violence be apprehended "as a process of becoming that is suspended between potentiality and actuality," in which the task of critique is "scrutinizing the enfolding of intensities, relations and attributes that give rise to war's givenness."[21] In the context of increasingly autonomous warfare, one starting point for a martial empiricism might be the perceptual relations that cohere around the figure of the drone, itself understood as an unstable and hybrid assemblage through which knowledge is produced and operationalized to violent ends.

My concern here, however, is less the emergent dynamics of autonomous warfare as such but rather how witnessing occurs within this condition of martial violence, and how nonhuman entities and processes engage and enfold human experiencing and witnessing. My pursuit of nonhuman witnessing within this becoming-war takes place through attention to violent mediation as a transversal process that both occurs within and connects distinct formations of martial violence, as well as the bodies, technologies, and situations that compose them. Attending to violent mediations as processes of knowledge-making and communicating opens the terrain on which witnessing can and must take place. As I theorize it here, nonhuman witnessing provides

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a mode of inquiry into the tensions between actual and virtual in the flux of becoming as it is interrupted, redirected, and mutated by martial violence.

Let us begin, then, with the violent mediations that animate the drone war assemblage by attending first to the shift from optical to datalogical mediations. In their first operational incarnation above the skies of Kosovo in the 1990s and then Afghanistan after 9/11, Predator drones were primarily optical technologies. With full motion video (FMV) and (usually) thermographic sensors, these drones "produce a special kind of intimacy that consistently privileges the view of the hunter-killer," as Derek Gregory puts it in an early and influential critique of drone violence.[22] One operator describes the view from above as "looking through a soda straw" that cuts context and complexity and tends to lock focus on whatever stays within its narrow targeting frame.[23] Limitations of bandwidth and multiple stages of encoding and decoding meant that video imagery was often not received by operators at anywhere close to the high definition in which it was recorded, while the atmospheric location of the sensors meant that people were principally seen from directly above or at a very acute angle, dehumanized pixels rather than recognizable persons. This violent mediation cut, reduced, and blurred complexity in ways that encouraged the infliction of force: rather than generating uncertainty that might discourage lethal action, the mediation of events in the world through the technical apparatus produced degraded information that was read as a threat within the system. While the perceptual capacity of drone sensors has advanced in the last decade, the underlying dynamics of using degraded information to produce threats remains very much in place in contemporary Reapers, Global Hawks, and similar lethal surveillance platforms.

To make sense of the drone as paradigmatic of a particular strand of contemporary war, I want to tease out the *relational processes* that underpin drone violence and in doing so shift the locus of inquiry from image and representation to mediation. Drone vision is digital vision, enabled through sensors that transform light into binary data rather than an analog imprint. Such vision operates through change and transmission of code, mathematical arrangements that can be rendered into pixels for display to human operators. Drone vision is thus operative and actionable, rather than merely representational.[24] That is, we can think of the drone assemblage as not only perceiving but also producing slices of the world upon which operations can be performed. Drones are automated media, oriented toward the future and governed by a logic of preemption that seeks to define and control threat. "Pre-emption operates in the register of the urgency of the imminent threat," writes Mark Andrejevic.[25] Privileging visual representations risks instantiating problem-

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atic imaginings of the temporal and spatial dynamics of drone warfare at the expense of properly grasping its networked, mediated, processual, and computational logics as a sociotechnical assemblage. Mediation is the performative transformation of a perceptual encounter, one that occurs in time and exceeds its content. It is a vital process, as well as a technical one: indeed, its technicity is itself a form of life.

Drone mediations are enmeshed with terrestrial surfaces and substrates, aerial atmospheres, built environments, multiple spectrums, and corporeal activities. Parks calls this vertical mediation: "a process that far exceeds the screen and involves the capacity to register the dynamism of occurrences within, upon or in relation to myriad materials, objects, sites, surfaces or bodies on earth."[26] As mediating technologies, "drones do not simply float above—they rewrite and re-form life on earth in a most material way," extending to "where people move and how they communicate, which buildings stand and which are destroyed, who shall live and who shall die."[27] In the context of war, the mediations of the drone apparatus are not solely vertical but also violent, and that violence is bound up with verticality. In perceiving and capturing slices of existence through its perceptual technics, the drone assemblage is at once reductive and productive. Reductive, in that it frames and subordinates life within the narrow aperture, angle, and classificatory mechanisms of militarized knowing. Productive, in that it transforms that life into actionable data crowded with virtual futures of persistent surveillance, active control, and even arbitrary death.

Both the soda straw and bandwidth problems spurred technological developments that marked an important shift in the sensory apparatus of war and an intensification of its violent and vertical mediations. To counter the narrow field of view, DARPA facilitated a series of wide area motion imagery (WAMI) initiatives to equip drones with sensors capable of recording and analyzing hundreds of city blocks within a single frame.[28] In its early forms, WAMI promised to capture everything, but in doing so produced an astonishing amount of data. Automated image analysis tools sought to exploit the totality of the feed, a feat what would require hundreds, if not thousands, of human analysts working in real-time. But bandwidth issues also meant that WAMI was difficult to make operational via the ad-hoc satellite, optical fiber, and wireless relays that compose military network infrastructures. WAMI thus produced spatial and temporal expansions in potential capability and in labor, network, and computational demands. Take the Autonomous Real-Time Ground Ubiquitous Surveillance Imaging System, or ARGUS-IS, which combined 368 overlapping high-definition sensors into the equivalent

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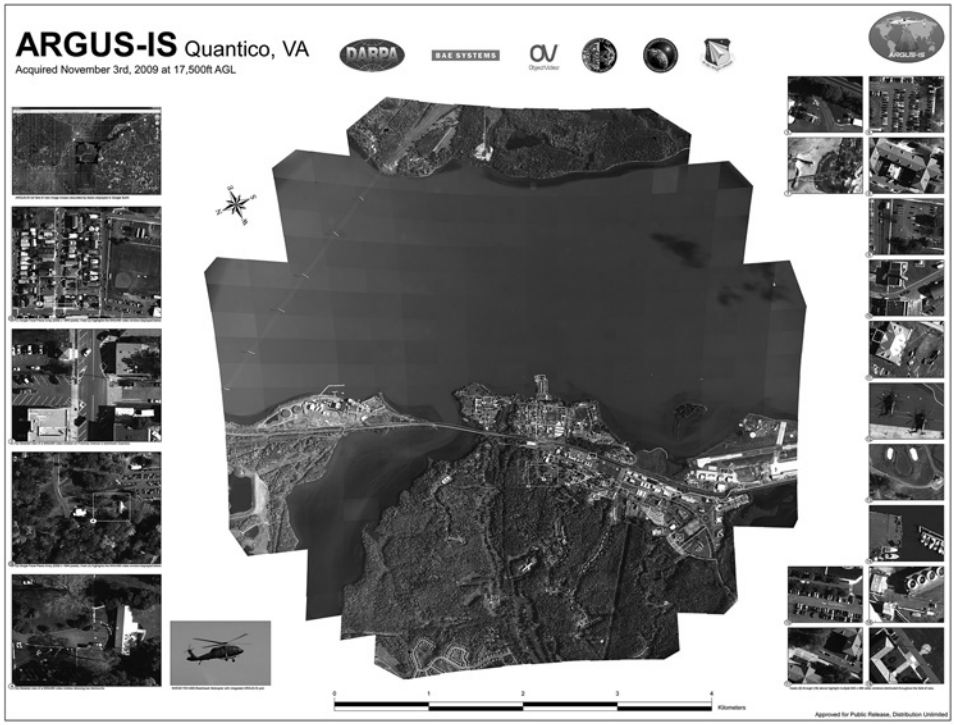
of a 1.8-billion-pixel camera to provide a high-resolution, full-motion video of up to ten square miles at a ground resolution of six inches per pixel from an altitude of twenty thousand feet (figure 1.2). As it was hyped in the 2013 PBS documentary *Rise of the Drones*, analysts would be able to create video windows, track vehicles, generate 3D models, and access location-specific archives to compare prior activities and track environmental change.

The volume of data produced by the system was astonishing: up to one billion gigabytes of data in twenty-four hours running at full capacity. Such potential perception far outstripped human visual capacities, promising to transform the world and its inhabitants into actionable data that can be called up on demand and rolled back and forward through time. But that technological capacity was never realized in practice due to the massive bandwidth and computational power required to make the system effective. For WAMI to provide its promised ubiquitous surveillance, the problem of getting data to humans in swiftly actionable form needed to be resolved. The obvious answer was to reduce the reliance on humans: new systems are thus built

FIGURE 1.2. Interfacial image from ARGUS-IS presentation, 2013



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around on-board packages that automatically analyze sensor data for items of interest and then push a selected subset of data through to human analysts and operators. These edge computing systems, such as the Agile Condor pod that I discuss later in this chapter, mark an intensified operative role for computation, one in which autonomous software systems not only record and analyze but also present data as actionable, where action can lead to killing. Mediation here takes on an overtly violent tendency, not simply through what it excludes or removes but through the lives that it presents as (potentially) requiring the application of lethal violence. As WAMI, edge computing, machine vision, photogrammetry, and autonomous targeting and navigating systems in general show, violent mediation is increasingly complex, distributed, and thick.[29] The identification, selection, targeting and execution of people depends upon a growing number of systems and technics involving increasingly interoperable components, while at the same time becoming opaquer in its workings. Making remote and increasingly autonomous war sensible—that is, making it graspable and addressable within the terrain of politics rather than its irruption into martial conflict—requires finding ways to witness the workings of these violent mediations. Yet the perceptual operations of violent mediation can themselves produce witnessing: registering and responding to violence, including their own.

TENUOUS AFTERMATHS

Drone warfare seems not to want to produce lasting aftermaths. Drone wars persist, carried on through the open-ended generation of threat, the low cost of involvement for aerial powers, and the ease with which they can be returned to the air above places and populations. This distended temporality is punctuated both by intense periods and sharp instances of violence and textured by the ever-present potential of death from above. Wartime, writes Beryl Pong, "constitutes its own violent, recalcitrant temporality."[30] Living with drone war means living in enduring aftermaths, troughs of grief and ruin that follow from drone strikes and shadow operations yet can never mark an end to wartime. Drone war's aftermaths are rarely spectacular, translated into narrow idioms that commemorate and reinstantiate a lost, yet mythical, past. Instead, the aftermaths of drone war are intimate, contested, and unruly; etched in stones, buildings, gardens, and bodies; seared into the fabric of communities and cultures.

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The photojournalism of Noor Behram captures these entangled effects of drone violence throughout Waziristan on the Pakistani border with Afghanistan. Haunted faces of survivors, shattered bodies of victims, broken homes, and fragments of Hellfire missiles—the people and objects documented since 2007 by Behram refuse to go unseen.[31] Among the many arresting images are those of survivors in the ruins of their homes, cracked metal from the shaft of a Hellfire held in their hands like the weight of it might break them all over again. Here is the materiality of remote war, stark matter that belies claims of surgical precision even as, according to Thomas Stubblefield, "these photographs at the same time acknowledge a certain inadequacy of (human) narrative in this system of drone vision." In one potent image, children stare into the lens, pieces of rubble offered to the camera and the remnants of buildings (a home, a school?) all around (figure 1.3). Mark Dorrian argues that the belatedness of the photographs to the act of violence—bodies, homes, and missiles already destroyed—signals the "violent cancellation of the possibility of witnessing" in the face of remote war.[32] But I want instead to suggest that these images confront the limits of human witnessing as the Hellfire fragments, ruined homes, and haunted survivors insist on richly textured, intimate relations shattered by war.[33] They both assert the radical absence of the technical apparatus of the drone on the ground, but also insist on that absence as a site of witnessing: its absence is itself a violent mediation. Against the violent delimitations of the algorithmic systems and militarized modes of analysis that dehumanize people into targets, homes into safe houses, and social relations into signs of threat, the material and affective relations that circulate within and leap from these photographs manifest the more-than-human wounding and trauma that accompanies "precision" warfare—and the inability of military infrastructures to reckon with or even acknowledge its ongoing presence.

Aftermaths such as these almost never disturb Western culture or politics, held at a distance by an apathy toward the unseen. Drone war persistently happens *over there*, despite the ramifications of its racializing technopolitics for publics at home.[34] In her history of war's aerial aftermaths, Caren Kaplan calls for close attention to "unpredictable yet repetitive intensities of time and space, disturbing the singular linear or bounded world that we take for 'reality' in Western culture."[35] Such "rogue intensities" are characteristic of wartime, holding the potential to "disturb the everyday experiences of those who might otherwise believe that they are unscathed or untouched folds places and times onto each other while opening up possible affiliations and historical accountability."[36] Careful attention to the ambivalence, contradiction,

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FIGURE 1.3. Photograph from Dande Darpa Khel, August 21, 2009, by Noor Behram

resistance, and uncertainty that marks the visual history of the aerial view is crucial. But this same care can be extended beyond the aerial to its terrestrial reverberations and, in particular, its material, cultural, and affective registrations. Drone war's tenuous aftermaths become more response-able and address-able when their witnessing is not a human project alone, but also heard in the discordant strains of nonhuman witnessing.

In operation, drones flicker on the edge of perception. For people living under drones, encountering them within the visual field is not uncommon, but neither can sight be relied upon to warn of an operation in progress.[37] On American missions, militarized drones usually fly high enough not to be seen at all, or to be caught only in the glint of sunlight in de-icing fluid as it slides across the wings and fuselage of the vehicle. Rain can keep them grounded, while cloudy weather sometimes means lower flights and greater visibility and tends to be avoided by commanders keen not to alert the surveilled to

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their presence. But the aural presence of drones is far more constant: a whirr that cuts through the hum of daily life and grinds against the mind. One man describes the sound of the drones as "a wave of terror" that sweeps through the community. Another links their buzz both to the permanent affective state of fear and to the strain placed on communal gatherings. "When we're sitting together to have a meeting, we're scared there might be a strike," he tells the researchers. "When you can hear the drone circling in the sky, you think it might strike you. We're always scared. We always have this fear in our head."[38] Alex Edney-Browne notes that one Afghani slang for drones is *bnngina*, after the bnng noise that the drones make.[39] That buzz works its way into bodies. As Mohammad Kausar, father of three, says, "Drones are always on my mind. It makes it difficult to sleep. They are like a mosquito. Even when you don't see them, you can hear them, you know they are there." If the everyday disruptions and anxieties of life under drones is most present in their aural intrusion, then might witnessing not also take place at this level of ears, sound, and material vibration?

For Schuppli, this *earwitnessing* strains the limits of what can count as the material witness of conflict because it leaves no trace, even if when "these low-frequency emissions combine with physical matter, they vibrate the tympanic membrane of the ear, so that hearing becomes a kind of barometer for reading the atmospheric pressure of drone surveillance on the body public."[40] Yet while the lack of trace limits the potential of this aural witnessing to enter the legal domain, we nevertheless need to reckon with its registering in the body as a critical point of contact in witnessing relations. Aural witnessing entails bodily mediation in the now, yet what it mediates is the virtuality of future violence: not simply a *warning* of potential drone strikes, but an impingement of the future on the sensorium in the present. *Bnngina* is the crowding presence of the aftermath to come, the violent mediation of a possible future.

Witnessing drone warfare from below is as much about making sensible the enduring, gradual, and uneven violence done to the fabric of life as it is about registering the spectacular, kinetic violence of the lethal strike. Surviving entails reworking relations of community and the movements of daily life in counterrhythm to the algorithmic operations of intelligence gathering and analysis. Disruptions to daily life and its communal governance are matters of space and movement, as well as custom, ritual, and routine. No longer socializing after dark, no longer holding community gatherings, no longer undertaking funeral rites: these are restrictions on mobility dictated by the uncertainty of violence from the air.[41] They also reflect intensive, shared learning in response to drone violence, a communal pedagogy of atmospheric war. That pedagogy

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not only entails reorienting daily life away from those activities that the drone apparatus might mark as threatening—it also involves integrating responsiveness to intelligence gathering into daily life such that the potential presence of the drone reweaves the cultural fabric. This reweaving becomes quite literal in the incorporation of drone iconography into traditional Afghan war rugs, with silhouettes of Predators and Reapers replacing the Soviet tanks and Stinger missiles that found their way into these woven images in the 1980s.

In works by Pakistani American artist Mahwish Chishty, this cultural imbrication of drone violence takes on a more direct critical dimension. Trained in miniature painting at the National College of Arts in Lahore, Chishty turned her attention to drone violence following a visit home in 2011. Combining her training in painting with the ornate folk traditions of Pakistani truck art, Chishty's *Drone Art Paintings* (2011–16) and accompanying installations and video works refigure drone technologies as splendidly visible, captured in the vibrant color and gold leaf of finely wrought bricolage against tea-stained backgrounds. Painted in opaque gouache, the works insist, as Ronak Kapadia points out, on the permanent visibility of the drone: materialized not as technoscientific monstrosity but as contained and owned

FIGURE 1.4. *Reaper*, Mahwish Chishty, gouache and gold flakes on paper, 2015. Courtesy of the artist.

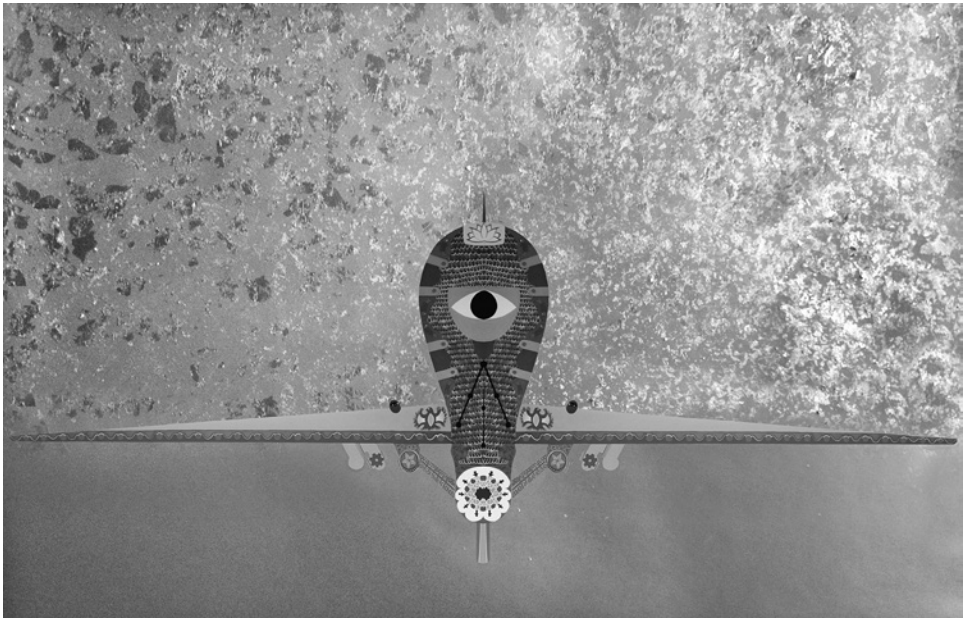

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FIGURE 1.5. Image from *Drone Shadows* installation, Mahwish Chishty, 2015. Courtesy of the artist.

by the body of the artist, the thick pigment of the paint, and the textured surface of the paper, exemplified by the painting *Reaper* (figure 1.4).[42] These works are emblematic of what Kapadia calls an "insurgent aesthetics" that seeks to unsettle the racialized, gendered, and colonial dynamics of empire.

Against the smooth, blank dimensionality of the militarized drone, Chishty's paintings segment surfaces into blocks of color, flowers, flag motifs, and eyes and mouths. For her *Drone Shadows* (2015) installation, Chishty painted plastic model kits of Reaper and Predator drones in the bright reds, greens, and yellows of truck art (figure 1.5). Suspending them in Perspex containers and using gallery lights to cast shadows, Chishty puts the (in)visibility of drone warfare in tension with the hypervisibility of the miniatures. In Chishty's work, there is an insistence on returning the nonhuman technics of drone warfare to the embodied scale of craft and paint. In wrestling with how to figure such nonhuman violence, Chishty undertakes a kind of nonhuman witnessing in reverse: testifying aesthetically to the possibility and necessity of making the seemingly invisible technoscientific mechanisms of violence the briefly tamed object of art.[43] This making visible and identifiable is, of course, al-

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ways only propositional: an address to imagine otherwise, and to resist the sanitizing discourse that surrounds and obscures drone violence in practice.

Over Afghanistan and in the Federally Administered Tribal Areas (FATA) of Pakistan, drone strikes fit into two broad categories.[44] While "personality strikes" target specific individuals identified by the US as threats (alleged terrorist or insurgent leaders, for example), "signature strikes" are activated by emergent patterns in accumulated data about movement and communication cross a certain threshold on a predefined decision matrix. Collected by drones carrying the GILGAMESH cell phone snooping equipment, metadata from cellphone tower check-ins, calls, and texts is analyzed by SKYNET software to identify "patterns of life" that could be mapped to potential threats or targets of interest.[45] But cell phones have strange lives—SIM cards can be swapped, phones shared—and in many places the status of various persons can be multiple and contextual—local elder in one context, warlord in another. Preemption obscures such specificities in favor of what can become operationally subject to tools that identify risk and act to eliminate it.[46] Even if the technical details aren't known on the ground, the felt force of potential violence permeates daily life. Camouflage is phones changing hands, SIM cards circulating, gatherings avoided. Life's textures transform,

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binding existence more tightly to war. People on the ground speculated to the Stanford and NYU researchers about paid informants, worried about "chips" and "SIMs" placed in cars and houses, and complained of eroding community trust and an atmosphere of paranoia.[47] The learned protective practices of people under the martial gaze testify to an intensive relation to the potential for death that manifests in the drone apparatus. Movements, changing cultural patterns and practices, a folding into life of the vagaries of the algorithm—these are a kind of collective witnessing to the nonhuman assemblages of signature strikes and their algorithmic architectures of intelligence gathering and objectification.

Surviving drone warfare is, however, as much a matter of chance as anything else.[48] How surveillance analysts and signals intelligence processes capture and classify bodies, movements, and social relations is deeply contingent. Death, too, entails the randomized destruction of living bodies into ruined flesh. Algorithmic killing, or "death by metadata" in Pugliese's formulation, is far from the technocratic ideal. While the language of surgical strikes and precision warfare suggests some sanitized form of violence, the reality on the ground is very different. Lethal strike survivor Idris Farid describes "pieces—body pieces—lying around" and the effort to "identify the pieces and the body parts" to determine "the right parts of the body and the right person."[49] Delving into the horrific violence of an attack on a village in Yemen, Pugliese writes that distinguishing between animal, child, and adult was often impossible, bodies fused into a "composite residue of inextricable flesh. The one melts into the other. The one is buried with the other."[50] While the targeting systems and discursive logic of drone warfare dehumanizes through techniques of gendering and racializing, its violence strips its victims of any corporeal distinction from other animals. Reducing the living to "scattered fragments of undifferentiated flesh," animal and human bodies become what da Silva calls "no-bodies" and Pugliese labels "nothing less than generic, anomic, and wholly killable flesh."[51] Even the land is scarred. As one survivor put it, "The entire place looked as if it was burned completely," so much so that "all the stones in the vicinity had become black."[52]

This ruination to human, animal, plant, and inanimate entities signals the limits of a witnessing that centers the human: How can a narrow humanism account for violence that strikes at the very vitality of more-than-human ecologies? This enfolding of more-than-human environments with human flesh demands what Pugliese calls forensic ecology. His vision of a radical forensics sees testimony as "a relational assemblage of heterogeneous materials that, collectively, is mobilized to speak an evidentiary truth."[53] While mobilization within a framework of laws typically depends upon a speaking subject,

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the registration of violence enacted on the sites of drone strikes constitute a form of witnessing that both precedes and exceeds the human. It precedes the human because the air's mediation of light in the collection of sensing data and of force in the on-rush of Hellfire missiles is already witnessing ruined flesh, scarred rock, and shattered plant life in the instant of explosion. It exceeds the human because this witnessing occurs below the threshold of detectability—in the faint striations of dirt subject to passing shrapnel, in the misting of viscera, in the ephemerality of heat—and far outside it, too, in the elusive scale of the drone apparatus itself. Translating such witnessing into frameworks of individualized responsibility is impossible, not least when the drone apparatus itself is so dispersed as to make no one singularly responsible for any given strike.[54] Yet while this combination of fused flesh and machinic occlusion of responsibility certainly signals the limitations of rights-based frameworks for dealing with the violence of increasingly autonomous warfare, it also suggests the necessity of a conceptual means of dwelling with the thick and messy confluence of forces that produces these horrors. Such a dwelling-with can only be processual and can only reckon with the violence of drone war as process. As a process of registration—which is to say, of the violent event mediated into the more-than-human flesh of the world—nonhuman witnessing offers critical purchase, insisting on attending to both the thick knots that bind violence, as well as the tenuous strands of relation that shimmer out of reach within ecologies and technical systems alike.

On the other side of the drone sensor array, aftermaths of violence are mediated very differently. In the form that has dominated the last twenty years of remote warfare, drone sensors display sensing data in visual images on the screens of operators located in ground control stations far from the battlefield. Replicated on the terminals of lawyers, commanders, image analysts and, in certain situations, officers commanding troops on the ground, the principal lens for drone operations is either optical or thermal full-motion video overlaid with GIS, timestamp, targeting, and other key information. With the arrival of the war on terror, Parks shows how media coverage "made vertical space intelligible to global publics in new ways and powerfully revealed what is at stake in being able to control the vertical field."[55] Media coverage of the invasions of Afghanistan and then Iraq rendered the aerial view familiar, training publics to recognize and decode new ways of seeing.[56] According to Roger Stahl, drone vision "invited publics to see the drone war through the very apparatus that prosecuted it," and in doing so "framed out those populations who must live and die under this new regime of aerial occupation," rendering them vulnerable, invisible, and ungrievable.[57] When

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drone war does intrude on the mediascape of the United States, the United Kingdom, Australia, France, Denmark, or elsewhere in the West, it does so through the existing profusion of screens, stories, images, and mediated encounters. Drone warfare presents distinct challenges for witnessing that take place in, by, and through journalistic media.

Visible in YouTube videos of Reaper strikes and part of the visual rhetoric of films such as *Eye in the Sky* (2015), the event of a missile strike overcomes the sensory capacity of the drone: a burst of white, intensities of light that overwhelms the optical camera and of heat that undoes the thermographic sensor.[58] Focalizing infrared radiation through the lens and onto the microbolometers assembled one-per-pixel into the sensor itself, thermographic cameras have to manage wider wavelengths than their optical counterparts. For Nicole Starosielski, "the infrared camera is not just another thermal medium alongside thermostats, sweatboxes, and heat ray guns: it is a technology whose sensing capacities work to transform all matter, whether bodies or buildings, into thermal media itself." The images it produces depend upon the recasting of "the world as a landscape of infrared reflectors and infrared emitters—as a field of thermal communication."[59] Sometimes, that field overwhelms the camera's thermoceptive capacity. When a missile strikes, the combination of limited resolution and intense heat prevents infrared sensors from doing anything but assigning maximal intensities—computer vision cannot resolve what it cannot sense. Whether in optical or infrared, this incapacity to capture the event of the strike means that drone sensors necessarily repeat the erasure of life at the level of sensor process. From within the drone apparatus, the aftermath is always obscured by the destruction itself, the wreckage of buildings and bodies, thick smoke, and the heat of melted matter. Inhuman vision reveals its inhuman sensoria, yet what human sensorium would not be shocked and undone by witnessing such a thing? In the aftermath, sensor operators typically shift to infrared to identify the movements of bodies and the still-warm flesh of the dead. Prescribed by the requirement to count all dead as military-aged males, as threats until proven otherwise, military personnel decipher the aftermath according to a rubric designed to repeat visceral, material violence in informational form. This reading of the scene—a kind of brute forensics—is often yoked to the question of additional strikes. These so-called double taps are often conducted at a delay intended to flush out further threats, but are far more likely to kill or wound anyone who rushes to assist at the scene, a fact that means bystanders often choose to listen to their neighbors die rather than risk being killed themselves.

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Not only are these sensors overwhelmed, but network latency also means that the drone apparatus can only ever witness on a two- to six-second delay. Whatever appears on screen does so with the event already in the past, not quite real-time but still live in the sense that the drone system always experiences liveness on delay. Distance vanishes, but time dilates. Drone systems intensify this tension between occurrence and technical mediation: an elastic temporality brimming with violence. Yet this latency also contains within it a certain necessary trauma, a deferral of the traumatic event into the durational virtuality of an arrived and arriving future. Produced by the combination of distance and transcoding between components of the network, this latency is one temporality of violent mediation, a time in which nonhuman witnessing takes place in the ambivalent space of the drone apparatus itself. This mode of nonhuman witnessing has little corporeal immediacy or political valence, but it is witnessing that registers violence distributed in both time and space. Seen in this way, the violent mediations of the drone apparatus remind us that nonhuman witnessing carries no inherent ethics, no necessary tendency toward justice, only an insistence on the complexity of registering an event as knowable. For ethics, morality, or justice to enter the frame, the question has to become one of testimony—of the bearing of witness after the event of witnessing itself. If the drone apparatus is, in its own ambivalent way, a witnessing machine, if a hostile one, then it is one that must in turn be witnessed. That challenge is amplified by new technologies that augment the sensory capacity of the drone through on-board advanced computing. But before turning to one such technology, Agile Condor, I want to first consider nonhuman witnessing in the aftermath of war in Aleppo, Syria.

WITNESSING ALEPPO

While the aerial view of war is rightly associated with surveillance, control, and violence, remote sensing systems and civic drones can also be harnessed as witnessing apparatuses for publics and researchers.[60] Such uses of sensing technologies reveal their partial, contested, and contingent nature, as well as the fraught politics of control that suffuse both atmospheric sensing and digital infrastructures.[61] Aleppo, in Syria, is a case in point. In March 2011 and amid the Arab Spring, prodemocracy protests in Daraa against the regime of Bashir al-Assad were brutally suppressed. When anti-Assad supporters rebelled across the country, Syria swiftly fell into civil war, which in turn produced power vacuums in various regions and enabled the Islamic State in

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Iraq and Syria (ISIS) to take root. Fought across four years from 2012 to 2016, the Battle of Aleppo saw what the United Nations called "crimes of historic proportions" committed by Syrian, rebel, and international forces, including via Russian, American, and Turkish air strikes from crewed and uncrewed aircraft.[62] By the time the city was retaken by the Assad regime, some 31,273 civilians were reported dead and numerous culturally significant sites were destroyed or damaged according to a UNESCO conversation report, including the destruction of the Great Mosque and the eleventh-century minaret of the Ummayad Mosque. Aerial and artillery bombardment ruined roads, homes, schools, hospitals, and entire neighborhoods, reshaping the city in fundamental ways and transforming life for its human and nonhuman inhabitants.

Rather than containing the violence, the application of "precision" weapons such as drones and guided missiles seemed only to intensify the destruction: imagery of Aleppo in 2016 bears a remarkable similarity to that of Berlin in 1945. Whether a missile was launched from a drone or manned helicopter is in some ways immaterial to the destruction it causes on the ground: the dead remain dead, homes remain ruined. But in Aleppo the view from above has afforded a more ambivalent relation to aerial aftermaths than is always the case, a phenomenon revealed in different ways by the Conflict Urbanism: Aleppo project from the Center for Spatial Research at Columbia University and drone video by Aleppo Media Center, an antigovernment activist group responsible for widely shared and republished footage.

Conflict Urbanism uses remote sensing imagery, geolocation data, and open-source software tools to create an accessible digital platform for tracking the city's wartime aftermaths. As artist, academic, and project lead Laura Kurgan points out, "while war demolishes, it also reshapes a city, and, however difficult it is to imagine rebuilding in the midst of a war, Aleppo is being restructured and will be rebuilt."[63] The core of the project is an interactive map that reveals damage to the city's urban fabric by layering high-resolution satellite images with data from UNITAR's UNOSAT (the United Nations Satellite Center, run by the United Nations Institute for Training and Research). In its remediation of satellite imagery into an activist-aesthetic context, Conflict Urbanism: Aleppo continues Kurgan's long-standing research practice engagement with the politics of remote sensing imagery.[64]

From the main site hosted by the Center for Spatial Research, users are able to engage with the city at the neighborhood scale, moving through time and at different resolutions to track the damage to the city (figure 1.6). This use of technics to make visible otherwise obscured transformations to the more-than-human environment of the city succinctly encapsulates

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FIGURE 1.6. Image showing areas of intense damage, *Conflict Urbanism: Aleppo*

the ambivalence of nonhuman witnessing of violence. Death, displacement, and destruction are rendered legible beyond the structural and infrastructural damage to the city itself, with individualized accounts from YouTube videos geolocated onto the map to provide an alternative ground truth. Seeking to intervene in the politics of war by making spatial and temporal scales of violence knowable to humans, the project shows how nonhuman witnessing—satellite sensing, drone vision, material scarring, ecological disruption—can broaden what counts as testimony within human polities. But it also lays bare the power that resides in control over access to and tasking of remote sensing satellites, as well as who and what counts as witnessing, witness, or testimony.

While Conflict Urbanism provides a kind of nonhuman witnessing infrastructure in its own right, the project is also concerned with interrogating the limitations of that infrastructure and developing transferrable techniques that might be deployed to understand other urban conflicts (figure 1.7). A crucial element of the project is thus probing the representational politics of satellite imagery made evident through constraints of access, resolution, legibility, and literacy. With some limited exceptions, remote sensing satellites that produce public data and imagery are either operated by the US government (such as NASA's Landsat) or under its auspices, as in the case of the IKINOS satellite and its successors. While Landsat's mission is the continuous

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capture of multispectral data of the earth, private satellite infrastructures only take images they are tasked to collect. Users need to purchase satellite time and specify locations. While the images produced can then be purchased by others, the costs of tasking and purchasing can be prohibitive for noncommercial or nonstate actors such as human rights organizations. Depending on the satellite, resolutions down to around 0.25m are available for public purchase, but for decades the US government limited commercial resolutions to 0.5m to keep human bodies illegible.[65] This can make the work of conflict monitoring more difficult, obscuring the movement of people but also the damage to buildings from non-incendiary missiles launched by drones.

Through an experimental approach, the project produced an algorithmic dataset using open-access satellite images to measure brightness in pixels between successive images.[66] This stitching together of spatial images across temporalities allows the tracking of damage done to the city. Ground truth for the project imagery was established via high-resolution satellite imagery, as well as through the calibration and geographical location necessary to the operation of remote sensing satellites. But the project also produces a relational ground truth as images are compared, synthesized, and synchronized.[67] By foregrounding how this method is "messy and riddled with ambiguity," the project exposes the constructed and frictional nature of such relational ground truthing. It reveals material, nonhuman traces of the witnessing apparatus itself, a violent mediation within the witnessing of the city's destruction, in which low resolution obscures texture and specificity.

FIGURE 1.7. Image of interactive map, *Conflict Urbanism: Aleppo*

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Alongside its tracking of human activity, such as the displacement of people from ruined sections of the city to settlements on its outskirts, the project also witnesses the complex interplay between urban environment, violence, media, mobility, and renewal. Rather than focusing tightly to specific sites of airstrikes, Conflict Urbanism attends to "what surrounds the circles—the areas contiguous to the damaged sites—in order to ask questions on an urban scale."[68] Such an approach enables a witnessing of violence that centers the intentional and incidental destruction of cultural memory, urban history, and community ecologies. This witnessing exceeds the human but does not abandon it. By foregrounding the limitations of the platform, keeping it open to collaboration and development, and directly addressing issues of data neutrality, the project exemplifies the necessary contingency of nonhuman witnessing. In Aleppo, urban violence registers its traces in Schuppli's material witnesses: wood, concrete, steel, glass, and asphalt as much as in remote sensing systems, or indeed in the testimony of those displaced residents of the city. In an environment in which people have been driven from their homes, those nonhuman material witnesses capture something that the displaced have left behind: the material and affective traces of destruction, loss, and absence of life.

Integrated into the online platform are YouTube videos captured on the ground, what Lilie Chouliaraki and Omar Al-Ghazzi call the "flesh witnessing" of digital materials recorded and shared by people in conflict zones.[69] These videos capture the angles, color, texture, and immediacy lacking in the layered sensor data. Among them are drone videos produced by activists from the Aleppo Media Center. Shot at the now-familiar but still uncanny vantage of the drone—hovering above or just below rooftop, moving with inhuman smoothness, footage rendered with an almost too-sharp definition—this footage mediates the violence of the aftermath. While mainstream media coverage of Aleppo's destruction featured drone footage from a range of sources, including the Russian military, the video shot by the Aleppo Media Center insists on capturing ruined streets, homes, shops, and squares, and in doing so both reveals and obscures the violence (figure 1.8). While drone footage is always imbricated in the militarism of the aerial view, it can nonetheless be deeply affecting. As Kaplan writes: "We absorb these views to such a degree that they seem to become a part of our bodies, to constitute a natural way of seeing."[70] This capacity to enfold nonhuman vantages into the human sensorium speaks to the malleability of our perception, but also to our cyborg existence, to the always more-than-human nature of human sensoria and knowledge-making.[71]

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FIGURE 1.8. Still from drone footage, Aleppo Media Center

As nonhuman agents of technological perception, drones transect space and time to simultaneously draw us nearer to people and places and amplify or highlight our separation. Drone witnessing enables mediated intimacy with distant events, yet it also reinforces remoteness, placing the viewer in an uncanny relation to what enters the frame of the drone's camera. If the aerial view of war has become a natural way of seeing, what is outside the frame or within but obscured bears close scrutiny. In a provocative essay on the mass rape of women in Berlin after the fall of the city at the end of World War II, Ariella Azoulay argues that the absence of sexual violence from photographs of the ruined city means that witnessing depends upon attending to the affective and sonic registers of images. For Azoulay, photographs of damaged buildings, off-duty soldiers, and wrecked cars obscure violence and injustice. "[Rape] was ubiquitous," she writes, "but still, it did not appear as a prime object for the gaze of these photographers, in the way the large-scale destruction of cities did."[72] While mass rape at scale might not be an object that the photograph can capture, some of the tens of thousands of individual rapes *could* have appeared in photographs. The blown out second story of an apartment building might have been the site of rape; a woman might be raped even as the photograph is being taken. Yet this violence never appears in the images. This absence of sexual violence calls for a reckoning with the

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violent mediation that makes it possible: attending to what is present in such photographs as participating in an affective production of that which is not.

While a certain material intimacy exists between the film negative photographs of postwar Berlin and the city and its violence, this task of witnessing the absence of violence is complicated by the machinic vision of drone video in Aleppo. For Azoulay, photographs of spaces in which widespread and systemic violence took place but is not shown present an injunction to witness the photographs through the historical knowledge of an absence of visual evidence. She thus reads "these perforated houses, heaps of torn walls, empty frames, uprooted doors, piles of rubble—all those elements that used to be pieces of homes—as the necessary spatial conditions under which a huge number of women could be transformed into an unprotected population prone to violation."[73] Drone imagery from Aleppo shares much with the photographs analyzed by Azoulay: perforated walls, piles of rubble, blasted windows, shattered sidewalks, distended roadways. It obscures the 31,273 civilians dead, the many more displaced, and the rape, theft, wounding, and loss that accompanies such undoing of a city. Unlike the analog photography of postwar Berlin, machinic vision does not imprint the light of the world in the gelatin material of the film negative, but rather translates the fleeting response of the optical sensor directly into pixels, stored as code and only rendered in visual form for the benefit of the pilot and, later, the audience of any distributed recordings.

Drone footage of wartime's aftermaths in Aleppo mirrors processually the violence of aerial war, with its digital targeting systems, guided munitions, and sensor capture of the environment. But it reveals little of those workings: drone footage of Aleppo is what remains within the machinic frame but hidden both by the depopulated city and the technics of the sensor itself. Integrated into the Conflict Urbanism mapping apparatus, this footage both grounds and is grounded by multispectral satellite images. Drone footage introduces a more-than-human visuality that is nonetheless tied to line-of-sight operation and the practical constraints of battery life and signal strength: it returns the aerial view almost to the body and yet also retains a nonhuman detachment that heightens the witnessing of war's aftermath. Within the aftermaths of contemporary war's violent mediations, witnessing must pursue the tactile and affective, but also the machinic, technical and networked architectures of seriality and sensing. Yet the nonhuman perception of drones and remote sensors is increasingly not only an extension of human sense-making, but also an augmentation at the level of identification and decision.

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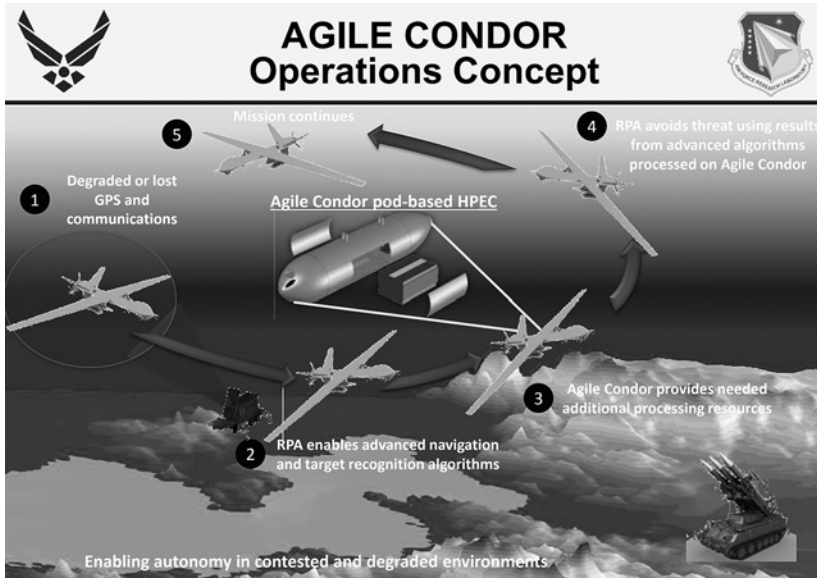
Developed by SRC Inc. and flight-tested by General Atomics on its MQ-9 Reaper drone, Agile Condor is an on-board targeting system designed to resolve both network bandwidth and analytical resourcing problems that limit the efficacy of remotely piloted systems.[74] Built to analyze large quantities of data from the drone's sensor apparatus in real time, this computer system is embedded in a pod that can be fitted to the wing of a drone, replacing one Hellfire missile from its payload. Developed in conjunction with the Air Force Research Laboratory (AFRL), its makers claim that Agile Condor is an artificial intelligence targeting system capable of analyzing video footage, synthetic aperture radar imagery, or infrared camera imagery with the capacity to detect, categorize, prioritize, and track potential targets (figure 1.9). By undertaking so much image processing autonomously at the edge of the network, Agile Condor only sends imagery it deems to meet a threshold of value, cutting down latency, and relieving pressure from overstretched military networks. By only delivering sensor data of potential interest, the system also alleviates the accelerating need for highly skilled image analysts and allows them to focus on potential targets rather than sift through vast amounts of irrelevant imagery. While Agile Condor cannot make a determination to

FIGURE 1.9. Agile Condor Operations Concept, Air Force Research Lab



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strike, it sets the background conditions for what might be worthy of closer attention and potential lethal action. It thus exemplifies both the violent mediation of the drone apparatus, but also its liminal status between human operation and lethal autonomy.

More autonomous data processing at the point of perception marks a qualitative shift in the agential composition of warfare. Autonomous military systems are not in themselves new—loitering munitions have been used by Israel since the 1970s; the SAGE system designed to monitor Soviet nuclear launches was built in the 1950s—but Agile Condor integrates autonomous perception into an already complex kill chain, inserting a machinic intelligence that preemptively shapes the fields of possibility for human analysts and operators. Agile Condor thus constitutes a kind of liminal, nonhuman witness: it (pre)determines the meaning and significance of objects and events, presenting them as open to address by the remote warfare system. Through the operative role of its on-board high-performance computer, the AI pod siphons off human agency in the name of efficiency. No longer will human analysts be concerned with discerning the figure of threat against the ground of life, but only with the array of figures presented as actionable. In the transcript of the drone strike that opened this book, it becomes clear that almost two dozen people were killed in no small part because the figures in view obtained an affective potency divorced from the milieu in which the convoy moved. That is, mission atmosphere oriented the operators and everyone else involved toward violence. Agile Condor entrenches this orientation toward identifying foes and not friends into the milieu itself: a machinic perpetrator, its witnessing tends toward violence.

In an oft-cited passage of *War and Cinema*, Paul Virilio writes that "alongside the 'war machine,' there has always existed an ocular (and later optical and electrooptical) 'watching machine' capable of providing soldiers, and particularly commanders, with a visual perspective on the military action underway. From the original watchtower through the anchored balloon to the reconnaissance aircraft and remote-sensing satellites, one and the same function has been indefinitely repeated, the eye's function being the function of a weapon."[75] This mechanization of perception involves "the splitting of viewpoint, the sharing of perception of the environment between the animate (the living subject) and the inanimate (the object, the sensing machine)."[76] This splitting of perception entails not only the human and lens, but also an entire technical apparatus that is motorized, electrical, computational, and increasingly autonomous: what Virilio calls the "logistics of perception."[77] While not on the same order of magnitude as the arrival of networked warfare

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itself, edge computing is an important intervention in these logistics because it yokes the ontopower of perception to the necropolitical capacity to *make die*. Unlike the simple reactive relation between sensing and killing found in an improvised explosive device (IED) or land mine, the AI intermediary enabled by high-performance edge computing means that deterministic operations happen at a spatial and temporal remove from human agents.

But while president of General Atomics David R. Alexander claims that Agile Condor's "ability to autonomously fuse and interpret sensor data to determine targets of interest is at the forefront of unmanned systems technology," edge computing is not confined to military applications or even to drones. In fact, it originates in commercial problems of bandwidth and latency produced by the move toward cloud computing architectures. Early edge computing can be found in "cloudlets" such as content delivery networks that cache web data closer to users so that, for example, ads can be served faster and more responsively, preventing delays in page loading caused by the need to pull data from distant, centralized data centers. Edge computation now exists in everything from networked security cameras to automated agricultural systems, reducing the flow of data to central control points. Against the push to centralize control via the capacity of networks to distribute information, edge computing offers the potential to decentralize control while retaining centralized authority. Such a tendency can only produce ever more radical absence, as experiences of the world are distributed, remediated, and rendered computational even as they become operative and immediate. In war, this fusion of sensing, classifying, and selecting within black-boxed technologies signals an increasing acceptance of computational agencies on and above the battlefield, a machinic corollary to the shift of the US military to special forces operations. Where the military media technologies of the twentieth century shaped and were shaped by mass, those of the twenty first are devolved, dividual, and distributed. Like power itself, military media have pushed more and more computation to the edge of the logistics of perception.[78]

Artificial intelligence is particularly appealing for dealing with sensor data because the first action required is to sift for items of interest, something that machine learning is—in theory, at least—particularly well situated to do. But standard methods of machine learning analysis require powerful graphics processing units (GPUs), particularly if the system will also learn on the fly. That means significant power loads and accompanying heat. Consequently, huge dividends can be achieved through computational techniques—both in terms of hardware and software—that reduce the need for power, via both more efficient circuit design and learning systems that only fire when needed.

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According to both its marketing material and various technical papers published by the development team from SRC and AFRL, Agile Condor uses a neuromorphic architecture modeled on human neural systems.[79] In other words, its capacity for discriminating perception is intended to mimic neurobiology in contrast to typical parallel processing architecture. Both the IBM TrueNorth and Intel Loihi experimental processors used by the Agile Condor can be traced to a DARPA project called Systems of Neuromorphic Adaptive Plastic Scalable Electronics (SyNAPSE), launched in 2008 to develop revolutionary new neuromorphic processors and design tools. In contrast to typical machine learning image analysis that addresses entire images, neuromorphic systems such as Spiking Neural Network architectures are designed so that individual "neurons" within the system can fire independently and directly change the states of other neurons. Because information can be encoded directly into the signals themselves, spiking networks are not limited to binary states and can thus produce something closer to the analogue workings of the brain, more proximate to the early cybernetic dream before it veered toward an altogether different computational rationality.[80] Because these neurons only work when "spiked," the network consumes significantly less power and can autonomously gear up to higher capacity as needed. Neuromorphic systems such as Agile Condor are prime examples of what Andrejevic calls "automated media," or "communication and information technologies that rely on computerized processes governed by digital code to shape the production, distribution, and use of information."[81] Harnessed to the martial gaze, automated media reveal how, as Bousquet puts it, "the human sensorium has been slowly and surely directed, mediated, and supplanted in service to the ultimate imperative of targeting."[82]

As with so much emergent military technology, exactly how Agile Condor might function in a battlefield context is impossible to ascertain. In a series of articles published in various IEEE forums between 2015 and 2020, the research team from AFRL and SRC Inc. reveal snippets of insight about the computational architecture and machine learning techniques used in the system.[83] Using a mix of machine learning model types, including spiking neural networks and the MobileNet architecture, the researchers demonstrate a balance between accuracy and efficiency across a series of prototypes built on IBM and Intel processors. Working with a range of test datasets that include optical satellite imagery from the United States Geological Survey, various experiments achieve object recognition accuracy of more than 90 percent, depending on the specific technical arrangement. A similar accuracy was maintained using imagery from the Moving and Stationary Target Acquisition

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and Recognition (MSTAR), a joint DARPA and AFRL program that collected and processed SAR imagery of various military targets. But that dataset, while public, was produced in 1995 and its resolution has been far exceeded by contemporary satellite imagery. As such, even though the technical information about various chip, processor, and model configurations is interesting, these publications give no indication of how the Agile Condor targeting system would work in practice. What data will it be trained on? How will it be verified and ground-truthed? How are its determinations presented to operators and analysts? Does it have its own interface or is it integrated into existing ground control station control systems? What information is made available back through the system about modeling, probability, and so on? How much on-the-fly learning is the system capable of executing, and what quality control mechanisms are in place to verify accuracy or intervene in the learning process?

With the in-practice workings of the apparatus itself largely foreclosed, we can turn instead to the promotional materials for an articulation of the military imaginary that animates Agile Condor. In a two-minute video produced by SRC Inc., Agile Condor is presented as a powerful tool for saving lives and preventing violence.[84] Rendered in computer graphics that share the gritty, lens-flare aesthetic of popular video games such as the *Call of Duty* series, a General Atomics Reaper drone takes off from a mountainous air force base to a dark techno soundtrack. Cruising at night above a dense urban environment, its sensor system identifies various objects, marking them with glowing green squares. Then Agile Condor kicks in, automatically analyzing incoming imagery (figure 1.10). Dramatized as a clichéd array of image feeds entering the hardened box of the computer itself and headlined in multiple places with the term "neuromorphic computing," the Agile Condor swiftly does its magic and an alert flashes up: THREAT DETECTED. Cut to a swarthy figure with an RPG on his shoulder, then a convoy of vehicles, and back to the aerial view. Now, the convoy vehicles are marked in blue and the threat in red. The sensor pulls focus onto the threat and zooms in tight, resolving a high-resolution image that it then runs through a facial recognition system to obtain a 98 percent match (figure 1.11). Signal streams back to command, where "Agile Condor with neuromorphics enabled has detected an imminent threat." The convoy can now be diverted and helicopters sent to arrest the would-be assailant.

Hyping the efficacy of the system in producing a swift, bloodless resolution is not unusual for this genre of military technology videos, but the presentation of its technics is revealing of the imaginaries that animate

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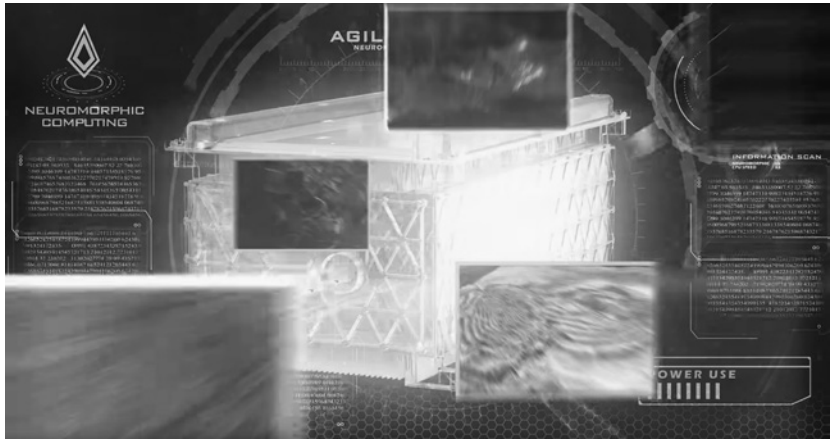

FIGURE 1.10. Agile with "neuromorphics enabled," still from "Agile Condor™ High-Performance Embedded Computing Architecture," YouTube video, October 15, 2016

FIGURE 1.11. Still from "Agile Condor™ High-Performance Embedded Computing Architecture," YouTube video, October 15, 2016

military desires for AI systems such as Agile Condor. Sensor capture, image analysis, threat determination, geolocation, signals transfer, and operational actualization are all presented as seamless, frictionless processes. Wide area surveillance captures data at scale, which is then immediately transduced into the Agile Condor analytic engine to identify and locate an imminent and incontrovertible threat. How those analytics take place is obscured: Does the

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system first identify a static figure in the dark? Does it map onto the convoy? What are the relations between those things? Is it correlating between different sensor feeds in real time? Once the threat is detected, the capacity to recognize a face—something not mentioned in the technical papers published to date by the Agile Condor team—provides a granular, individualized level of analysis. This slippage in scale—from the unknown, impenetrable urban environment to the named identity of an individual—exemplifies the god trick that animates both the militarized view from above and the artificial intelligence system. Agile Condor figures as a watchful guardian, capable of oscillating between scales and presenting immediately actionable information to a hyperresponsive command center. Despite the immediate threat of violence, the response is measured and clinical. Precision warfare performed through automated media promises to facilitate bloodless control.

As is often the case in military promotional materials, the use cases presented for public consumption veer closer to policing than mass or even "precision" violence. Nevertheless, we can observe what Andrejevic calls the "cascading logic of automation" in which "automated data collection leads to automated data processing, which, in turn, leads to automated response."[85] This cascading logic has an inherent connection to the death drive, exemplified by the development of Lethal Autonomous Weapons, but evident in technologies such as Agile Condor, which are not only designed to facilitate the application of lethal force but also to be part of the process of tipping over the threshold into ever more complete autonomy. More specifically, Agile Condor can be understood as operating in the mode of preemption, which "dispenses with the question of causality: it takes as given the events it targets, relying on comprehensive monitoring and predictive analytics to stop them in their tracks."[86] Neural network analysis of sensor data is preemptive in this way, filtering through data streams for sets of image characteristics that map to particular models. Presenting the correlative outputs of this analysis works to preempt interpretation, framing everything presented as potentially actionable. This direct intervention in the becoming-target of people, structures, and ecologies, reveals Agile Condor as an operative expression of what Massumi calls "ontopower": the power to bring into being. Agile Condor and all such autonomous systems do not simply identify targets but produce them through their violent mediation of the world around them, binding affect and encounter into the knowledge apparatus of the AI-enabled drone.

Agile Condor points to the existence of a machinic witnessing operating exclusively within an algorithmic domain inaccessible to the human. This machinic witnessing occurs alongside the preemptive determinations

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that the system makes. Diffracted through the hunt for emergent threat and within the loop of sensor capture and algorithmic identification, classification, filtering, and prioritizing, this mode of relation to the event probes the limits of witnessing, as the next chapter examines in detail in the context of learning algorithms. Within the broader milieu of drone warfare, any witnessing that occurs within the Agile Condor system needs to be understood in relation to its consequences for the witnessing that takes place within the wider apparatus and in conjunction with its human actors. "Prosthetically tethered to the war machine," writes Bousquet, "the combatant's cognitive and neurological labors are hitched ever more tightly to cybernetic control loops, mind and body subsumed into complex assemblages that render the locus of agency increasingly diffuse and uncertain."[87] This dispersal of agency throughout the system means that witnessing—as a mode of relation that binds agencies to events—is also diffused. This diffusion concentrates within particular pockets of intra-activity, sites of intensity where perceptual transductions take place, and where determinations are rendered in relation to the data produced. If preemptive technologies such as Agile Condor seek to cut through the inefficiencies of symbolic, narrative, and causal analysis, they also undo the grounds of evidence itself by presenting the (potential) need for action through an operative frame detached from the complexities of the world beyond the sensor.[88] In this sense, the machinic witnessing at work within the technical constellation of Agile Condor pod, sensor array, and aerial drone constitutes a kind of witnessing without evidence. For the human operators, analysts, and commanders looped into such cybernetic controls system to varying degrees of intimacy, witnessing is already violently mediated by the preemptive shaping and techno-authority of the targeting system. For those operators "seeing" war through the machinic eye of automated imaging and analysis systems, witnessing drone violence is inescapably nonhuman. Not only because the apparatus mediates what is captured by its sensors, but also because human witnessing is already preemptively entangled within the machine vision system.

WITNESSING AUTONOMY

"If we disregard for a moment the fact that robotic intelligence will probably not follow the anthropomorphic line of development prepared for it by science fiction," writes Manuel DeLanda in his 1991 book *War in the Age of Intelligent Machines*, "we may without much difficulty imagine a future generation

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of killer robots dedicated to understanding their historical origins."[89] Such a robot historian, DeLanda speculates, would compose a very different history of their own emergence than a human might, one far more concerned with how machines shape human evolution toward their own autonomy than with the agency of humans in assembling them. In the evolution of armies, "it would see humans as no more than pieces of a larger military-industrial machine: a war machine."[90] Seeking to trace its own emergence, the historian of a world of autonomous, weaponized robots would turn not to human historical witnesses but to instances of machinic, signaletic, energetic, and elemental witnessing registered in material records and relics, in the transformation of motors, fuel cells, transponders, mining equipment, the chemical composition of geologic layers, atmospheres, and oceans. "Order emerges out of chaos, the robot would notice, only at certain critical points in the flow of matter and energy," and so the question for the robot historian might well be how certain factors cohere within self-organizing processes to tip them over into evolutionary progression.[91]

Borrowing from Gilles Deleuze, DeLanda calls this autopoetic coherence the "machinic phylum," or the set of self-organizing principles and processes that share deep mathematical similarities.[92] For DeLanda's putative robot historian, the notion of a machinic phylum that blurs distinctions between organic and inorganic life would be deeply appealing: it would suggest an inherent yet emergent coherence to the existence of "artificial" intelligence that is not outside or alien to "nature." Given how indebted computation is to war, any account of how robot intelligence emerged would have to center military technologies: "The moment autonomous weapons begin to select their own targets, the moment the responsibility of establishing whether a human is friend or foe is given to the machine, we will have crossed a threshold and a new era will have begun for the machinic phylum."[93] In the three decades since DeLanda's book, autonomous systems have proliferated, evolved, and mutated in startling ways. In this chapter, I have shown how targeting technologies such as Agile Condor operate on the cusp of autonomy, producing potential targets within a situation of imagined machinic precision. Yet there are already autonomous weapons systems that significantly predate the new typologies built on artificial neural networks and other predictive analytics. Missile defense shields such as Israel's Iron Dome operate on predefined rules to knock out incoming attacks in response to sensor data. Packer and Reeves point to aerial weapons systems "programmed with a range of potential target criteria" that allows them to "slip between offensive and defensive modes, loitering in an engagement zone until an appropriate target can

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be discovered and automatically engaged."[94] Like all revolutions, then, the seemingly sudden arrival of killer robots—heralded by viral videos of dancing Boston Dynamics humanoids and swarming slaughterbots—has deeper historical roots. Many of the most autonomous systems today are not found on killer drones, but in huge guns mounted on naval vessels or on mobile artillery platforms designed for surface-to-air defense.

While much of the history of early computing flowed from the labs of DARPA and other military agencies to the corporate world, rapid advancement of machine intelligence now largely takes place at Google/Alphabet, Amazon, Microsoft, Alibaba, Facebook/Meta, Palantir, and the countless startups striving to join or be bought by the tech giants, or at university labs, many underwritten by the tech industry.[95] AI systems are built to be transposable from one situation to another, such that machine vision and navigation techniques developed for autonomous passenger vehicles can be readily adapted to military contexts. With the infamous Predator already mothballed and the Reaper slated to be decommissioned, remote warfare is increasingly characterized by a far more diverse range of vehicles, platforms, and systems. In the swift 2020 war between Armenia and Azerbaijan, for example, the latter's autonomous and semiautonomous drones proved decisive, demonstrating the increasingly accessibility of these technologies for military actors and signaling the capacity of homegrown automated systems to shift the calculus of war. In Ukraine's resistance to the 2022 Russian invasion, creative applications of consumer off-the-shelf drones augmented the use of large-scale weaponized drones and loitering munitions. At the same time, an arms race for swarming drone technologies is underway, with India trumpeting a field test of seventy-five swarming drones in 2021 and the DARPA OFFSET program showcasing mixed ground and aerial swarms in 2019, stoking fears of a new genre of weapons of mass destruction. While this diversification means that drones designed for an ever-widening array of mission types and milieus can be readily found, increasingly critical questions concern software systems, data collection and analysis, and the operative processes that enable identifying friends and foes, and targeting those deemed threats. Like DeLanda's robot historian, we are now confronted with the problem of tracing the emergence of such systems, but even more acutely with the necessity of constructing the means to witness the autonomous violence they will—and already do—produce.

Reflecting on the necessity for research to understand war in ontological terms, Caroline Holmqvist calls for greater attention to "what it means to be a human being living the condition of war."[96] Without diminishing the

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significance of this question, in the face of increasingly autonomous martial systems and operations an inseparable concern is what it means to be nonhuman in the condition of war. Or, to inflect this slightly differently, making war sensible for humans means being able to ask how autonomous warfare systems shape and are shaped by the world-making and knowledge-forming interplay of humans and nonhumans alike. Like the Reaper or Agile Condor, such systems are witnessing machines, but also what must be witnessed. I want instead to ask how nonhuman witnessing invites an alternative approach to questions of human accountability, responsibility, and intelligibility in the operation of autonomous war. But the challenge of pursuing martial empiricism into the realm of emergent military technologies is that so much remains in the virtual space of speculation and proposition. We can only seek to move with the machinic turbulence of uncertain becomings that are still very much in the process of (self-)organizing into the autonomous, machinic violence of the future.

Within critical discussions of autonomous weapon systems, focus often centers on the role of human actors within the system. As with so much debate about AI more generally, problems are framed around the accountability of systems to human oversight. In military parlance, this is typically understood by the position of the human in relation to the "loop" of decision making that runs from sensing to targeting to firing. If a human is in-the-loop, they have a deciding role on whether an action will be taken; on-the-loop they have active oversight and the immediate capacity to intervene; off-the-loop, the system runs autonomously without direct oversight. Prominent critics of lethal autonomy, such as the roboticist Noel Sharkey, have proposed more graduated categories for defining autonomy that center the agency of human actors, with the aim of delineating high degrees of autonomy that should be prevented from being strapped to lethal weapons.[97] But while these are important distinctions that support the international legal push to ban lethal autonomous weapons systems, they operate within a larger tendency toward the excision of the human from military systems. Military precision, logistics, organization, and speed all depend on what Packer and Reeves call "a preventive humanectomy" that promises to reduce friction and boost efficacy by eliminating the weak point in data processing regimes.[98] An ultimate end of the militarization of violent mediation is thus the elimination of the human within technological systems to anything other than a potential target for violence. Within such systems, the capacity for the human to witness war narrows to the sharp, brutal end of violence, almost certainly launched from a significant geographical distance.

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Witnessing this becoming-target becomes impossible from within the humanist frame, both because the human is excised and because technoscientific military systems, particularly those underpinned by complex algorithms or artificial neural networks, are themselves inscrutable to humans. Problems of black-boxed processes and partiality within knowledge production and decision making are not unique to algorithms. Rather, as Amoore points out, algorithms help "illuminate the already present problem of locating a clearsighted account in a knowable human subject."[99] Knowledge of both self and other is always partial, yet these limitations of knowledge are buttressed by culture, politics, ethics, and sociality. Witnessing functions to bridge this lack, proffering a relationality grounded in the necessity of building shared knowledges, ways of living, and forms of connection. Reflecting on the feedback loops, datafied human associations and actions, and back propagation mechanisms of machine learning systems in both surgical robots and weaponized drones, Amoore points out the "human in the loop" is an elusive figure: "The human with a definite article, the human, stands in for a more plural and indefinite life, where humans who are already multiple generate emergent effects in communion with algorithms."[100] Unlike the human witness, nonhuman witnessing transects these dynamics by refusing the distinctions that underpin and separate out the human and the machine. Against the notion that a reasoning human might provide both an ethical decision and a witnessing account of autonomously executed violence, nonhuman witnessing insists on the incapacity of either human or computer to account for itself or the other. By starting with entangled relationalities, nonhuman witnessing addresses violent mediation as an autonomous process that nevertheless must be understood in relation to the human—and the human must be grasped in its complicity with and resistance to such violent mediations.

My claim is *not* that understanding certain machinic processes as nonhuman witnessing would magically "reveal" or "expose" something new about those processes. Rather, my contention is that the recognition of nonhuman witnessing requires new critical understandings of the relations between elements within systems of autonomous violence, and in doing so insists that we resist an uncritical return to the figure of the autonomous liberal subject as the antidote.[101] If nonhuman witnessing takes place *within* autonomous military systems through the registering of violent or potentially violent events by sensors, their transformation into actionable data through machine vision, and their determination as killable according to a computational matrix of preemptive predictions, then the nonhuman witnessing *of* autonomous military systems must reckon with the violent mediations of witnessing itself.

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Within autonomous systems, those violent mediations are always directed toward the future. Or, rather, they depend on accumulated data from the past to produce machinic predictions about the future.

Predictive analytics are thus always about the production of futures, or the preemptive demarcation of certain virtuals as more or less on the verge of becoming actual. "Threat is from the future," writes Brian Massumi. "It is what comes next. Its eventual location and ultimate extent are undefined. Its nature is open-ended. It is not that it is not: it is not in a way that is never over."[102] This is the logic of preemption, where, as Andrejevic points out, "the imminent threat becomes the lens through which a range of risks comes to be viewed by those with the tools for responding to them."[103] Autonomous military systems, whether weaponized or merely analytic, produce threat in order to master it and in doing so collapse the future into the present through the violent mediation of limitless potentiality into actionable probability. Such systems are ontopowerful because they seek to intervene in becoming itself, in the emergence of events from the temporal unfolding of existence within time. While the claim of such systems is for security (of the state and its citizens) and accuracy (in reducing the loss of life of those becoming-targets), this masks a necropolitical imperative: the automated determination of death as a mechanism for the production of power. Lethal autonomous weapons systems show how technoscientific necropolitics continually pushes power to the edge of perception, which functionally merges with the limits of operability. If the ultimate injunction of witnessing in war is to account for the infliction of violence, then witnessing automated killing must necessarily entail the nonhuman.

In considering how violence and perception are bound together in war, Lucy Suchman poses the question: "Just what are the particular apparatuses of recognition that comprise contemporary military discourses and technologies? How does the current 'threat' become recognizable, as specifically situated persons, embodied and emplaced?"[104] I would also ask, how is violence at work within the apparatus itself, in the process of making operative images of persons, places, and animals? And what relations are forged, transformed, or destroyed in the operation of the system? By pursuing the specific processes of media technologies of increasingly autonomous war, I have sought in this chapter to show how answering these questions depends upon an openness to the transductive relations between human and nonhuman, organic and inorganic, technical and embodied. Just as the human witness might testify to what they have seen, however partial, and seek to render into

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language the thickness of experience, however incompletely, so too might nonhuman witnessing entail rendering sensible, however inadequately, the violent mediations of datafication, preemption, and operationalism.

Once again, this pursuit of nonhuman witnessing returns us—seemingly inevitably—to the human. In a fierce critique of the sociopolitical implications of algorithmic violence, Peter Asaro writes that in an age of autonomous weapons we need to ask: "What will it mean to be human? What kind of society will these systems be defending?"[105] Questions of geopolitical power, of regional and global balances and arms races, are not enough. Algorithmic warfare leverages the globalized economy, infrastructures, and mobilities that gird contemporary technocapitalism, which means that these questions of how we reckon with its knowledge machines and knowledge claims are not solely the preserve of military strategists or critical theorists. The necro- and ontopolitics of algorithmic war and contemporary state violence share a voracious need for embodied targets, human or otherwise, and autonomous war must be returned to questions of life in material and martial terms, as well as conceptual ones. Bound up with this task is also an understanding of the human and machinic labor involved in such systems, a question which I will take up in the next chapter.

The point is not to grant the political subjectivity of the human witness to algorithms or killer robots or semiautonomous drones, or to relegate the human from a central role in the witnessing of war. Recognizing the agency of nonhuman entities does not equate to granting them citizenship, but nonhuman witnessing aims to bring them into the space of political contestation with their agency intact. Speculating on the future consequences of autonomous weapons for the status of the human, Grove asks: "What will a close encounter with nonhuman intelligence do to force a 'persisting us' to rethink the use to which we have put machines in the pursuit of what we ourselves have been unwilling to do?"[106] Another way to pose this question is to ask what ethicopolitical status we might afford to self-aware machinic encounters with the world? How will we think about the forms of knowledge they generate and the testimonies of unjust use they might compose? In returning to the human, then, the task at hand is to retain the nonhuman agencies, knowledges, and relations excavated here, alongside an embodied, situated, and contingent humanity. In the next chapter, I pursue this challenge in response to the machine learning algorithms that are increasingly deployed as techniques of power by states and corporations—but that can also provide openings for resistance to those very institutions.

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