Ecologies of the Wayward Drone

From Above

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On a recent clear evening in December, as the sun was setting over the Texas horizon, a Mexican drone entered U.S. airspace and crashed into a backyard in El Paso.

In another time and place, a drone falling from the sky could have elicited a high degree of alarm. In this particular border neighborhood, however, it is not much of an event. Flanked by an army of surveillance cameras, floodlights, thermal imaging systems, inspection apparatuses, ground sensors, and mobile surveillance units -- fortifications that, together with an enormous barricade of cement, steel, and barbed wire, define the border with Mexico -- the region is home to a cavalcade of mysterious machines that populate the skies: reconnaissance aircraft, relentlessly prowling for illegal activity, extending ground patrols into the air. As the doomed drone lay tangled in the desert scrub brush and softly blowing sand, its processing ability weakened and its connective capability disabled, the resident calmly picked up his phone. He did not call emergency services. At the onset of this particular catastrophe, he did what any vigilant citizen in this part of the world would do: he called U.S. Customs and Border Protection.

Drones -- also known as Unmanned Aerial Vehicles (UAVs) -- are prone to system failures and pilot mistakes. Bad weather can bring them down; relatively small and vulnerable, they can be felled by something as simple as a gust of wind. The source of this particular El Paso crash was revealed to be a mechanical malfunction. It caused operators, who always operate at a distance, to lose control of the pilotless plane. As is often the case with unmanned vehicles, it was not clear who those operators were. A Mexican Attorney General spokeswoman denied her country's involvement with the drone, but later that same day, another Mexican official said it was being operated by the Ministry of Public Security and was following a target at the time of the incident. A spokesman for the Mexican Embassy in the United States said that the drone, while belonging to Mexico, was part of an operation in coordination with the U.S. government.

The impact had opened up more than just a small hollow in the sand. It disrupted and opened the rituals of neighbors, the connectivities of machines, the routines of public agents, and the choruses of desert cicadas. It destabilized the coherency of the crashed drone itself, which, far from sitting intact, was now distributed into the routines and spaces of the various agencies that were engaged in parsing its failure, sustaining its role, or coordinating its return. At the onset of its weakened capacities, phones were dialed, conversations started. A collection of material and discursive components, it was now available for reassembly. At the international level, the accident brought into play the governmental agencies concerned with the maintenance of relations between the two countries, along with the global Israeli company Aeronoautics Defense Systems, agent of the drone's manufacture, all of whom sought to maintain the perception that the drone "works," whether in terms of mechanical infrastructure, data, or public relations. At the national level, it brought into play the investigative agencies of the National Transportation Safety Board, concerned with regulation of the skies in which UAVs travel, and the Department of Homeland Security, chief enforcing agents in the area of border protection and regulation. These arbiters of the safe and legal passage of people, traffic, and goods harnessed the drone as a case study, distributing its components within an investigative landscape of national security discourse, drug smuggling, gang violence, public health, and private commerce. At the city level, it brought into play the El Paso Fire Department, attender to the emergency and modulator of its material risk, along with the local Police Department, dispatched by a U.S. Customs and Border Protection agency whose presence in the region, along with its brother agencies in immigration and drug enforcement, is considerable. Unlike the Police Department, it operates its own drones.

The return of the UAV was a humble affair. The U.S. Border Patrol, in the capacity of several agents and a van, pulled up to an international bridge in a cloud of smoke and dust. They stepped out of the vehicle, extracted the drone from the rear, and handed it back to Mexican officials. Perhaps a ceremony of some kind was involved, but the handing over of the drone was, in terms of physical exertion, fairly easy, since it was in the "Mini" class -- an Orbiter Mini UAV -- with a total wingspan of about seven feet. The entire system, disassembled, fits into a backpack.

The recovered drone, relatively intact, might have been reassembled quickly. According to the manufacturer's specifications, this takes about ten minutes. Yet, the UAV was dismantled by an array of forces that violated its coherency in a deeper, more long-lasting sense. Between the drone's destruction in a backyard and its delivery at a bridge, the component agencies necessary to operate and maintain it became newly revealed. Dislodged from their mainframe and rendered vulnerable, these component agencies, however operational, institutional, or discursive, become newly active in their negotiations and attachments. Phone calls are made, conversations started, extensions orchestrated. At the same time as they are distributed, however, they are consolidated -- resolved to a territorial or ontological specificity. Escaping abstraction, they become embroiled in a geopolitics that may have been overlooked or erased.

In the onset and aftermath of the catastrophe, the coherency and centrality of the drone is destabilized, its deceptive unity revealed. It cannot be reassembled in quite the same way.

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UAVs made their appearance on the world stage just after September 11, 2001, in the wars in Iraq and Afghanistan. The U.S. now relies on them heavily, most notably for surveillance and bombing missions across the Middle East and North Africa. Primarily due to their perceived success in these military operations, their potential has come to be widely recognized in many sectors of the U.S. government, and pressure has been growing to allow them into domestic skies. The Department of Defense and the Department of Homeland Security have besieged the Federal Aviation Administration (FAA) with requests for the flying rights of a range of pilotless planes into civilian airspace for the purpose of domestic security operations, law enforcement, and disaster relief. So far, they have obtained FAA permission to operate unmanned planes along limited zones, including the Southwest border from California to Texas. In the case of large-scale catastrophes, drones can be operated nationwide in the search for survivors.

While many countries across Asia and Latin America -- Israel, Japan, South Korea, Brazil, and Mexico, to name a few -- already allow UAVs for domestic use, and while the E.U. is planning to have them integrated into civilian airspace by 2015, the process of developing regulations in the U.S. has been slow and fraught with complication. FAA officials are concerned that, in domestic skies, there is a greater danger of collisions with smaller aircraft than in the war zones in which UAVs have been tested. The fact that UAVs come in such a wide range of scales -- the Global Hawk is as large as a small airliner, while the hand-launched Raven is just 38 inches long and weighs four pounds -- makes matters worse. The FAA is are worried that drones might plow into airliners, cargo planes and corporate jets at high altitudes, or plunge into low-flying helicopters and hot air balloons. (Raven drones, in fact, have been known to collide with manned helicopters in the crowded skies over Baghdad.) The rapid growth of unmanned planes of all sizes not only threatens safety in the skies but on the ground. With UAVs coming as small as the 13 inch Wasp, it is easy to imagine a tiny drone, malfunctioning or wavering offcourse, crashing not into a border-town backyard but through a living room window.

One of the FAA's key concerns is that remote operators can lose communications with the aircraft. In the world of drones, loss of communication with the aircraft can lead to loss of control. Many UAVs, when they lose a connection to ground stations, are programmed to fly off to a safety zone and try to regain contact. But often, this does not work. The plane goes renegade, disappears or plummets to earth. Loss of communication and control can occur from a systems failure, a software glitch, or, as in the case of the Mexican drone crash in El Paso, a mechanical malfunction. The drone can also be cut off by an atmospheric disturbance, a hostile interception from the ground, or an enemy hack. In one way or another, human error often plays a role, whether in the form of a faulty program, mechanical oversight, or coordination mistake.

Human error was revealed as the cause of a yet another crash into the backyard of a border town residence -- this time, in a neighborhood much like El Paso but about 300 miles west, near Nogales, Arizona. The catastrophe, which occurred before sunrise in the early morning hours, was caused by a ground operator's failure to follow procedure. The failure set forth a cascade of collapse. It caused the ground control console to lock up, which caused the UAV's engine to shut down. On loss of its engine, the Predator began turning off its electrical systems to conserve power. It then descended below the minimum altitude, turned north into Arizona, and awaited further commands.

No such commands came. Operators had completely lost contact with the plane. It floated about the desert night, abandoned, aimless, and invisible. Air traffic control operators, faced with the danger of an unlocatable, headless robot lurking in the air somewhere, quickly closed off large chunks of airspace. Tucson International Airport was nearly affected. The out-of-control and powerless Predator then dove into an area of upscale ranch homes and crash-landed in the backyard of a large house.

The accident was reported when residents of the neighborhood, sleeping quietly amid the sounds of insects, television hum, and soft rustling leaves, were awakened by the explosion. The scale of this pilotless plane, a Predator B built by the California-based company General Atomics, is as large as some commuter airliners -- nearly ten times larger than that of the Mini UAV in the El Paso incident -- and undoubtedly, its resounding crash at this hour elicited no small degree of alarm. The plane missed two houses by about 200 feet. Abruptly catapulted from their beds in a violent crescendo of machine grind, metallic crush and earth upheaval, these homeowners may have first called emergency services. However in this case too, a call to U.S. Customs and Border Protection might have been most appropriate, since this was the agency that was operating the plane.

The downed drone, smoldering amongst the cactus, scrub brush, and sand sage in a cloud of smoke and dirt, was most likely a peculiar sight. A twisted geometry of spilt forms and unmasked roles, of networks sought and broken, it now offered itself to connection, continuity, and salvage. Among the spilled cables, machine parts, microprocessors, storage units, and sensors that were dislodged by its slam to earth there would have been little trace of human presence. In the place of a cabin, within which pilots, sitting amongst angular consoles, molded door panels, and worn seats, work the controls that are sculpted around them, there is only a solid, bulbous mass teeming with hardware and data flows. The violent spray of metal, electronics, rubber, and engine fumes that is released by the impact would have contained few shards of glass, for there are no windows that line the plane's dense hollow and no monitors within its confines. There are only the tiniest portals of cameras and sensors, peering downward out of its underbelly, sucking in data from the ground below.

Drone Desire

The demand for unmanned vehicles is not limited to the military, homeland security, and law enforcement. Civilians, too, want their drones! Tornado researchers want to send them into storms to gather data. Energy companies crave their use for geological surveying and and pipeline monitoring. Security companies want to send them up for new surveillance applications. Commercial upstarts yearn to service them and train their operators.

Perhaps the most visible drone desire is that of the everyday consumer. Homegrown drones sprout up everywhere, their production and operation facilitated by an expanding network of hobbyist groups and blogger communities. Ignited by their prominent roles in sci-fi literature, television, and film, drones populate social and cultural imaginaries. They appeal to generations of gamers, who relate to the control interfaces through which they are operated and the first-person-shooter style images that are streamed from them, often accessed on the very same computer screens upon which these games are played. Flying a drone is like playing a game, and drones often populate games. User-generated websites like DIY Drones, information resources like Dronepedia, and drone applications for mobile phones that allow actual drones to be controlled and virtual ones gamed together function as social networking platforms, recreational outlets, and learning environments. They serve as catalysts for the development of shared, distributed forms of thinking and practice, bringing into play new knowledges and skills. Building and flying a drone might require one to learn principles of aerodynamics, airframe engineering, robotics, photography, and piloting via radio control. It requires awareness of regulations on the ground and in the air, however social or environmental, and the skillful management of one's identity and stature within groups. The need to display knowledge, talent, and agility is often a driving force, whether in competition or cooperation.

There is an erotic dimension to this sharing, acquisition of expertise, and display of prowess. One might build drones because, as one suburban teenage DIY blogger puts it, they are a "chick magnet." Drone display flourishes out of backyards, streets, abandoned lots, and open fields, and in the consequent posting of video and photographic documentation on social networking sites. Nestled amid the sagebrush along the California side of the U.S./Mexico border is even a small DIY drone airfield. Makeshift and unkempt, devoid of pavement and infrastructure, it is unremarkable in the absence of the gathered assemblies of amateur pilots, planes, and spectators for which it is intended. One might well overlook it, yet perhaps in some way it serves as a model of sorts, a harbinger of airports to come: a preview of what drone airfields might look like, writ large, in their absence of traditional control platforms and optical infrastructures. Much like this one, the unmanned airport would contain no centralized control tower presiding over the runway and no lighting tracks reflecting its contours. There is no need for a commanding view from above. The distributed and windowless drone, devoid of any interior, requires no human sightline for its flight. In an operational sense, its trajectory is not visual. Geometries of looking, whether from a cockpit or a control tower, have been replaced by networks of sensing, some visually oriented, but most not. Interior/exterior relations, at least in any conventional, spatially-continuous sense, diminish in their structuring relevance.

If the drone were to provide a model of subjectivity, it would not be defined by a logics of enclosure. There is no incomplete interiority to be recuperated. There are no external objects to drone desire, only internal parts of its distributed architecture, opaque to observation. So, too, with those who would harness the drone's allure for the purpose of erotic display: there are no counterparts to an erotics within which all desiring agents are immanent.

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For the drone aficionado of all sorts, drones are curious, kick-ass, and cute, a potent combination of menace and allure, and in this combination, one might embody in them the workings of the sacred or the sublime. Hence the erotic potential of the image of the shiny drone, glowing against a clear blue sky, as well as the smashed one, twisted amongst the desert brush.

The erotics can spill into the realm of politics, mobilizing civilian groups in the pursuit of social and political causes, united under the sign of the drone. Of the vigilante groups who now fly drones along the U.S./Mexico border, the most visible and technologically advanced is the American Border Patrol. Its UAV, a ramshackle plane called the Border Hawk, is operated from a ground control station on a private ranch situated on the Southeastern Arizona borderlands. Endeavoring to provide public access to transmissions that are usually shrouded in secrecy, the group streams all of its drone video footage live on the web.

The plane's inaugural flight took place over the San Pedro River, a popular site of cross border activity. To ensure that the drone proved its effectivity in spotting actual, living people, volunteers from the American Border Patrol masqueraded as illegal border crossers. Jutting to and fro, stealthily wending their way across the harsh desert borderland, conscious of the view from above, they mimicked the very people they aimed to target, adopting their renegade behavior in a caricature of criminality. The complex pleasures of crossing over in this manner, through appearance, disposition, and demeanor, are well known to the deviant maneuvering to "pass," with whatever degree of conformity and sacrifice this might entail. These pleasures are often undetectable to those who man the optics: visual mastery is privileged over groundlevel display, at the expense of any awareness of the correspondences of self that the targeter finds reflected, extended, and propagated in the scope.

As glimpsed in the amateur officiality of their nomenclature, groups like these straddle the line between governmental and non-governmental agency. Aiming to assist the Border Patrol in the apprehension of illegal immigrants, they see themselves as providing a valuable public service, filling in the gaps among the limited number of Border Patrol agents that are available to patrol the entire 2,000-mile stretch. At the same time, they regard themselves operating as government watchdogs. Suspicious of their state apparatus and disillusioned by the ideologies of their generation, these groups, dominated by retired military and security men, patrol the border as if in search of something far more than illegal activity: the recuperable myth of white male privilege. Situated far from the contemporary sci-fi imaginary, they seem to embody, instead, the genre of the Western -- the pre-technological harbinger of its cyber-frontierism. Drifting about the desolate landscape, drones at the ready, they guard their version of the American Dream.

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Allowing unmanned aircraft into domestic space heightens a number of civil liberties concerns. It expands the government's ability to surveil its citizens -- adding to its already substantial patrol arsenal of sensors, night vision scopes, video surveillance systems, directional listening devices, and data mining systems. The cameras on drones like the Predator can read a license plate from two miles up; the electro-optical sensor systems of the Global Hawk can identify an object the size of a milk carton from an altitude of 60,000 feet. And while domestic drones are not presently armed, they can be easily outfitted with weaponry -- as they were after the September 11, 2001 attacks, when Predators were quickly armed with Hellfire missiles (fired, frequently, at the wrong targets). Drone strikes often slip into the cracks between regulatory domains; their responsible parties, often combinations of actors working across the boundaries of national governments and domestic agencies, are difficult to pinpoint. Among the hundreds of deaths -- some say thousands -- that America's drone strikes abroad have caused there is little accountability.

Many of these concerns are superseded by the drone's allure. Even when considering social costs and ethics, the use of drones is widely supported by the general public. Guarding the border is understood to be paramount to U.S. national security, and the practicalities of domestic security loom large. Politicians do not want to risk appearing "soft" on border security. They argue that UAVs could operate as "force multipliers" allowing the Border Patrol to deploy fewer agents and improve coverage along remote and sparsely patrolled sections. The synthetic-aperture radar, infrared sensors, and electro-optical cameras on a UAV like the Global Hawk can provide the capability to survey over 60,000 square miles a day. According to Homeland Security, UAVs have proved their effectivity, helping to intercept thousands of illegal immigrants and pounds of drugs.

In a more general sense, it is widely understood that unmanned systems, for both military and domestic security operations -- considering, for the moment, that this distinction still stands -- are the wave of the future. The Department of Defense has invested aggressively in their development and use, and by Congressional mandate, this investment must continue to increase. The perceived advantages are many. As with many robotic systems, drones are unhampered by the physiological and psychological limitations of humans; they can easily take on jobs that are dirty, dangerous or dull. They can stay aloft and loiter for prolonged periods of time, persisting on targets over ten times longer than piloted aircraft, at far less cost. The human risk factor, at least on the U.S. side, is vastly reduced. As a general rule, drones do not result in the injuries and deaths of their crews.

But they do crash.

They crash frequently -- many more times than manned aircraft.

They crash not only into American border regions and backyards but into global hotbeds of military activity.

They have slammed into Sunni political headquarters in Mosul, Iraq. Nose-dived into the Wales airport runway. Struck power lines and cut off power in Alberta Canada. Vanished into Pakistan's tribal region in North Waziristan. Plummeted into uninhabited terrain near Ghanzi, Afghanistan and the Indian/Pakistani border. Collapsed into the Gaza Strip. Plunged into the Mojave Desert. Disappeared into Turkey's desolate Mardin province. Cannonballed into the coast of Spain. Ditched into the Iraqi countryside. Rolled with scrub brush across the rough desert terrain near Indian Springs, Nevada. The Italian Air Force has discovered one of its downed drones floating along the surface of the Adriatic Sea, its body glistening in the sunlight like the bleached skin of a whale.

If a demo reel of Oscar-worthy drone crash moments were assembled -- perhaps in order to pitch the drone for a starring role in the ubiquitous action-adventure movie -- it would be composed of clips like these. In true commercial fashion, it would seek to harness the drone's menace and its allure, its potent combination of desire and threat. Like any good object of desire, it would give us what we want and what we fear. As a conduit of identification and affect, it would allow us to extend ourselves, in all our sensory acuity, into a landscape devoid of everyday political rationales and ethical or moral judgments: to plunge headlong into the melee.

The resulting drone crash action-adventure documentary would be geared for the everyday viewer primed for the economies of disaster, of pleasurable violence transmitted on private screens -- sites where drone games are played and drone missions consumed. Its trailer might go something like this. Ground control operators have suddenly lost control of an armed Reaper flying a combat mission over Afghanistan. A manned U.S. Air Force fighter is dispatched to shoot down the renegade drone before it flies beyond the edge of Afghan airspace. (In the world of robotic warfare, human pilots are apparently still good for something: shooting down wayward drones.) The tension builds: disciplined man against chaotic unmanned.

The fighter plane arrives too late. The renunciant Reaper, speeding headlong into its own future, crashes into the side of a mountain. Abstracted in a shower of engine oil, smoke, lost data, and crushed metal, its dissipating fuselage drops. Amplified in a rush of sensation and adrenaline, its absorbing body elevates.

Salvage Operations

When UAVs crash, they provide a bounty of potentially valuable information and parts. Their databases are rendered vulnerable to access, their components susceptible to retooling -- absorbed into affiliations that can enhance the warfare capacity of foes. In order to prevent enemies from obtaining sensitive materials, almost every drone crash involves an intensive recovery operation.

It can be difficult to secure the wreckage. When a Canadian UAV crashed around three kilometers from the U.S. military base at Ma'Sum Ghar in western Kandahar province, American military forces were too late: within 22 minutes, the drone had been fully stripped and hauled away by locals. If a recovery is not possible in time, a drone may be destroyed by its own government: British special forces once bombed a Reaper that had crashed in Afghanistan, in order to prevent its parts falling into the hands of the Taliban. Smaller drones like the Raven often simply disappear into the hands of enemies, as they have frequently in Iraq.

A U.S. Predator crashes in Jahayn, a remote village in Yemen. Local residents, who frequently complain of the noise that the widely-used drones make as they relentlessly circulate in the skies overhead -- some say it sounds like a lawnmower -- most likely meet this downed drone with some degree of relief. Discovering the wreckage, they call the police. The felled drone is recovered, hauled away from the oil-stained sand. As the convoy heads back, however, it is intercepted by gunmen. The armed rebels, reported to belong to Al-Qaeda, hijack the plane. The Yemeni Ministry of Defense dismisses these reports as baseless rumors. How solid is its claim? According to diplomatic cables released by WikiLeaks, the Yemeni government deliberately covered up the crash of a previous American drone, the Scan Eagle, claiming that the aircraft, which washed up on the coast of Hadramout, was an Iranian spy plane.

Unlike the smooth coordination of agencies involved in the El Paso incident, which resulted in the crashed UAV's return to Mexico, there is no handing over of the drone by the Yemeni government. It scatters into the routines and spaces of renegade agencies. Its parts, however material or discursive, are absorbed into other systems of meaning and affect, however straight or wayward, countered or modulated, amplified or diminished.

The dispersion, more the rule than the exception, is always accompanied by gathering, a consolidation. As the drone's material parts, each endowed with a distinct spatial boundary, are assembled in a coherent, stabilized form, its discursive components are often consolidated into a linear narrative -- outfitted with a beginning and an end. Which story to believe and invest in? One will most likely prevail: a descriptive phrase, like a material part, seeks consistency, endurance, and relevance, of which those that work best for the task at hand, or become most useful, achieve a higher degree.

At the onset of the El Paso crash, Mexican officials were pressed to speak. Citing national security concerns, they dodged the inquiries -- replying, as most government officials do, that all information related to unmanned aircraft systems is classified as restricted. The dodging is typical. Governments will disclose the nature and quantity of their UAV operations and arsenals only when hard pressed, and only when drones drift -- or rather, plunge -- into the public sphere, often in the form of an accident. The CIA has a highly active but covert drone program -- its bat-winged Sentinel stealth drone played a role in

Osama bin Laden's capture -- but while drone crashes are publicly acknowledged by agencies like the U.S. Air Force, its accident figures are never released. Crashes in the "Mini" and "Micro" classes are seldom if ever reported by anyone.

Even when UAV failures are acknowledged, the technical details are often obscured in bureaucratic maneuverings. Officials of the National Transportation Safety Board, who are still parsing the cause of the El Paso incident, say that a typical investigation can take almost a year. Even when finally released, the accident reports of military institutions can be difficult to decipher. Inquiries regarding drone crashes in the testing and marketing stages fall into the cracks between private companies and client governments. When pressed about the details of a catastrophe, manufacturing companies often reply that they were ordered by governmental officials not to discuss the details, as Lockheed did when asked about the crash of its Polecat UAV.

In spite of these maneuverings, the crash, as an *event*, cannot be contained, and this is precisely the source of its compelling power. Destabilized, its parts scattered, it cannot be reassembled, however hastily, in quite the same way -- in spite of the considerable rhetorical power that might be mobilized to accomplish this feat. Fault lines appear, allowing new discursive openings.

Stories develop coherence, weaving together disparate parts into a whole, yet they also create separation where there was none. Conversations gather around the *event* as it reverberates through its discursive agents, whether official agencies through their portals or gathered friends at a social settings. As there are entire websites devoted to the drone's fetishization as an object, there is a growing body of interest in its destruction and disappearance: drone crash lore. Stories are woven around downed drones and their sites however accurate they might be or outrageously fabricated they might seem. As drones are outgrowths of the histories of UFOs and robotics, as they have been integrally tied to warfare, war technology, and anxieties of invasion, however real or fictional, at least since the mid-twentieth, the inevitable corporate and national spin that is woven around the accident and its aftermath is often, as with mid-century UFO crashes, seen as a coverup or conspiracy. As with many news reports, intentions are interpolated in ways that conform to one's own beliefs, and in a world of viral media, even reports that seem ridiculous are given legs. At one time three U.S. drones were reported to have been deliberately flown into the dome atop the Iranian nuclear reactor at Bushehr. The reports of this event can still be found online with a simple search. Such stories propagate with little or no verification, especially as they activate the imaginary, affirm ideological orientation, and offer easy munitions in wars of attention.

Conversations intersect with or spin off into others, amplifying or diminishing in scale and intensity as they become harnessed to personal concerns, anxieties, and desires, aligned with group imaginaries and ethical codes, and enabled by communications platforms. They might involve the particularities of technology and impact site, the vagaries of luck and community governance, or the generalities of warfare, nationhood, freedom, and oppression. They might stabilize into stories, some propagating and enduring, some vanishing by sunrise. They might create new conflicts or fuel existing ones, produce new images and dreams, rearrange or reinforce existing routines. They might obscure specific details, overlook obvious connections, or forge entirely new ones.

As these conversational actors magnify or wane, speed up or decelerate, and accumulate relevance, influence, and intimacy, so, too, does the material *event* that they draw from -- the material occurrence with which they have entered into affiliation. Agential networks and events are intricately tied together and mutually influencing. At the most basic level, even causality and temporality are up for negotiation.

In this way the narratives that are woven around the drone's fate -- circulated around crash sites, dinner tables, cookouts, online forums and board rooms -- have a vitality. They are social actors that negotiate realities even as they are negotiated by them. Yet the fate of the drone's carcass is but one narrativized outcome of a much larger and more vital function that the catastrophe performs. The crash is important because it destabilizes the coherency of the drone and embroils it in a politics that was heretofore invisible or diminshed.

At the onset of the catastrophe, the drone and its component material and discursive actors, occasioned by the reverberations of the *event*, are catapulted into a more public space, rendered newly exposed and available for affiliation. The agential components of event and drone become newly active in their negotiations. The catastrophe reveals an agential dispersal: the network of the negotiation.

Yet at the same time, revealing the elements with which actors and events affiliate in order to maintain their centrality and force, the catastrophe orchestrates a consolidation. It stabilizes relatively coherent or consistent forms -- however spatial, linguistic, affective, or rhythmic -- that embody or heighten the specifics of the crash site, the actor, the part, rendering it singular, bounded, and unique. The drone crash, both materially and discursively, is an *event* that both disrupts and congeals the dynamic. It provides an exception, but also an amplification.

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The El Paso crash, in its dispersions, helped reveal the specific details of Mexico's UAV program. Until then, it was not publicly known that Mexico was using drones along the border. To maintain this level of focus on the drone is to amplify its history, its manufacture -- how it came to exist in a specific built form. Mexico operates a fleet of drones purchased from three Israeli companies -- Aeronoautics Defense Systems, Israel Aerospace Industries, and Elbit Systems. The Heron UAVs that it has purchased from Israel Aerospace Industries have also been sold to Canada, Turkey, and Ecuador, where the company now has a branch office, in addition to its offices in Brazil, Colombia, and Chile. Elbit Systems, in addition to selling its UAVs to Mexico, has also sold them to the U.S., U.K., Singapore, Croatia, Georgia, and Brazil, where it has a subsidiary, AEL Sistemas. Drones are marketed to these countries for a variety of purposes including jamming signals, locating enemy satellite dishes, spotting drug plantations or cartel hideouts, or monitoring police forces for corruption. The specificity of drone manufacture, when pursued, opens out into multiple corridors, each of which can be followed to reveal others: networks of affiliation that operate at a number of scales, magnitudes, and degrees of stability, from research to assembly to testing and marketing. Zooming out to the largest consolidating scale, the production and consumption of UAVs is a global phenomenon, with about 60 manufacturers operating in at least 48 countries. The U.S. military is the single largest consumer. Along with their manufacture and selling, drone operation is also a trans-national endeavor: the Turkish Herons that Canada owns, for example, are flown and operated in Afghanistan by the Australian Air

Force. So, too, with drone training and logistics.

The geographical specificity of the material *event* reveals the distinct spatial politics in which these distributed drone economies are embroiled -- economies that, in their vast scale and speed, and in their considerable rhetorical arsenals, blur impact at groundlevel. The site tells its own story. The Mexican Orbiter drone crash in Texas occurred in a specific spot on the earth, its collision etched onto the ground of a unique El Paso backyard, its temporal streams collapsed into a singular date and standardized time. The impact occurred on December 14, 2010 around 6:25pm. The site is located on Craddock Avenue near South Yarborough Drive, in the city's Lower Valley neighborhood. It is just over the border from Ciudad Juarez, one of Mexico's key epicenters of violence. The drone could have easily landed there, amidst the very region that it was clearly intended to monitor -- a region where rival drug cartels battle for control over smuggling and drug trafficking routes, their caches filled with American weaponry, and thousands of killings occur each year.

The contrasts of these two sites could not be more extreme. The operation of American and Mexican drones along this stretch of border -- often only glimpsed in terms of their failures -- reveals its specific geographical, social, and political climates, as it is sliced through with a border barricade, surrounded with a surveillance apparatus, and embroiled in discourses around domestic security and drug use. For politicians, ever more intricately connected to the global economies of done manufacture, sales, and operation, the "force multiplying" factor of UAVs saves lives, increases manpower, improves coverage, enhances relations, and reduces crime. It draws a harder line in the soft desert borderland.

However hardened, the line is breached ever more intricately by the trade of weapons, people, and narcotics, much of it driven by U.S. demand. The violence in the Juarez region is of such a scale and nature that it has been analogized to that of an insurgency. (The Mexican Army has been known to go into the city bearing artillery.) If, indeed, this is true, then perhaps, like others of its kind abroad, this insurgent force has the capability of jamming the signals that UAVs rely on, causing them to go astray or out of control. The material specificity of the *event* reveals its technological infrastructures, however actualized or latent. The GPS signals necessary to steer drones and locate their targets are weak and easily interfered with, as are the electromagnetic waves generated by radio signals, computers, electronic equipment, and various other machines. Spurious, unidentified signals can cause engines to mysteriously shut down (as they have with Bell Helicopter's Eagle Eye UAV -- a signal whose mysterious source has never been identified).

Perhaps the Mexican Orbiter went off course into Texas because it was hacked. The drone's devices and communications are vulnerable because many of its software and electronics components are "off the shelf," riding on existing structures. About 95% of the military's communications travel over commercial telcom networks, including satellite systems. The DIY drone jammer may have a political aim, but, as with its hobbyist counterpart, there is a creative and erotic dimension to this acquisition of expertise, skill, and display of prowess. It can amplify stature and social currency. As drones populate the imaginary through games, sci-fi literature, television, and film, so, too, does the hacker ethic, often embodied in the agency of the hero. Bringing down a drone can engender as much affective thrill as launching one: the *jouissance* of the crash reverberates across the body that it helps render social, firing up electro-chemical connections and igniting its sensorium. In keeping with the ethos of DIY cultures, the "stupidity" or simplicity of homegrown solutions is prized: a quotidian "know-how" that resists the dictates of commercial knowledge production regimes. The underdog sweeps in to score -- the resurgent rebel fighter who, in the nick of time, shoots down the vessel of the oppressor.

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As the material specificity of the *event* reveals its deeper technological substratum, the renegade force that is the drone's undoing may be buried within the machine, in a site where human agency is much harder to locate. A U.S. Air Force Global Hawk, the largest unmanned plane in the military's arsenal, was once brought down by a small, renegade part. An investigation of the crash revealed that the plane's rudder had become loosened during a previous mission. It was not detected on routine maintenance checks. During the fatal flight, it began flapping uncontrollably. Though comparatively small, this particular part plays a crucial role, and its flailing was persistent enough to destabilize the mammoth plane and send it plummeting to earth.

Failures of the Global Hawk are not uncommon. The Air Force had lost two of them just before the excessively flapping rudder catastrophe. The first crash was due to a simple input error: the plane was programmed to taxi at 178 miles per hour. The second was due to operators inadvertently engaging a self-destruct code while the plane was aloft. Ooops!

Inquiries into the maintenance of the rudder, the programming of the mission, and the writing of the code reveal the drone's concealed infrastructures -- its systems of operation, logistics, and maintenance. For most American drone operations abroad, ground crews service the mechanical systems of the planes at regional bases in war zones, as flight crews operate them thousands of miles away, out of converted trailers at air force bases in Nevada (and soon to be joined by bases in Arizona, California, and Texas). The material realities and infrastructures of these bases, along with their geographical and institutional embeddedness, play a large role, as do the highly specific, routine practices they register and call forth. The single-wide trailers out of which drones are operated are oddly humble, given the considerable expense of the UAV program. They sit isolated amid the vast desert landscape, parked amongst the scrub brush. If not for the barbed wire around their peripheries, one could mistake them for the typical mobile home encamped at any trailer park in the American southwest, replete with enormous satellite dishes and cables that link them to the world beyond.

A typical UAV requires a flight team of four. A pilot maneuvers the plane and is the chief person responsible. A sensor operator manipulates cameras and sensing devices. A mission monitor receives requests from "customers" and sends them required images or information. A flight engineer monitors the status of the aircraft. While the ground crews wrestle with the vagaries of small parts, the flight engineer monitors their operational states in the form of technical data arrayed on one of the crew's displays. Another display contains navigational data: GPS signals and other locational data downloaded via satellite transmission and translated as coordinates on a GIS, for use in directing the plane and positioning targets. Another display contains image data: the drone's view from above.

Data flows through satellite transmissions link the assembled flight crew to the plane, as data flows through radio transmission or otherwise connect the flight crew to intelligence teams and arrangements of commanders and troops on the ground. These links and flows are determined through existing connections, platforms, and procedural agencies, yet at the same time, they help instantiate them. Transmitted signals are modulated and rendered discrete as code, in concert with the actors -- programs, hardware, organizations, personnel -- that rely on them. As they flow through actors, they are filtered, constrained, related, and interpreted, and in the context of this activity, actors acquire rhythm and articulation. They configure, and are configured, through limitation and correspondence.

Most of the algorithmic and machinic operations necessary to operate the plane and negotiate its trajectories across geographical, national, and institutional territories are those that bypass the corporeal agency of personnel. The plane flies as an affiliation of maintained and monitored states through the activity of a multiplicity of actors, however human, mechanical, informational, environmental, or institutional. These actors operate at various scales and levels of complexity, whether at the level of hardware, software, image, data, controls, flight or ground crews, or at the scale of logistical support, service, or operator and maintenance training.

Through it all, the rudders remain stable. The transmissions are cleared, the connections maintained. Collective intelligence and skill emerges for operation. Hardware, personnel, and supplies are integrated into tactical formations. Communication protocols and pathways fit together in stable systems. Ideas fit together in doctrines. These actors stabilize and cohere because of the procedural structures, standards, and programs of the higher-order affiliations into which they fit -- affiliations that might exist at the level of algorithm, hardware, or logistics, or at the local, the regional, or the national.

The component actors within these affiliations are relatively discrete and stabilized. Yet they are active: they band and disband, accumulate and release, extend and consolidate. Some links are weak and some more solid. A dispatch is simple while a doctrine is complex. Even internally, composites that would seem to be solid and enduring are embroiled in bandwidth battles and interservice rivalries. All must be actively maintained, with varying levels of frequency and force.

The "salvage operation" -- the "recovery" of the drone's sensitive materials -- begins by disengaging these component parts from conventional ontological categories, and instead, regarding them in terms of their performative functions or roles. What these actors *are* is what they *do* in the environments of the affiliations in which they bond and circulate. They do not sit idly, severed from the world of their making, but affiliate and perform in active, systemic and routined fields through which their ontological distinctions and functions are redistributed. To understand individual actors in terms of their relevant practices -- the functions they perform in the organization of the affiliation -- is not to minimize their singular materiality. The "recovery" operation, in "restoring" actors to their performative activity, places specificity and distribution, part and practice, consolidation and multiplicity, together on the same analytical plane.

Since affiliations, and their component actors, come to perform in certain ways, at various scales and speeds, with varying degrees of reliability, influence, and intimacy, the next step in the salvage operation is to explore *how* they come to perform -- the relational structures and organizing principles through which they are coordinated and combined together at various scales, magnitudes, speeds, and levels of complexity, and the mechanisms through which this is sustained. The next step involves opening up the possibility that these components can be hacked, retooled, reprogrammed -- appropriated into new patterns of use. The operation is not primarily reductive and critical but affirmative and constructive: the production and mapping of new ontological platforms, epistemological itineraries, and political possibilities.

Ontologies of the Drone

Consider the rudder, excessively flailing on the luckless Global Hawk -- the renegade part that was the cause of the drone's undoing. As the hulking, ungainly vehicle roars through the sky, resembling a strange sea creature with no eyes on its disproportionately large head and no features on its vast, smooth stretch of luminous white skin, the rudder swerves back and forth at the ass end, lodged within the plane's fin. Its smooth, curved form is the material outcome of the need to harness the properties of moving air: to maximize the efficiency of the interactions between air and the solid bodies that move through it.

Essentially, this part is rather dumb: a surface that awaits control. The control is provided by an actuator. The rudder is attached to its output hub and secured in place with hinges. Basically, an actuator consists of a motor that drives a control surface -- in this case, the rudder. The actuator-rudder coupling can be regarded with a degree of autonomy: one can, when necessary, isolate the mechanism, regard it in terms of its material and functional specificity, marvel at the contours of its design. The task that it must perform is relatively simple when understood at the level of each scale of its operation. At the most basic scale, its job is to move back and forth along a determined range of motion in accordance with received instruction. At a larger scale, its job is to change the shape of the tail fin's surface and subsequently vary the amount of force generated by it. At a still larger scale, its job is to control movement of the plane about its vertical axis -- to change the horizontal direction in which the nose is pointing.

These tasks, while crucial, are pointless when done alone. In order for the plane to maneuver in space, the rudder must work in conjunction with the plane's other directional control surfaces. It cooperates with the elevators, the horizontal control surfaces on the tail section that control pitch, and the ailerons, the control surfaces attached to the wings that impart roll. Cooperation occurs across a number of scales and fronts. Actuators drive control platforms at their own local scale, in ways that alter their aerodynamic characteristics, and these movements, in turn, alter the aerodynamic characteristics of the larger-scale platform -- in this case, the plane. Larger-scale actuators -- such as the propulsion system, including engines and propellers -- may also effect smaller-scale platforms. The overall cooperative job is to provide stability for the aircraft -- to keep it straight in flight.

In order for the aerodynamic characteristics of their platforms to be altered, the motors of the actuators must drive their control surfaces in accordance with received operational commands. Data must be sent to them, singly and collectively. In order for the correct information to be input, environmental conditions must be sensed -- changes in states detected and measured. These measurements might take place within media that are mechanical, electrical, magnetic, or chemical. They might involve rate gyros for the various axes of motion. They might involve direction, air speed, and altitude. They might involve the distance to nearby objects. They might involve activity on the ground below. Once these conditions are sensed, the data is processed by the flight computers. The necessary information is exchanged via transmitters and receivers. The flight computers transmit relevant information to operating crews and other teams of actors. They drive the actuators to adjust relative position, speed, and attitude and steer the vehicle accordingly. A cohesive flight is produced.

These actuator-control surface affiliations, then, are only able to perform their tasks accurately by connecting to affiliations with these sensing, processing, and linking functions -- affiliations that might take the form of pressure transducers, range finders, digital compasses, or electro-optical and infrared cameras. Understood in this way, the UAV -- or as it is increasingly coming to be known, the UAS (Unmanned Aircraft System) -- is an affiliation of components and systems that includes sensors, computers, communicators, actuators, and control platforms.

The affiliation, both material and informational, necessitates the use of common frameworks, parts, and communicative programs. In order for a context to be created for the information, communication among components facilitated, and inferences from the data drawn, the system overall must function in terms of common standards. The tasks performed, whether at the small scale of control surfaces or the large scale of control infrastructures, are only accomplished by linking to other affiliations and functioning in accordance with them in the terms of common programs. It is a matter of the modality of this linking across multi-scaled components and systems. It is a process of bonding, synchronization, calibration, and agreement that does not simply involve a conventional relationality. The difficult question is not how actors relate to one another as separate entities, but how they gather together to stabilize in cohesive wholes that are more than the sum of their parts. It is a matter of how, once sufficiently stabilized, they replicate, become redundant and standardize, at various scales, across various platforms of endeavor.

The functions of sensing, processing, communicating, and actuating are distributed, shared, and consolidated across a number of ontological platforms. Many biological and machinic assemblages perform all of them. At the most basic level, all component actors are sensors and transmitters of energy. They transmit and absorb electro-chemical signals and electric or nervous impulses, and they emit and receive vibrations whose different frequencies they process in terms of language. These transmissions traverse the kinaesthetic and kinetic dimensions of experience: between movement that is sensed, experienced, and perceived internally and external environmental forces like gravity, momentum, speed, and phrasing. Transmitting agencies filter and calibrate flows, modifying one another at the level of affect, rhythm, and code, in ways that increase or diminish their ability to act, apprehend, relate, and materially exist. Within the exchanges and modulation of these flows, they acquire rhythm and articulation. The foundational structure of this relationality is not primarily based on difference. Actors may consolidate as discrete entities, yet they also vibrate in terms of constrained transmissions and modulated thresholds, however approached, attained, or crossed, at various frequencies or rhythms. Relationality involves the correspondence of elements, yet also involves the limitation of flows.

In the terms of the "recovery" operation, it is a matter of suspending recourse to conventional ontological categories and instead, regarding agencies in terms of their performative functions -- the roles they perform in affiliations at various scales of operation. Functions are always consolidated and embedded in the specificities of actors, which might be human, institutional, technological, spatial, or atmospheric in nature -- a fuselage, a microprocessor, a rudder, a communication link, a tag, an engine, a crew member, a military base, a controller, a program. These actors achieve a level of discreteness -- functional and agential specificity -- in concert with other actors that rely on them. But the recovery operation is one of holding specificity and the distribution together -- placing consolidation and multiplicity, part and practice, component and system, together on the same analytical plane. The rudder's direction in manned aircraft was once manipulated with the movement of a pair of foot pedals by a pilot. While most of the Global Hawk's operations are now the result of programming and commanding the autopilot's computers -- a rudder command is sent encrypted via fiber optic overseas cable and satellite, and takes about three seconds to reach the plane -- this does not mean that the agency of the pilot has been fully replaced by a program or relocated in one human crew member at one site. It a matter of looking at the distribution and embeddedness of the piloting function: of understanding how its capacities have been redistributed in sensing, processing, and actuating affiliations at various scales and consolidated in new clusters of ontological significance.

As with all affiliations, the further one zooms in, the more complex matters become. Often the necessity of the zooming is only revealed in the advent of the failure, the crash providing the impetus for the probe.

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At the onset of the Global Hawk catastrophe, the investigation was set into motion. It located the rudder-actuator: its failure, its uncontrolled, excessive flapping, was pinpointed as the agent of the plane's demise. The fault could have been located deep within the actuator itself -- in the input shaft/crank mechanism, electromagnetic brake, stainless steel gearing, or servo valve -- or in a defect of its lacquered, controlled surface, flailing in the sky. It could have been located in the canals that regulate the coursing of fluid or the flow of wind. As it is not just a matter of the functional makeup of the affiliation itself, but also that of the affiliations within which it is embedded and with which it functions in accordance, the fault could have been located in the agency that commanded the actuator.

These agencies, as with all component agencies of the drone, can be material formations consolidated in space or scalar zones distributed in time. They can exist as configurative instantiations or transmissive fluctuations: elements related or flows constrained. The UAV is a rigid flying platform, yet it is a dynamical system that is also defined by the atmospheric, technological, and institutional systems that it moves through -- air, informational transfers, protocols. The faulty agency of the actuator's command, then, could have been located in the signal that was sent to it, in the instructions themselves, in the program through which these instructions were mobilized, or in the agency that programmed them, however located in the information flows within the vehicle or between the vehicle and its larger command networks.

The functioning of the actuator's output hub is monitored by a sensor connected directly to it. The sensor provides a position feedback signal. Because the loosening of the rudder-actuator complex was not detected, the fault could lay in the sensor's performance. There could have been a loss of accuracy through a small bias in measurements, or a slow-drifting of them. Or, the sensor could have become stuck on one particular value. These faulty measurements alter the measurements required by controllers, and, depending on their severity, may scale up to degrade the UAV feedback loop. The UAS, like all complex affiliations, is built of a collection of components functioning at different levels of physical scale and organization. The output of each level provides units of assembly for the next level up the scale, in ways that can also rebound back to effect lower levels. The sensor's data could have been transmitted and processed correctly at one scale but processed incorrectly at another -- even at the level of the crew unit (another type of information processing machine). Communications are subject to environmental intrusions, however atmospheric or manufactured, that interfere with the signals and block their paths, introducing echoes, noise, and jamming. The actuator could have failed completely and become unable to respond to any command. Or, if its output hub had indeed become loosened, the attached rudder could have responded only partially, or not at all, to the instruction sent to it, no matter how correct the command. One contingent fault may lead to another, cascading upward through the levels of the system to effect its overall performance. Small-level inaccuracies may have the larger-scale effects of destabilizing the overall flight path. The small-scale fault can lead to the large-scale failure -- the malfunction of a system component or function to its complete breakdown.

Actors relate as discrete entities, yet they also modulate and constrain flows at various thresholds of experience. The threshold might be that of scale, magnitude, or frequency. It is determined by affiliative complexity: the extent of bonding, synchronization, and agreement across populations of actors. It is determined by the nature and influence of an affiliation's organizing principles: the programs through which actors gather together to stabilize in cohesive wholes that are more than the sum of their parts, and through which they can replicate and standardize. A failure is a fault that, having accumulated a higher level of affiliative complexity, has crossed a critical threshold. As there are no hard-and-fast boundaries between actors, or between affiliations, there are no hard-and-fast boundaries between fault and failure. But there is a transition point. It is a matter of developing a control system equipped with a sufficient degree of robustness to fault. It is a matter of the efficient, enduring management or maintenance of sufficient stability against instability. The overall "health management" of the UAV -- one dimension of its control system -- is designed to absorb faults. If the control system is not equipped with some form of fault tolerance, or if the fault-tolerant control system is not capable of providing sufficient recovery to the fault, the component or function may lose stability and exhibit an unpredictable pattern. Loss of stability at one scale can lead to a loss of continuity and cohesiveness at another -- perhaps to catastrophic ends.

It is also a matter of catching faults in advance through routine system checks. However, the checking itself could be faulty, the blame located in the quality and frequency of the particular system test in question, whether it might involve position accuracy, torque, speed, stiffness, or frequency and step response. The ability of a test to accurately detect fault is due to the quality and enduring relevance of its assumptions and procedures. It is due to its effectivity within changing conditions, including anomalous behaviors and abrupt environmental shifts. It is due to the agencies of its application. A test, like a text, is nothing outside of the modality of its usage, its constitutive agential positionings and enacted routines. Like any actor, it is a matter of its functional role in the system. It manifests by way of its action and maintenance: through the ways it comes to perform, at various scales, magnitudes, speeds, directions, and degrees of complexity. The *action* of the test is neither internally nor externally decided: it courses through its attendant actors, as these actors perform within the dynamics of the situation. It is a question of how the situation *matters* -- its shared priorities that come into play, as they are sustained in practices: recurrent composites of action, stance, and form.

The drone's component parts and systems take shape in degrees of coalescence and disruption, at various frequencies, rhythms, magnitudes, and scales of endeavor. They subject to external forces, to the environmental stress placed upon them. How much can a part take before it fails, decouples from its job, spins out of synch? Forces of temperature, mass, and vibration conspire against it. The pressure is also discursive. The plane flies as an affiliation of maintained states, and adequate performance is a matter of maintaining sufficient stability at numerous scales of practice, whether these might involve software, hardware, or institutional and public dialogue. The drone works as a platform because the agents that it helps assemble, however organic or inorganic, material or discursive, "agree" that it works.

It is a matter of how these "agreements" come to exist, how they bond and calibrate, how they endure over time. In order for actors to move and endure, they must find their way from one moment to the next by drawing on available resources. They must modulate flows and facilitate correspondences, however affective, rhythmic, or linguistic in nature, as well as cultivate their own availability for the modulations, calibrations, and correspondences of external agents -- increasing or diminishing their potentials to materialize and endure. They must cultivate their modulation in affiliations that can maintain them, offering consistency and coherence, and the gaining of influence, relevance, and intimacy. In so doing, they must negotiate adherence to the demands for movement and attendance that these affiliates maintain. It is a matter of the setting of the terms -- the common organizing principles, or programs, through which sustained affiliation is achieved.

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On a brisk winter evening in Southern Arizona, a Shadow UAV plowed into the earth near Fort Huachuca, about fifteen miles north of the U.S./Mexico border. A volatile mix of colliding metal, electronics, engine fuel, and dry air, the drone violently destabilized, its energies cascading outward and out of control. The violent expansion sparked a flame. Gathering momentum, it began to ravage the countryside. Awash in combustible greenery, the fire burned across two acres of land. As with any incident that ignites a large blaze in the arid, forested landscape of this part of the country, where wildfires can easily burn out of control, the catastrophe was met with no small degree of alarm. However in this particular military base, home to the largest UAV training center in the world, catastrophes of this scale are generally no big deal. Drones slam into the earth here on a regular basis. Their resulting explosions and fires, blazing fiercely across the terrain, are simulated with ease. A cavalcade of drone wrecks can be called up at will, their burning remains smoldering in storage.

The burgeoning global UAS market relies heavily on companies and organizations that provide service, logistics, and training for the unmanned vehicles that proliferate across the skies. Facilities like those at Fort Huachuca must accelerate their output of skilled operators to meet the growing demand for drones. Since access to national airspace is largely restricted, much of the training is done on simulations. The interfaces of these simulations are familiar to any aficionado of games, roleplaying environments, and high-tech adventure films. Like the control panels of actual flight crews, sitting in their Nevada desert trailers, they bear the traces of the commercial game formats from which they are derived. One can detect the influence of Xbox controls, used by the Army, and the engines of games like Halo, upon which Raytheon's UAV control system is based. Even simulations like the Marine Corps's Virtual Battlespace 2 are based on commercial game engines that are boldly reflected in their titles.

Like the actual drones of which they are a component, the coherency and discreteness of these interfaces and applications dissolve upon scrutiny, scattering into arrays of component actors that are shared by other affiliations. These component actors -- visual and rhythmic motifs, behavioral conventions, perspectival formats, software codes, tags, controllers, users, corporate procedures, game architectures, rules -- circulate and bond across multiple domains of experience, traversing the divides between corporation and government, combat and entertainment, simulation and reality. The particular applications in which they accumulate, largely developed by the commercial game industry and influenced by commercial formats of cognitive and affective engagement, are made to excite the gamer, with characters that run faster and jump higher than is humanly possible, and explosions and flames that burn more fiercely than normal -- much brighter and more intensely than that which actually occurred in the wake of the crashed drone outside the Fort Huachuca facility, which surely would have disappointed the seasoned player. The problem is not that people, environments, and behaviors are un-lifelike, but that they are more than lifelike and must be downscaled, along with the expectations of their human accomplices, to calibrate with the velocities, magnitudes, and textures of the real world.

The component actors of these gaming, control, and simulation affiliations relate as discrete entities, yet they also modulate and constrain flows at various scales of experience. They are relatively stabilized, consolidated platforms but also dynamical systems defined by the atmospheric, technological, and institutional systems that they move through. As they configure and fluctuate in their relations and modulations, they require continuous adjustments across the various scales, rhythms, and magnitudes at which they are active. The agency of this adjustment traverses the bounds of the interface, neither fully internal nor external to any ontological divide.   In the world of the simulation game, action emerges in a shared landscape of participation: one wants to get into the flow, carried forth by the activity, responding to situations in direct ways that bypass the mechanisms of thought. Differentials, commonalities, and alignments are negotiated, discrete changes or shifts in scale responded to, but in ways that do not involve hard and fast separations between user and action: one endeavors to get fully absorbed, to cease being aware of oneself as separate from the actions one is performing. The activity into which an actor is "swept up" is initiated neither fully internally nor externally, but courses through all of the actors in attendance, as these actors perform within the dynamics of the situation. It emerges in a shared field of endeavor. It is a matter of being attuned to the situation property, so as to be alerted to its priorities: the movement, stance, and positionality that it summons as most opportune.

Agency manifests by way of its action and maintenance: through the ways it comes to perform, at various scales, magnitudes, speeds, and degrees of complexity, and the extent to which this performance is recognized, valued, and maintained. An actor endeavors to be an adequate player of the game. It is a matter of what is deemed adequate performance: the shared priorities that come into play, as they are sustained in recurrent composites of practice. It is a matter of maintaining sufficient stability at numerous scales of practice, to the extent that shared formats, agreements, and standards can come to exist -- programs that can be allied with, offering propagation and endurance over time. The adjustments and calibrations required are entraining: actors are acclimated to one another within the terms of these specific formats, programs, and practices. Agential form is a matter of adjustment and compromise, across the various frequencies, rhythms, magnitudes, and scales of experience in which affiliation occurs.

Simulations often require nothing more than a joystick and personal computer -- a laptop can run all of the vehicle dynamics, including the sensors. Rendered portable, the same high-end environments that are found in stationary systems can be brought home for practice or taken directly into the field. Further narrowing the gap between rehearsal and mission, some simulations are plugged directly into the ground control stations that are used to manipulate real UAVs, allowing for training and operation to be done together, with operators toggling between simulation and actuality within a functional crew station.

The integration between gaming, simulation, and mission happens not only at the scale of the crew station but at the level of the command structure. Simulations like Virtual Battlespace 2 allow data that is gathered by UAV sensors within the gaming environment to be fed directly to command and control systems for a commander's strategic planning. It is said to provide a more comprehensive view of the battlefield, with real participants vying with simulated ones for evaluation, engagement, and participative hands on training, in networks that amplify access to knowledge, situational awareness, and collaborative endeavor. It also provides analysts with simulated back-end processing of the raw data collected by the sensors. Ground base operations, inter-service and multi-national training events, and game based training situations together become essential precursors to deployment, increasingly integrated into command and control systems and actual operations in realtime.

Ground control stations, training simulations, and video games occupy a common economic, affective, and cognitive terrain: sites of data rendered actionable. Together they constitute an interlocking, visual, rhythmic, and orienting complex, harnessing the imaginary, that conditions orientation in the world. Like the material realities and infrastructures of the bases and training facilities within which it unfolds, however virtually, geographically, or institutionally embedded, the enacted routines of this complex play a large material and materializing role. Their transmitted signals, electrical and vibratory, are modulated and rendered discrete as coded meaning, in concert with the software and personnel that channel them. The relations and modulated transmissions are mutually generative: they configure agency, and are configured by agency, through their limitations and correspondences in the enacted routines of practice. They course through their attendant actors, as these actors perform within the dynamics of the various situations that arise, in various degrees of attunement to the shared priorities that they may reveal: priorities acted upon and inhabited, in various degrees of frequency, scale, and magnitude, in stance and position.

The situation *matters* in stances and positions. It matters in the evaluative alignments and postures that are taken in communicative encounters, however expressive, referential, or material, as they traffic between routined physical activity and larger social structures. It matters in the dynamic agential roles that are instantiated in communicative encounters, which help to give directional form to experience. The mattering might accumulate in values, tastes, desires and dispositions. It might involve body alignment, pace, expression, stylistic action, voice, shift of footing, poise, manner, affinity, or mood. In order to matter, it must be sustained in practices -- recurrent composites of action, stance, and form. Actors are integrated with, and instantiated through, these composites, registered and enacted at the level of one or more platforms of affiliation, primed in various patterns and integrated into coordinated response systems. They emerge from the dictates of a developing structure, but are neither fully internally or externally decided. Flows are absorbed and released, constraints enacted, forms negotiated, correspondences staged. Data from the environment is absorbed, contexts created for that data, internal and external communication facilitated, inferences drawn, and appropriate physical response output. Action is catalyzed, guided both from within and without the staged confines of the actor.

As the material agency of trained crew members coalesces an affiliation of maintained states, in alliance with a multiplicity of actors -- however human, mechanical, informational, environmental, institutional -- so, too, does the material agency of the drone that is flown. Through practices, they are maintained in continuities, cooperating and competing for endurance, in whatever degree of simulation or actuality. They do not always conform or affect one another in linearly causal terms. The affiliations of the pilot and plane are connected, in resemblance and limitation, to a degree and scale that they can be stabilized and sustained: they exist in the world, inform and influence one another, with some degree of reliability, relevance, and intimacy.

Some routine practices stabilize into organizing principles, or programs. While programs are dynamic sites of social negotiation and organization, some achieve a higher degree of endurance, influence, and intimacy. Some work more efficiently or better than others, some have more allies, some more relevance. They perpetuate their standards such that other actors come to move in accordance with their terms. Actors necessarily adjust themselves in accordance with the programs of the gatherings with which they affiliate, acquiescing to their terms of negotiation. They entrain, and are entrained, in accordance with the programs through which sustained affiliation is achieved. Things fall into place.

Across these dynamic, entraining affiliations, functional organizations of knowledge and skill -- capacities enacted and roles played in the organization of the system -- are redistributed and re-constrained, along with positions, categories, and divisions of labor. As agencies circulate and bond across multiple domains of experience, traversing the divides between corporation and government, combat and entertainment, research and commerce, affiliations composed of unlikely bedfellows are brought together through economic need. If the "unmanning" of systems moves soldiers off the battlefields, it brings technology companies directly into them, in search of groundlevel feedback for updating existing products and developing new ones, in an increasingly competitive global industry. The redistribution of manpower in the "unmanning" -- the shift from soliders in battlefields and fighter planes to those in double-wide desert trailers and high-tech command centers -- challenges the stances, positions, and qualifications that have defined previous generations. The values, tastes, and dispositions of unmanned warfare do not always align with the gendered roles, imaginaries, and concepts of adequacy that were present in the noble, heroic ideals of the past. The Air Force now trains more drone pilots than fighter and bomber pilots combined. The "top gun" archetype is on the wane. Yet, as past ideals of heroic masculinity are threatened new ones are created, embroiled in new forms of agility, knowledge, and prowess display. They might be manifest in the subtle alignments of the body, its pacing, expression, stylistic action, inclination, or mood. Warrior archetypes migrate into alternative geometries of privilege, however gendered -- myths of male identity wrestled with in the reinventing, rather than resuscitating, of a fading ideal.

With these redistributions comes a retooling of notions of skill and expertise. As intelligence migrates into unlikely, shared sources, even those spatial and atmospheric, and agency is understood to be distributed and embodied in all manner of organic and inorganic actors, a concept of skill emerges whose source is in negotiation rather than domination: an alliance with material actors rather than an assertion of command over them. Here an actor works with a material rather than against it, cultivating an existing, emergent meaning rather than externally imposing one -- a "knowingness" that is not simply categorical but affective and rhythmic. It transforms objects into situations, their contours not determined in advance but arising within the terms of the encounter. When an object becomes a situation, one cannot assert one's authority over it so easily. The benefit comes not from taming so much as listening: it becomes an occurrence to be learned from, patiently. This is about proximity rather than power, an "excessive closeness" to that which cannot be contained or possessed, and over which the impulse to control diminishes. It requires a break of routine, a more flexible notion of practice that can accommodate that which is revealed in the negotiation, often unexpectedly and outside of preoccupation. An affiliation's enduring relevance is not just due to competition but cooperation, often in subtle, sensory ways: it is not just influence but intimacy. In the face of these concepts, analytical notions of power and desire diminish in their relevance.

The situational *event* of the crash reverberates across a dynamic agential field. It is a matter of being attuned, to a sufficient degree, to what *matters* there. Occasioned by the dynamics of the crash, drone ontology bleeds into epistemology.

Amplifying Expertise

It is a crisp October day in Afghanistan, in the midst of Operation Enduring Freedom. A U.S. Predator has just taxied and departed from Kandahar Air Field for a routine reconnaissance mission. The plane is assigned to an Expeditionary Wing at Creech Air Force Base in Nevada and operated by crew members at March Air Reserve Base in California. Suddenly, during the flight, the crew receives a direct task order from the Combined Forces Air Component Commander: they are to provide immediate air support to U.S. and Afghan ground forces that are under siege. The enemy fighters, numbering about 300, appear to be carrying out a large, coordinated attack. Given the intensity of the battle on the ground below, the circumstances of the attack, and the immediate and critical need for support -- U.S. soldiers were being killed -- the Predator crew is consumed with a high-degree of urgency. Their attention fully focused the battle, their awareness of the bigger picture diminishes. The pilot's distraction leads to a fatal mistake: he fails to see that the UAV is headed toward a looming, 17,000-foot mountain. The drone smashes into it, abstracted into a cloud of black smoke, its parts scattering into the desolate terrain below.

Human attention can be too tightly focused along one zone of experience, to the exclusion of wider expanse of contextual information -- what the military calls "situational awareness." It can also be too scattered: not focused enough on anything. In order for it to be effective, a dynamic between stabilization and destabilization must be actively maintained. Yet however vigilant it might be, human attention it is faulty and undependable -- ill-equipped to keep up with the demands placed upon it. As drones gain the ability to "dwell and stare" -- recording activities on the ground over much longer timeframes -- the vast amounts of data they absorb can easily outrun the capacities of personnel. (On a single day the Air Force must process nearly 1,500 hours of full motion video and another 1,500 still images.) Cameras and sensors become ever more sophisticated, yet they are of limited value unless they can be accompanied by improved human intelligence and skill. The task of interpreting what the UAV is seeing falls partly into the hands of the flight crew, who always has access to the aircraft's live video feed; they may also be joined by an image expert trained precisely for this purpose. The video is also sent to image analysts at other bases -- analysis and dissemination sites like the Joint Base Langley-Eustis in Virginia, inside of whose cavernous rooms image analysts sit, filtering vast streams of data arrayed on constellations of monitors. They, too, are hard-pressed. Staring for hours on end, nearly inert at their chairs, they try to ferret out the singular target -- the single, telling deviance in the normalized flow. Armed with the skill of extracting relevant data from image flows and information arrays, they attempt to organize that data into patterns of affiliation from which further extrapolations can be made.

The UAS, as an affiliation of components and systems, relies on analysis and dissemination sites like these. They are vital platforms of the drone in its shared perceptual and analytical capacities, its sensing, processing, communicating, and actuating functions -- nodes through which its data is streamed, formatted, tagged, and rendered searchable across networks of datasets. The platforms and nodes of these affiliations are many, from personnel bases in Nevada to storage facilities in Iowa -- repurposed shipping containers within which arrays of servers, tasked solely to house the video data generated by Air Force drones, quietly hum, as unremarkable as the double-wide trailers in which their operating crews sit. As the image data is organized and stored, it becomes the primary site through which correlations can be made and inferences drawn. Databases, activated through search algorithms, become the primary repository of knowledge. A backlog of replayable events is generated, seen from above: a searchable, historical record of a region's activity, as viewed from the UAV.

This movement that is detected, however geographically understood, is not necessarily causal and continuous: a history inscribed upon ground or air.   It is rather a result of calculations calibrated across datasets: correlations among relatively stabilized and standardized elements that do not move across space so much as flicker or fluctuate within it. Movement is less a continuous transfer -- over ground, land, or spatial volume -- than a configurative interpolation.   It is a trajectory assembled in retrospect, piecemeal as a correspondence of points: a behavioral composite into which movement and intention are inferred.

A typical drone requires 19 analysts. A single drone outfitted with "Gorgon Stare" technology -- which can capture live video of an entire city -- requires 2,000 analysts. This advanced video capture system, paralleling the teeming array of snakes emerging from the head of the mythical creature referenced in its title, has a spherical array of nine cameras -- five electro-optical and four infrared -- emerging from the underbelly of its platform. Its software compiles the various camera views into a broad, continuous mosaic, of which personnel on the ground or elsewhere can simultaneously grab slices -- its analytical requirements farmed-out, in real time, to a network of analysts and computing platforms.

Like the winged fusion of human, beast, and machine that is its namesake, with claws of steel, bulbous head, and large unblinking eyes, the gorgon drone is equipped with a deadly, commanding stare: it looks at you, but you cannot look back, lest you be turned to stone. Although menacing in its demeanor -- fangs bared and nostrils flared as it readies to inhale and consume -- it is understood to have protective qualities for its deployers. Heir to the symbolic apparatuses of myth, its figures are everywhere present on objects, documents, ideologies, and units of value exchange, manifesting hopes of warding off evil. Its potential for domestic protection is not lost on the U.S. Departments of Defense and Homeland Security, who are exploring its panoptic potential for border security: Gorgons now joining the cavalcades of machine beasts flying high over the desert borderland, with no illegal activity going unchecked, be it immigration, drug trafficking, or the very flows of terror.

The technology is not without its substantial problems. While it may "see" over a wider swath of territory, it does not necessarily understand the significance of what moves within it. The challenge remains that of tracking vehicles, objects, and humans on the ground with a higher degree of precision, in ways that lessen the demands on human personnel. The challenge with UAS in general is to amplify the overall intelligence of the system -- heightening the level of skill and expertise that the affiliation can engender. This often takes the form of enhancing the capacity of tracking and search algorithms, along with the network processing capability required to parse and coordinate the data. It involves increasing the ability of UAVs to sense, reason, learn, and make decisions, and to collaborate and communicate, with a minimal degree of direct human involvement.

In popular terminology, this is called automation or autonomy. When approached within the terms of the "salvage operation," however, where agency is situated in shared composites of intelligence and skill -- affiliations among all manner of actors operating at various scales, magnitudes, and degrees of complexity, whether at the level of hardware, software, flight crews, or institutions -- these discourses of autonomy are resisted. The unmanned system does not eliminate the human so much as redistribute the agencies of warfare. The capacities of sensing, dispatching, analyzing, and alerting -- the intelligence and skill required to interpret and store information and act on the results -- are shared by an affiliation of actors, however algorithmic, organic, or systemic. The focus is on their performative practices within the functional organization of the system. It is a matter of how they are maintained as dynamically stable entities -- sustained, naturalized, and rendered discrete -- and the programs through which this is accomplished.

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Image analytics software is used for the recognition of objects, vehicles, and people. Even the most rudimentary drones, such as the Orbiter, have some form of algorithmic tracking, even if it is only basic motion detection. The software takes input from cameras, then recognizes and identifies the objects in each frame to learn what activity normally takes place within the area under observation. With the norm firmly in place, the software then aims to detect activity that deviates from it: the exceptional occurrence that stands out from the domain of the ordinary. Algorithms screen out non-critical movement activity and foreground the critical, in order to maximize the attention spans of observing experts. Once alerted to aberrant movement activity, its nature and intent is to be inferred by these experts, who then decide what action to take.

The norm is based on the practiced rhythms and regularities embedded in everyday space -- the patterns inscribed in the timespaces and infrastructures of observed populations through travel routines, social habits, building configurations, and communication forms, as these are aligned with the rhythms and regularities of the observing institutions of the UAS, cohering through flight patterns, transport timetables, interchanges, regulations, monitoring systems, base locales, and operating habits. It is a calibration among systems and data derived from both the object of observation and the observing institution itself -- the stabilization of dynamic fields that have been limited and brought into correspondence with each other. The UAS learns the everyday norm as it co-constitutes it. Embedded regularities coalesce in the "air" and on the "ground": embodied practices respond to the regularities that they help sculpt, in ways that can further stabilize or destabilize their defining platforms and programs.

It is always a question of the priorities that come into play: the patterns and flows that are deemed most appropriate to the circumstances, as they are stabilized and maintained in practices. Some aspects of practices, prioritized as such, stabilize into higher-order principles, and once sufficiently stabilized, they replicate, become redundant and standardize, at various scales, across various platforms of endeavor. The endure as programs -- dynamic sites of social negotiation and organization. The terms of these programs, potentially, are equal, though they are always hierarchized, however temporarily: some are more enduring, influential, and intimate than others, some more effective and relevant, in part because they have more valued affiliations. Their standards, perpetuated, set forth the terms of social negotiation, and in so doing, they compel external actors to move in accordance with these terms. Movement is affiliation, and affiliation happens in program.

The norm is constituted through the categorization and standardization of information. A logical grid is summoned on which categories are made. The phenomena that appear in algorithms and databases must pass through this logical grid: they must pass through the standardized forms of information that the system, as a whole, admits. A particular scaffold gains influence over others, and in so doing, sets forth the terms of engagement and interpretation. Things fall into place. Objects are classified according to pre-programmed definitions and specifications, and rules are established that are tailored to these objects within the observed scene. Moving phenomena are stabilized, constrained, and defined in accordance with these database associations and the programs through which they are ordered. An object is disengaged from its maintaining network and a form, atmosphere, space, or force is normalized, no longer understood in terms of these operations.

The normalization of activity is what makes possible the detection of abnormal movement -- an *event*. An actor is taken up within the arena of attention as an exception because that which surrounds it has been standardized, regularized -- transformed into atmosphere.

Advanced-stage UAVs now incorporate cognitive architectures and machine learning capabilities that allow them to recognize and identify objects with a more complex and integrated capacity of expertise. The parameters for the algorithms to recognize behavior or objects need not be set in advance. A learning engine gathers information about dominant object content -- tracking, for each object, features like size, color, reflectivity, sheen, shape, and level of autonomy -- and forges object classifications without any pre-programmed definitions or specifications. The software analyzes the scene to learn and identify normal and anomalous behaviors by way of a constant study of the types of objects that exhibit those behaviors. It learns from experience, internally adapting to changes in the observed environment, detecting and classifying activity that was not previously defined or anticipated.

Drones like Teranis, developed by the British firm BAE -- among the world's largest military contractors -- combine these cognitive analytics with vehicle control systems. Integrated flight control systems are already in use with the Global Hawk, which, after its launch, carries out a pre-programmed mission by downloading GPS coordinates via satellite. However BAE has developed a comprehensive mission-handling system that combines image analytics with flight control. Its MANTIS and HERTI drones are said not only to fly themselves, but to conduct target searches on their own -- reducing the risk of human distraction and error as well as communications and data link requirements between the vehicle and the ground.

Lockheed Martin's Polecat drone was also said to be a fully autonomous system. Its prototype, however, crashed upon its unveiling. It plunged into a Nevada test range after a failure in the ground equipment caused its automatic, fail-safe flight termination mode to activate. The fail-safe mode is intended to minimize danger to civilians should the plane deviate irrecoverably outside its range boundaries. It is designed to prevent human operators from recovering control of the UAV. Perhaps the true meaning of an autonomous system can only be achieved in such a state of complete and utter relinquishment. Rendered powerless, the operators could only watch as the drone plummeted to earth.

The tailless, 90-foot wing-long Polecat looks like something straight out of science fiction. Had it not crashed -- as did its predecessor, the ominously named Dark Star -- it could have well been the flagship of advanced drone lust. Its material constitution was exemplary. It was built of composite materials rather than metal. It was comprised of less than 200 parts, many of which were built in rapid prototyping. The digital models of these component parts were produced with a computer-aided design system and output to a 3D printer, inside of which two powerful laser beams, steered by a computer, were finely focussed at a composite powder -- sintering it, layer by layer, to form complex, solid volumes. Until now, this technique was only used in the industry to make test parts, to assess their adequacy for the final job; the strength of parts produced in this way has improved to such an extent that this intermediate stage is not necessary. A wing strut, formerly only a prototype, becomes the real thing.

These 200 component parts were not riveted together but glued with adhesive. When the Polecat slammed to the ground, its identity abstracted in a burst of composite materials, electronics, sensors, and smoke, the original contours of these component parts would not have been visible. They were, in any case, only provisionally-stabilized platforms in a larger process -- one whose origin might just as well be located in composite powders or programs. Like all parts they coalesce as affiliations at various scales, magnitudes, and spans of endurance, their geometries abstracted and opened in the advent of their collision with other affiliations of more solidity, permanence, and force. Offered up anew in a spray of oil and dirt, burnt rubber and wire, recovery logistics and salvage discourse, their negotiations and consolidations continue.

Lockheed Martin did not divulge whether the source of the crash was human error or technological malfunction. The company did however attest to the reliability of the flight termination software, which according to them, performed exactly as expected.