



ECOLOGIES OF EMPIRE: On the New Uses of the Honeybee

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The state of the honeybee is dismal. A considerable decline in honeybee populations began even before the latest reports of “colony collapse disorder” (van Engelsdorp and Meixner 2010). In 2006, the number of hives in the United States stood at approximately 2.4 million, less than half of what it was in 1950 (Cox-Foster and van Engelsdorp 2009). Global environmental changes, including the intensification of industrial agriculture, toxic pollution, climate change, loss of habitat, and disease, have been devastating. But the most recent trouble came in 2006 and 2007, when almost 40 percent of honeybees in the United States disappeared and millions of hives around the world were lost (Cox-Foster and van Engelsdorp 2009; van Engelsdorp et al. 2009). That drop in honeybee populations eclipsed all previous mass mortality in the bee world, making it the worst recorded crisis in the multimillennial history of beekeeping. There is still no consensus about the reason for this decline.

The consequences of colony collapse are serious. Aside from honey and beeswax, over one-third of current global agriculture production depends on the honeybee for pollination (Cox-Foster and van Engelsdorp 2009). The U.S. Department of Homeland Security, enacting a Presidential Directive to defend the agriculture and food system against terrorist attacks and other emergencies, has put the collapse of bee populations on its agenda.¹ In response to the crisis, geneticists are combing through the newly mapped bee genome, insect pathologists are trying to isolate a viral culprit, toxicologists are tracing chemical residues, and bacterial entomologists are scouring the intestines of sick bees. Few researchers, however,

are systematically situating the crisis, whatever its cause, within historical, political, and economic relationships between bees and humans. It is not enough to ask, "What is happening to the bee to cause this crisis?" Instead, there is a more fundamental question: How has the changing relationship between bees and humans brought the modern bee into existence in a way that has made it vulnerable to new threats?²

This question demands attention to entangled histories of humans and bees and to current remakings of the modern honeybee.³ It also requires an epidemiology mindful of how human interests, fears, and desires have become part of the material form of the bee. This remaking is not just symbolic. The bee has experienced transformations to its exoskeleton, its nervous system, its digestive tract, and its collective social behavior. There are many sites (from federal laboratories to the backyards of beekeepers), as well as many pressures (from industrial agriculture to global climate changes), involved in the remaking of the bee.

In the last century, beehives have been designed for easy observation and manipulation by beekeepers and for transportation on the back of semitrucks to serve as pollinators at sites separated by thousands of miles. The social organization of bee colonies has been transformed, with fewer guard bees, a shortened or nonexistent hibernation season, and a modified, larger-sized prefab wax comb (Kritsky 2010; Stephen 1969). The bodies of individual workers have changed color from black to yellow, become almost one-third larger in size, and sport more hair. Bees now have a reshaped digestive tract and an exoskeleton almost twice as thick as those of their ancestors just a hundred years ago (Michener 1974; Winston 1987). Workers are more docile than they once were and have a life span shortened by 15 percent (Preston 2006; Stephen 1969).

This essay explores how ecological legacies and practices of empire have come to bear on the honeybee in the 21st century. It examines how the bee has been remade as a military technology and strategic resource for the battlefield. Bees have become more "human," in that human sentiments and interests have become inscribed in the bee's physical and social life. Humans are making bees into sensory prostheses that embody military interests.

I first came across bees in a defense industrial context while working on forest politics around Los Alamos National Laboratory (see Kosek 2006). I met researchers using the honeybee to map plutonium in the landscapes of northern New Mexico. Since then, I have followed the honeybee through the labyrinth of the military-industrial complex. Deploying the tactics of multisited and multispecies ethnography (Kirksey and Helmreich this volume; Marcus 1995), I encountered bioengineers at national laboratories who train bees, military strategists at private

think tanks who talk about bee social behavior, mathematicians who write equations to describe bee swarming, and private military contractors developing new technologies more generally for modern warfare. There were limits on where I could go and what documents I could see because of intensified security surrounding these bee lovers post-9/11. At the same time, most of the people I interviewed were open with me about their fascination with bees, enlisting me into their excitement about the possibilities of new honeybee research.

There are questions of method at the heart of these issues, some of which begin in my own practice as a beekeeper in Berkeley. I look, listen, and taste to come to know how bee behaviors have been structured by histories of beekeeping—from hives designed as “factories” to facilitate honey production, to prefabricated combs used to change the size of bees. I watch how queens move, how guard bees take turns at their posts, how nurse bees wait their turns, how drones are thrown out of the hive to die at the end of the year. I mark individual bees and follow their movements, recording their relation to others. My behavioral studies are oriented neither to discerning the nature of bees in general nor even of the specific bees in this hive. Nor do I attempt to speak for bees by constructing what Bruno Latour calls a “speech prosthesis,” which would “allow nonhumans to participate in the discussions of humans, when humans become perplexed about the participation of new entities in collective life” (2004:67). Derrida (1976) and Spivak (1988) are too much a part of my own formation to want to return to the politically anemic posture of the colonial ethnographer of the Other. Instead, I look for behaviors that do not fit the norms of bee behavior described by entomologists and military planners who work with and on bees. One of my hives has multiple queens, others have kept their drones over winter, and some bees do not follow the work patterns that are supposed to define the hive. Swarming, a form of collective action that has been recently appropriated by Pentagon strategists, is the way honeybee colonies move into a new nest. In my experience, swarms are often gentle, sometimes confused. I have even seen a swarm return to a hive that it previously left—a collective behavior that is not supposed to happen.

Insights gleaned from watching honeybee interactions have helped me map the changing contours of apiary ecology under U.S. empire. Most U.S. politicians, of course, avoid the language of imperialism. Even so, under the George W. Bush administration, some officials began to slip: “We’re an Empire now,” said one senior Bush administration official, “and when we act, we create our own reality. And while you’re studying that reality—judiciously as you do—we will act again, creating other new realities, which you can study too. That is how

things will sort out. We are history's actors . . . and you, all of you, will be left to study what we do."⁴ Efforts of empire building, although often hidden, have clearly been consequential to different ecologies and species; some are transformed while others are destroyed—through bombings, depleted uranium, landmines, or massive infrastructure development. But more than simply being influenced by these political transformations, species and ecologies are integrated into empire building itself. Material ecologies take the form of political aspirations and serve imperial efforts in ways that transform ecologies and species. It is this integration of ecology into new forms of empire building that I am interested in here. The honeybee dwells in a shifting biopolitical terrain, where nature and culture are being refigured, where humans and nonhumans are being remade by discourses and material practices in the war on terror.³ Many scholars have maintained that the politics of nature and the human–nonhuman divide are central to the war on terror (see Asad 2007; Butler 2006, 2009; Devji 2009; Gregory 2004). This essay draws from literature on the cultural politics of nature, as well as from science and technology studies, to understand emerging insectoid forms of warfare under the Bush and Barack H. Obama administrations.

BEES IN WAR, FROM ANTIQUITY TO THE WAR ON TERROR

There is a long history of writing on insects, both as models and as metaphors for human sociality, morality, and politics. From fighting ants to racialized lice to industrious bees, the size, sociality, and ubiquitous presence of insects has made them a source and site for creative and scholarly writing. There is renewed interest among anthropologists and scholars in kindred disciplines about the role insects play in human sociality (i.e., Raffles 2010; Sleight 2006). And insects are more than metaphors. Timothy Mitchell's (2002) "Can the Mosquito Speak?" explores the consequential materiality of the mosquito in social and landscape transformation in Egypt. Joseph Masco (2004) analyzes how the monstrous radioactively mutated ants of the cold war movie *Them!* bespeak anxieties about the fate of humanity in the nuclear age. And Hugh Raffles's *Insectopedia* (2010) offers a range of explorations of the complex and intimate relationships between humans and insects. If animals are human Others, insects are the Others of animals, intimately involved in our lives but much maligned. Insects are powerful sites and sources for the production of human nature.

The environs of insects are also an intimate part of changing ecologies of empire. Much has been written about green imperialism (Crosby 1986; Grove 1995). Scholars have traced how colonial endeavors have transformed landscapes, how

gardens serve as spatial and taxonomic representations of race, hierarchy, and territorial ambitions (Mukerji 1997) and form the basis of nature governance (Drayton 2000; Matless 1998) through imperial practices of the science of “improving” the world. Schiebinger (1993, 2004) explores these histories and rhetorics of gender, race, and empire through the science of botany, while McClintock (1995) and Stoler (2001, 2008; Cooper and Stoler 1997) demonstrate that nature is central to the violence and geography of imperial projects.

The honeybee has served as an archetype for understanding human collective society, the subject of treatises by apiarists and scientists as well as by philosophers, kings, sociologists, criminologists, physicists, and poets (Crane 1999; Preston 2006). These cultural texts of bees are often marshaled to aid in making claims about human collective behavior. These understandings in turn influence our relationship with the honeybee, whether we understand the bee as a bucolic part of nature or as a domesticated workhorse. The political, economic, and cultural histories through which bees are made intelligible are entangled with how humans breed, select, and relate to them. The frameworks humans have mobilized to understand the “races” of bees, the organization of bee labor, “gender” in bee society, or the character of hierarchy in bee worlds have been inscribed—sometimes quite materially—into bees’ biology.⁵ To treat the bee as a wild and instinct-driven object of a nature apart is to erase the political and military history of honeybees’ biology.

Bees have been used in warfare since antiquity, when hives were dropped on invading armies or launched into fortified tunnels, caves, forts, and bases. The well-documented decline in the honeybee population during the late Roman Empire is now believed to be because of their extensive use in warfare. In the 16th century, a multiarmed catapult launched hives at enemy fortresses like a windmill. The entomology and etymology of the bee are intertwined in war. The word *bombard* comes from *bombos*, which in Greek means bee, making an association between the threatening hum of an angry swarm and incoming projectiles (Lockwood 2008). In World War I, the bee became central to the war machine not as a projectile but as a source of beeswax that was used to coat almost all ammunition. As explained in a 1944 article in *Popular Science*, “How Science Made a Better Bee,” “Amazing new discoveries [new breeding technologies] bring improvement to nature’s masterpiece, enabling the busy little insect to do a better job for war” (Sinks 1944:8).

The bee is not alone among insects in serving militarized campaigns and torture. The Emir of Bukhara used beetles to eat the flesh of his prisoners (Lockwood 2008). Massive research projects took place during World War II in Germany,

Japan, Russia, and the United States, when hundreds of millions of insects were cultivated and tens of millions of beetles and mosquitoes were deployed to infest crops, soldiers, and civilians (Lockwood 2008). General Ishii Shiro released hundreds of millions of infected insects across China during World War II, causing the deaths of tens of thousands of people (Lockwood 2008). In the Korean War, U.S. airplanes dropped plague-infested fleas on North Korea and later used mosquitoes, wasps, and bees as part of torture techniques against the Vietcong in Vietnam. The Cold War also saw crop-eating beetles dropped on Vietnam, North Korea, and Cuba, along the way fostering research that transformed modern entomology (Lockwood 2008; Tucker and Edmund 2004). In the war on terror, the Bush administration approved the practice of placing bees and spiders in confinement boxes as part of the torture of U.S. detainee Abu Zubaydah (Scherer 2009).⁶

Anthropologists have long investigated how the science and practice of ecology became intertwined in broader questions of cultural politics of nature and difference (Moore et al. 2003; Comaroff and Comaroff 2001). These works call attention to the connection between ecologies and empire primarily in the 18th and 19th centuries. In this essay, I place such works in dialogue with other studies that have attended to the political economy behind the production of living organisms (Franklin 2007; Haraway 1989, 1991; Schrepfer and Scranton 2004; Vivanco 2001; Zylinska 2009).

If insects have long been recruited and bred for military purposes, the honeybee has now been enlisted in novel modes of material production in war. The amorphous character of the war on terror requires its own way of seeing and producing knowledge about an enemy that is difficult to identify (Rumsfeld 2001a). The enemy's lack of coherence—institutionally, ideologically, and territorially—makes the search for the enemy central to the politics of the war on terror, both in maintaining that there is an enemy and in demonstrating the connections, coherence, and intention of the terrorists. This has produced the possibility that terrorists are anywhere, making anyone a potential target or suspect. Objects themselves take on the possibility of being implicated in terrorism: a lost piece of luggage; an oddly parked van; a suspicious looking individual.⁷

How then to discern the intent of individuals, animals, and objects? We must know them, see beyond them, look inside them, and listen past what they claim for something inside, something more deeply hidden. As U.S. Secretary of Defense Donald Rumsfeld stated, "The war on terror requires new technologies of warfare but even more importantly new technologies of surveillance" (2001a). U.S. intelligence agencies made humans and nonhumans speak (cf. Latour 2004). Intelligence

gathering was not just limited to psychologists, sociologists, lawyers, and military planners, but came to include biologists, anthropologists, epidemiologists, and even entomologists.⁸

Rather than being used simply as weapons of war, bees have become involved in the search for what is beyond the reach of human senses. The behavior and physiology of bees have become instrumental in extending the capacity of the human senses. Bees have become *zoosensors* (cf. Connor 2005). The deployment of bees, or what military scientists call “six-legged soldiers” (Lockwood 2008), has resulted in new and intimate relationships. Experts have inscribed economic and military designs into the honeybee’s nervous system, migration patterns, and community relations. There is a new bee managerialism. The capacities of bees for detection and intelligence gathering have been harnessed. As Homeland Security states, they are “deploying bees as efficient and effective homeland security detective devices.”⁹

REMAKING BEES AT THE NATIONAL LABS

Apiary entomologist Jerry Bromensenk traces the use of bees as “micro sensor technologies” to ecologists’ fears about the health effects of pollution on honeybees. Toxicologists and environmental scientists began using these insects as “bio-monitors” for all kinds of toxic materials.¹⁰ Bromensenk realized that the sensitivity, social behaviors, and ecology of the honeybee could—as he explained to me—be an “apiary revolution . . . an incalculable boon for eco-toxicologists” (Interview, Jerry Bromensenk, 2009). Others from the Stealthy Insect Sensor Project Team at Los Alamos National Laboratory have begun to explore the potential for bees to be weapons detection devices. A few bioengineers at Sandia National Laboratory picked up on Bromensenk’s enthusiasm and have begun to use honeybees to monitor contaminated sites around Los Alamos, where the radioactive legacy of the Cold War will emanate for millennia to come.

During a series of interviews at Los Alamos and Sandia National Laboratories with scientists involved in biomonitoring, I stood with Paul Fresquez, director of the environmental sciences monitoring group at Los Alamos. As we watched bees flying back and forth over the 16-foot barbed security fences of Los Alamos’s top-secret areas, he told me: “You can simply place a hive in an area that you are worried is contaminated and the bees, thousands of them, will do field samples, literally hundreds a day, of almost any pollinating plant within two miles of the hive without disturbing anything.” He explained that traces of radionuclides, many of which are structurally similar to the calcium that plants take from the soil, are

detectible in flower pollen and nectar from contaminated sites (see also Masco 2004, 2006). Honey made by bees from these contaminated flowers can be tested for the presence and concentration of tritium and strontium-90. Honeybee bodies also have small-branched hairs with a static charge, causing them to attract chemical and biological particles, including a diversity of pollutants, biological warfare agents, and diverse explosives (interview, P. R. Fresquez, October 3, 2004). They also inhale air and water for evaporative cooling of the hive. Bees, thus, sample air, soil, water, and vegetation as well as diverse chemical forms of gaseous, liquid, and particulate matter. If a hive is well placed, it helps the Stealthy Insect Sensor Project Team produce very accurate gradient maps showing the distribution of radioactive materials and other toxic contaminants (see Bromenshenk et al. 2003).¹¹

Bees were used as environmental monitors by ecologists in the monitoring of toxic mining and radioactive sites for almost a decade before Los Alamos scientists considered their applications in espionage. After years of failing to develop mechanistic means for detecting chemical explosives through their scent, many researchers turned to animals for this work. Part of the program was funded by the Defense Advanced Research Project Agency's (DARPA's) Controlled Biological and Biomimetic Systems Program for work at Los Alamos, Sandia National Laboratory, and other research sites. Hives were eventually deployed around the world to test areas suspected to contain nuclear material, according to one anonymous source in the Stealthy Insect Sensor Project Team whom I interviewed in 2006.

I should say that the interviews I conducted in and around Los Alamos, Sandia, and elsewhere were difficult. Several people changed their minds about meeting me, and most meetings took place away from the laboratories. This material is not highly classified, but some researchers felt sensitive about it or about their involvement. Still, I found a wealth of material in openly published documents and scholarly journals. I found some researchers who were keen to create broader interest outside the lab in the scientific community. Such interest would legitimate their research and lay the groundwork for more funding from DARPA, but it would also open up new avenues for public-private partnerships on nonclassified material. So, in coffee shops and cheap restaurants, we discussed bee biology and behavior and the new uses of bees.

Some scientists directed me to publications about DARPA-funded research to train free-flying bees to detect certain scents—of landmines, for example—by placing traces of the explosive chemicals near food sources (Bromenshenk et al. 2003; interview, Robert Wingo, May 16, 2008). Bees associate the scent of the mine with food, and when placed in a minefield will fly patterns around the mines.

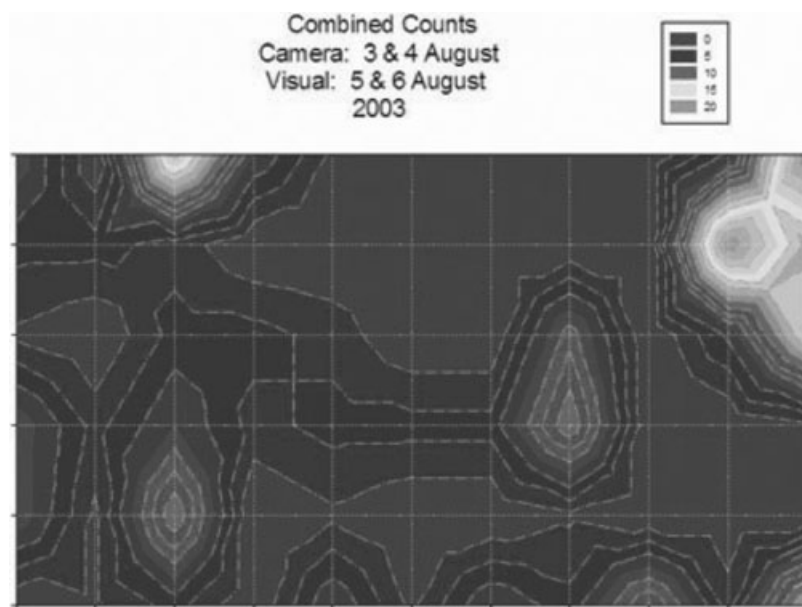


FIGURE 1. A map of landmines generated by the flight patterns of trained honeybees.

Bees are tagged using infrared technology and their flight patterns are recorded to create a map of the areas they have traveled (see Figure 1). Bees' foraging behavior is not completely changed but their purpose is redirected toward foraging for landmines rather than food (German 2002:1–3). I heard about plans to deploy bees on the front lines in active theaters of war—to map the large number of mines in northern Afghanistan (Hanson 2006). But, as this article goes to press, honeybees have not yet been deployed alongside legions of dogs who work alongside U.S. soldiers to detect mines in the Middle East.

Bees have almost as many olfactory receptors as dogs. With upward of 50,000 individuals per hive they have an ability to cover a greater area than canines. They need less attention than a dog and only a fraction of the time in training (interview, Kirsten McCabe and Robert Wingo with the LANL insect sensor project team, May 2008). Like dogs, bees have a large number of chemoreceptors that recognize signals identifying kin, as well as pheromones that enable social communication within the hive. The receptors also detect external food sources and other chemical agents. Each antenna is covered with thousands of separate individual receptors, and with paired antennae bees can very quickly determine the direction and intensity of an odor. Moreover, their ability to detect suites of chemicals, including those most common in various sorts of landmines (such as 2,4-DNT, TNT, 2,6 DNT,



FIGURE 2. Bees are trained at Sandia National labs to associate chemicals with food source.

and RDX) in concentrations as low as 50–70 parts per trillion, has made them, in Bromenshenk’s words, “indispensable agents for future chemical and biological warfare detection teams” (interview, Jerry J. Bromenshenk, January 12, 2009). (See Figure 2.)

Deploying bees to the battlefield, however, has presented problems for scientists at Los Alamos: As one member of the Stealthy Insect Sensor Project team pointed out,

it turns out bees have minds of their own, and that they can be delinquent from their training, for while they are easily reined in some respects, they do not always do as they are told. . . . We would like to be able to get bees to fly right past an apple bloom to the explosive or human target every time, but this would require more intensive training or more intensive intervention into the bio-physiology and genetics of the bee than we have yet been able to do. [interview, Kirsten McCabe, May 16, 2008]

Training bees to fly past flowers would involve feeding them entirely in the lab, never bringing them into contact with living plants outside. Even in those

conditions, though, bees do not always behave as they are taught, and only some bees are consistently trainable. In complicated conditions, where there are a lot of other “distractions,” such as the “instinctive behaviors for feeding and mating as well as responses to temperature changes” (interview, Robert Wingo, 2008). It is even harder for the bees to do detection work in these settings. The collective bee is less controllable and reliable than researchers would like. In some cases laboratories keep hives in small tentlike structures and never let bees out; in other cases, greenhouses an acre in size are set up to control nonexperimental variables of the bees’ habitat. This is why dogs (and other mammals like pouch rats) are currently the primary animals detecting chemical explosives for U.S. forces in the Middle East, and the honeybee remains a zoosensor of the future.

Bromenshenk, along with collaborators from intelligence agencies, has begun to explore new leads. The research team has focused training efforts on a specific response of individual bees. Bees are placed in individual Styrofoam cells, taped in place, and then, over a period of a few days or even a few hours, given the scent of whatever chemical a researcher wants them to identify with food. They learn, in a way that would make Pavlov proud, to stick their tongues out when they smell the scent of the chemical. The bees that do this reliably are placed in a cartridge and inserted into a machine. This gives the researchers a computer readout—both magnifying and graphing the bees’ response (see Figure 3). When bees stick out their tongues in this cyborg assemblage, their motion becomes an interspecies signal. Computers translate this signal into an alarm or flashing message on a screen identifying a chemical, a bomb, or a biological agent. With military grade TNT, this tongue response is 99 percent accurate. The trained bees last a few days to a few weeks. Then a new replacement cartridge is shipped, and “like a razor, you simply slip out one cartridge and replace it with another” (interview, Anonymous, June 13, 2006). (See Figures 3–5.)

When I asked two researchers from the Stealthy Insect Sensory Project about their relationships with bees, they looked at each other and smiled. One said, “I think they are okay, but she hates them.” In fact, the other scientist, a biochemist, readily admitted, “I am interested in the chemistry and mechanism of sensory detection, I hate working in confinement with bees—they give me the creeps.” I was not able to meet with all the members of this team, but none I spoke to seemed enamored with the insect itself or, for that matter, troubled by its incorporation into military technologies. Contrast them with Konrad Von Frisch, a 20th-century naturalist, who felt deep love for the bee even as he mutilated it for science. Von Frisch



FIGURE 3. Bees are fully individuated and placed in cells to be trained to be part of chemical detecting devices.

would lovingly (with another love), painstakingly (with professional patience) and delicately (with such safe hands) snip their antennae, clip their wings, slice their torsos, shave their eye bristles, glue weight to their thoraxes . . . manipulating their behavior according to the experiments' requirement, reconciling his will to structure the yawning gap that separated human from insect with his unspoken assertion of a natural sovereign power. [Raffles 2010:173]

For members of the Stealthy Insect Sensory Project, the bee was simply a mechanical device, and the project viewed more as an engineering problem than an instance of intimate interspecies interaction.

At other sites a biomechanical relationship with the bees is taken even further. I learned of a bioengineering project to insert new technologies into bees at the larval stage. This DARPA project aims at developing tightly coupled machine–insect interfaces by placing micromechanical systems inside insects during early stages of metamorphosis, with the aim of controlling insect locomotion (interview, Amit Lal, 2006).¹² In theory, if these bio+electromechanical interfaces are placed early enough in insect larvae, they will be able to fuse with the technology. This interface would allow humans to control insect behaviors and motion trajectories



FIGURE 4. Bees are inserted into cartridge to be placed in monitoring apparatus to detect chemical traces.



FIGURE 5. Bees extending their proboscis to signal the presence of a chemical trace.

via specialized GPS units along with optical or ultrasonic signals. Control can happen through direct electrical muscle excitation, electrical stimulus of neurons, and projection of pheromones (Johnson 2007).¹³ Many of these insects, whose nerves have grown into internal silicon chips, are becoming biotechnical cameras of sorts, bringing command–control–intelligence functions and the God’s eye

trick into new domains (cf. Haraway 1991). DARPA researchers are also raising cyborg beetles, powered by energy harvested from the insect itself, to drive various electronic devices (Zerner et al. in press).

After looking at DARPA's published material, I found myself skeptical of the likelihood that these attempts to create and control cyborg insects would actually come to fruition. My interviews with DARPA-funded scientists, including Wingo, Bromenshenk, Tim Haarmann (interview, May 17, 2009), McCabe, and others at Los Alamos, revealed complex relationships between technology and biological physiology—relationships more complex than DARPA's published material would have you believe. It is easy to fall into a kind of techno-conspiracy theory formulation that overstates efforts to control insect natures through intimate reworkings of technology and the physiology of bees. But it is also true that a great deal of money is dedicated to just such efforts at total control. Most is classified. Moreover, some of the successes that Charles Zerner and Masco have documented elsewhere make clear that even if insect biology is less mechanical than is popularly understood, such transformations and manipulations of insects' physical and social architecture should not be quickly disregarded as science fiction (Masco 2006; Zerner et al. in press).¹⁴

The modern bee is already a historical product of breeding, selection, and behavior modification that has also been employed to naturalize agribusiness interests, race relations, and policies about immigration. New uses of the honeybee reflect a different engagement, one that uses these animals not as weapons but as technologies of intelligence. Honeybees form part of a growing militarized ecology in which new relationships and new forms of both insects and humans are being made. Bees are becoming more human, in that human sentiments become part of the bee and humans come to know the world in part through the bee, although in a particularly militarized form.

SWARMS

The Animalization of Military Strategy and Tactics

The war on terror, we are told, is a very different type of war, and the language shifts into defining a new type of enemy and an appropriate response. As Bush put it, it is a war without "front lines," without a "definable territory," without a singular ideologically definable group, and without a "nation-state." The enemy has crossed the lines of civilized engagement and, as such, necessitates a new type of surveillance and response. As Rumsfeld states, "The nature of our response needs to be directly related to the nature of the terrorist threat" (2001a).

There is a parallel analysis made on the battlefield related to terrorist strategy: "Terrorists" will not fight by the rules of ethical warfare, which further confirms their uncivilized status and requires, as I show, a kind of animal mimicry to combat.

One new operational, strategic, and tactical approach to the war on terror draws on the logic of "swarming." There are many forms of the swarm, but the most often cited in military strategy are those of the ant and bee. For example, John Arquilla—an early proponent of swarming in the Department of Defense (DOD) analysis, an adviser to many generals, and a chief military adviser to Rumsfeld—wrote in his famous RAND Corporation study, *Swarming and the Future of Conflict*, that swarming needs to replace the AirLand Battle doctrine that has been the conceptual framework for the U.S. Army's European war fighting policy from 1982 up to the shock and awe techniques of the Iraq War. AirLand Battle emphasized close coordination between aggressively maneuvering land forces and air forces attacking frontline enemy forces. Swarming, as Arquilla and others define it, decentralizes force operations in a way that values mobility, unit autonomy, and continuous and synchronized real-time communication. Swarming entails the "systematic pulsing of force or fire by dispersed, interknitted units, so as to strike the adversary from all directions simultaneously" (Arquilla and Ronsedlt 2002:23).

Sean Edwards, another RAND Corporation researcher, explains that "swarms are complex adaptive systems, but have no central planning, simple individual rules, and non deterministic behaviors that evolve with the specific situation" (Arquilla and Ronsedlt 2002:32). Arquilla told a Congressional hearing that the war on terror is driven by an "organizational race" to build networks and swarms. Flexible, adaptive, collective responses, according to Arquilla, are at the heart of future military struggles (Arquilla 2008). Swarm strategies were outlined by the U.S. Joint Forces Command in 2003 and are expected to be fully operational in the war on terror by 2012.

These strategies are explicit in their use of bees and ants as models. As Deleuze and Guattari point out, "War contains zoological consequences. . . . It is in war, famine, and epidemics that werewolves and vampires proliferate. Any animal can be swept up in these packs and the corresponding becomings. . . . That is why the distinction we must make is less between kinds of animals than between the different states according to which they are integrated into . . . war machines" (Deleuze and Guattari 1980:243).¹⁵ Here, the animal is transformed through its integration into battlefields, becoming part human, part animal (werewolves and vampire), as both animal and human are remade and integrated into novel assemblages.¹⁶

Here, human nature is forged in the domain of the nonhuman, or more accurately, through interspecies relationships (cf. Haraway 1989, 2008; Kirksey and Helmreich this issue; Moore et al. 2003; Tsing in press; Wolfe 2003). Military understandings of the swarm are not solely metaphoric but made intelligible through specific understandings of animals that are then used to make possible new assemblages of people and animals, new forms of social relations, and new technologies.

Such understandings of the swarm are taken up in diverse ways in times of war. For Hardt and Negri, the swarm holds the promise of a radical new form of political organization: "In the swarm model suggested by animal societies . . . we see emerging new networks of political organizations . . . composed of a multitude of different creative agents" (2004:92). At the same time Eyal Weizman, in his exploration of Israel's military strategy and architecture of occupation, notes that the swarm, both as a model taken from bee behavior and, ironically, as part of critical theory (Gilles Deleuze, Felix Guattari, Baruch Spinoza, Guy Debord, Elias Canetti, etc.), has found a place to flourish within the modern militarized state (Weizman 2007).

What interests me more than these rhetorical deployments, however, is the incorporation of the bee not as abstract metaphor but as the behavioral basis for modeling military strategy. As defense analyst Arquilla told congressional representatives,

Swarming appears in the animal kingdom long before it did in human affairs. . . . As the name suggests, the concept of swarming comes from the nature of insect behavior, and many of these behaviors are directly applicable to military strategic and tactical operations . . . [Swarms of] bees and ants employ blanketing tactics when foraging outside the hive—striking their adversaries or prey from all directions. The goal is to overwhelm any cohesive defenses that might be mustered. Although these insects often move in linear formations, they are quite adept at shifting into a swarming mode at any point of engagement. [Arquilla and Ronsedt 2002:21]

Biological descriptions of the social and collective behavior of bees and ants serve as the foundational model for human strategies of war: sociobiology meets military planning. Arquilla and other military planners draw directly from the behaviors of insects as well as from entomologists and animal behaviorists, such as E. O. Wilson, to make sense of and generate new ways of organizing human behavior. Some researchers map patterns of swarm movement mathematically, others more

conceptually, but the insect is part of the constitution of this strategy of war not simply as metaphor but as model (Arquilla and Ronsedt 2002; Booker 2005; Edwards 2000).

French entomologist Pierre-Paul Grasse's 1950s work on bees and wasps has also been resurrected. These days, Grasse is commonly cited in military strategy, particularly his notion of lattice swarm behavior, or what he called "stigmergy," in which bees and wasps build complex structures by taking their clues from the structure and behavior of their neighbors. As the hive is built, bees observe its current state and change their behavior accordingly to build the next piece. As MITRE, a private military research corporation, explains:

An individual agent has a repertoire of actions it can use to move through this space and modify the environment. An agent's sensors detect information derived from local properties of the agent's current position in the lattice and the positions directly adjacent to it. Since each agent has only a local view of the overall activity of the swarm, some additional mechanisms of communication are available to coordinate the collective behavior of the swarm. [Booker 2005]

Drones

Bees are also operative in other ways in contemporary military strategy. Building on initiatives started under Bush, the Obama administration is employing an emergent form of behavior modeling based on bees. This is most visible in the targeted assassination of "terrorist" leaders through the use of aerial drones. In 2001, there were about 50 drones operated by the U.S. government; now there are over 250, and this only includes those of the U.S. Army. The CIA has reportedly grown its numbers of drones but will not disclose exact numbers (Mayer 2009). Regardless, in the words of Leon Panetta, director of the CIA, they are "the only game in town" in the war on terror and widely considered by the intelligence community to be "the single most effective weapon against Al Qaeda" (Mayer 2009). Drones have also led to more "collateral damage" than ever before, according to Jane Mayer (2009), and are largely responsible for doubling the number of civilian deaths in 2009. As targets and potential threats to U.S. interests are identified from thousands of feet in the air there are many civilian casualties and distributed effects of bombings. According to recent media reports, drones have been acquired by a multitude of other nations and even nonstate actors.

Drone attacks began under Bush, but under Obama they have been promoted as technical solutions to the legal, moral, and political conundrum surrounding targeted assassinations. The Bush administration had sought to develop an assassination program run by the CIA that would have deployed small special force teams around the world, deployable without regard to sovereign territory (Scahill 2009), but political opposition limited Bush's program. As unmanned aerial vehicles (UAVs), drones have the effect of distancing the act and actor in an assassination from the killing itself. Many of the drone attacks in Afghanistan are carried out by employees of private contractors sitting at computer terminals in Nevada (Mayer 2009). This has proved much more politically and morally acceptable than the Bush administration's assassination program. Because drones are unmanned, they occupy a legal loophole and can cross sovereign territory to carry out killings. The Obama administration carried out more drone attacks in its first year (almost one bombing a week) than the Bush administration did in the last four years of its tenure (Mayer 2009).

Until recently, these drones were guided by individuals gathering information from a variety of sources in the United States and abroad, coordinating that information, making changes, and then relaying it back to the drones. But the coordinated operation of the drones has become more difficult with the increasing number in the air. Two of the most favored armed drones in Afghanistan, the Predator and Reaper, can stay in the air much longer and collect more data compared to conventional piloted vehicles, but are not able to carry large quantities of ammunition nor coordinate attacks. The first generation of drones did not fully actualize military dreams of swarming; it has been difficult for them to respond to data or intelligence quickly and collectively. John Sauter, a private contractor, told me that it was "an inefficient and laborious 20th century technological warfare practice of including humans in every aspect of technological warfare decision making." He went on to say that "a central aspect of the future of warfare technology is to get networks of machines to operate as self-synchronized war fighting units that can act as complex adaptive systems. . . . We want these machines to be fighting units that can operate as reconfigurable swarms that are less mechanical and more organic, less engineered and more grown."

Here, the bee and the entomologists return. Military planners have mined the patterns of collective cooperation that are part of social insects in general and bees in particular to coordinate and collect small bits of information that can be synchronized to make collective action by drones possible. Interestingly, the Pentagon has not turned to entomologists to learn about such behavior, but has

reached out to mathematicians developing algorithms to describe bee behavior and install such algorithms into the computers of military drones.

Such swarm algorithms use what are called “digital pheromones” that enable “robust, complex, and intelligent behaviors,” in the words of John Sauter, a principle researcher on military swarm systems.¹⁷ In insects, pheromones are secreted chemicals that trigger a social response—a chemical means of coordinating and communicating within groups. Digital pheromones used by the military encompass all sorts of sensory data and are the product of ground sensors, cameras, intelligence, satellite information, and data from other drones. Drones now can communicate information to each other directly and react to received information without going through controller-coordinated activities in real time. Instead of six controllers working six drones in a strike, one controller manages one drone and the others adapt, react, and coordinate with that drone. Pat Johnson works for the private military contractor DRS Technologies and is the leader of a 12-man team whose job is to develop “an autonomous collaboration network” for aerial drones. Johnston stated that “we have gotten drones to talk to each other so they can swarm, work in teams, exchange target information and record strikes.”¹⁸ The first coordinated swarm drone attacks took place in December 2009, in which five drones attacked alleged Taliban fighters with ten closely coordinated hellfire missiles, killing fifteen people.¹⁹

As Patric Esposito, the president of Augusta Systems, another private contractor involved in coordinated drone development, told the *Defense Industry Daily*, “swarming algorithms are driven by digital pheromone-based maps of the area in which the swarms are operating. This is mapped from the actual reasoning used by bees, which is the base model for the swarming concept.” Another private contract engineer told me in an interview, “the swarming algorithm, independent of human intervention, determines where the camera needs to look, where the UAV needs to fly and the pattern of a collective attack. It allows for autonomous operation through connectivity and imputed behavior. Drones are not smart themselves but have the capacities of the brains of a swarm . . . each drone like that of the bee is individually pretty dumb but collectively they are remarkably capable.”²⁰

Geography and technology separate individual action from technologies, enabling the U.S. military and the CIA to compromise the sovereignty of other nations in new ways. The bee helps make unmanned air vehicles more beelike, becoming more effective semiautonomous actors, distancing themselves from the human in such a way that legal and moral codes are skirted and attacks are more lethal.

Mimetic relationships are not simply about imitation or representations of the real, but simultaneously a means for the production of alterity (Taussig 1993) and distinction (Caillois 1984; and see Butler 2006). Algorithms that purport to copy the animal (the bee) are being used as the strategic answer to barbaric aggression. The bee has also become a model for understanding the behavior of human soldiers. Techniques of communication and decentered coordination offer advantages in fighting an enemy. This pattern of collective behavior has become embedded within new “autonomous” technology that itself mimics other species. Civilization’s relationship to the nature of the bee and the swarm is one of imitation and, as one military strategist put it, “of deep respect for a complex system” (Edwards 2000). These are the new zoological consequences of the war on terror’s remaking of animal–human natures and apiary ecologies.

TOWARD A POLITICAL ENTOMOLOGY

Karl Marx famously drew the line between the human and the nonhuman on the back of the bee. He wrote that “what distinguishes the worst architect from the best of bees is this, that the architect raises his structure in imagination before he erects it in reality” (Marx 1990:284). For Marx the nonhuman does not engage in planning. Ironically, in war it is this exact attribute of the bee—the absence of planning, even intentionality—that is at the heart of its usefulness in modern warfare as a flexible, decentralized, adaptive form. Here, the shifting limits of animal and human are again remade, and we reach the limits of historical materialism, where political agency is reduced to the agency of human actors.

If these nonhuman bodies matter, they matter not as agents with Marx’s intentionality or through “agency” as commonly conceived. Rather, they matter as what Jane Bennett (2010) refers to as “vibrant matter,” possessing a vitality intrinsic to materiality, which is always a human-nonhuman working assemblage. Objects and animals are not just passive stuff, or machines, or divinely infused matter, or independent actors. The concept of “vibrant matter” allows us to avoid treating objects and animals as if they are animated largely (solely) through human production (by being mixed with labor). Rather, the materiality of objects and animals can be apprehended as part of politics without being attributed an “agency” that has to do with nonhuman intentionality or a politics simply animated by human practice.

The bee is being remade, both materially and symbolically, creating a crisis in a relationship thousands of years old that has led to a dramatic drop in the populations of bees. Understanding apiary politics requires a critical natural history

of the honeybee, one attentive to the political economy of industrial agriculture, to the chemistry and molecular biology of international chemical corporations, as well as to genetic laboratories searching for the bee's "social gene" (Robinson and Ben-Shahar 2002). A critical natural history of the bee also requires attention to the instrumentation of the bee as a means of tracking and tracing the boundaries of dangerous subjects and suspect objects. These new uses of the honeybee are part of a remaking of its material body, as well as the new ecological contours of empire. These ecologies of empire matter, for they constitute the materials from which future bodies, technologies, and relationships will be forged.

What is the legacy for bees and humans in their work as technological instruments of espionage and architects of the military strategies of the United States? How might we better understand these militarized ecologies? These questions emerge as part of a larger natural history of modern warfare, a part that is woefully absent from much of the scholarly work on the cultural politics of nature and the animal. At the same time that Homeland Security officials fret about the implications of honeybee colony collapse disorder with regard to national food security, the sociality of bees has become a model for both human strategic military behavior and algorithms for technologies that make enemy human bodies more vulnerable. This vulnerability and these remakings are part of the seemingly disparate modern lives of the honeybee, even as these remakings are also the product of earlier political formations and biological materialities.

Even as bees are mutilated in the name of the war on terror, they are also enlisted to make humans killable. There is a long history of people being imagined as unloved animals in times of war: from the "lice" of Nazi Germany (Raffles 2010) to the Hutu "cockroaches" of Rwanda (Copeland 2004) to the creatures that live in the swamp of today's war on terror (Rumsfeld 2001a, 2001b; see also Rhem 2001). There is also the history of soldiers becoming animals that are seen as super human (Deleuze and Guattari 1980). In either case, these human transgressions matter (Agamben 2004; Deleuze and Guattari 1980; Weizman 2007). The nature and boundaries of the human have become a central part of the war on terror: the animal is part of the discursive terrain on which certain bodies are made killable and others are celebrated as super human. What it means to be human is a product of the shifting cartography of what it is to be animal.

Looking at the relationship between bees and humans thus reveals the far-reaching "zoological consequences" of war. Metaphors of the swarm clearly matter, but they matter most as they are materialized in the software of unmanned aerial vehicles and in breeding programs that remake modern bee exoskeletons and

digestive tracts. They also come to matter in the new practices of warfare and its consequences living beings, human and animal. A new political entomology, or more broadly, a critical natural history, might start exploring the material consequences of insectoid becomings that are often left out of political and social theory that reckons with animal becomings.

ABSTRACT

This essay examines the rise of the honeybee as a tool and metaphor in the U.S. “war on terror.” At present, the largest source of funding for apiary research comes from the U.S. military as part of efforts to remake entomology in an age of empire. This funding seeks to make new generations of bees sensitive to specific chemical traces—everything from plastic explosives, to the tritium used in nuclear weapons development, to land mines. Moreover, in an explicit attempt to redesign modern battlefield techniques, the Pentagon has returned to the form and metaphor of the “swarm” to combat what it takes to be the unpredictability of the enemy in the war on terror. At the same time, honeybee colonies are collapsing. Rethinking material assemblages of bees and humans in the war on terror, this essay moves beyond the constrained logic and limited politics of many epidemiological investigations of colony collapse. Honeybees are situated within a more expansive understanding of the role of and consequences for the animal in modern empire building.

Keywords: honeybees, war on terror, ecology, empire

NOTES

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1. This is evidenced through the major research collectives’ conferences, such as the Mid-Atlantic Apiculture Research and Extension Consortium and the American Beekeeping Federation.
2. The honeybee in modern history is so bound to industrialism, modern capitalist agricultural production, contemporary forms of breeding, and genetic manipulation that to call the bee fully nonhuman is to miss the intimacy of the relationships that have made not just the environment but the bee itself—its nerves, digestive tract, skeleton, flesh, size, behavior (individual and social), and its molecular and genetic structure. As Hackenberg told me during an interview, the bee that I work with today is not the same creature that my dad worked with and is not the bee that God made. He did not make the bee to travel 15,000 miles in a year on the back of a semi, or subsist on pesticide-laced, pollen-enriched corn paddies imported from China, and to pollinate one crop and one crop alone for weeks at a time. But what can we do? The crops need pollinating.

- We need a political geography of this modern creature, both as a means of understanding how the current crisis came about and to understand the intimate remaking of relations of the society and the environment that modern science and capitalism afford.
3. I do not mean to imply that there is a modern bee, only that bees have come to be standardized in many practices of beekeeping. It is the ideal type imagined through these standardized processes that I refer to when I speak of "the modern bee."
 4. This quote is from Pulitzer Prize-winning author Ron Suskind who was asked to meet with senior advisers to President Bush in 2002, after writing a not-so-kind review of Bush's policies. In the meeting, one of the advisers said that Suskind was "lost in what we call a reality-based community," which he defined as "people who believe that solutions emerge from your judicious study of discernable reality." Suskind, taken aback, murmured something about empiricism, but was cut off when the aide launched into this quote about Empire (Suskind 2004).
 5. Bees are most commonly called races, not species. Debates about sex and race and the politics of bees goes back at least as far as Charles Butler's 1634 volume, *Feminine Monarchi or the History of Bees*.
 6. The legal memorandum for the CIA, prepared by Assistant Attorney General Jay Bybee, reviewed ten "enhanced interrogation techniques" for interrogating Abu Zubaydah and determined that none of them constituted torture under U.S. criminal law. See Scherer 2009.
 7. For a treatment of the changing notions of security see the virtual issue of *Cultural Anthropology* on Security. <http://www.culanth.org/?q=node/258/>, accessed August 1, 2010.
 8. For anthropology, see, for example, King 2009.
 9. Interview with the Stealthy Insect Sensor Project Team at Los Alamos National Laboratory, Los Alamos, NM, May 2006. There is a deep irony here, for thinkers from Aristotle to Marx to Heidegger to Geertz, as well many others, have turned explicitly to the bee as a social being with a complex society to explore the similarities between humans and bees. All have ultimately delineated the human from the bee with recourse to the human ability to think. After centuries of philosophical work that differentiates the animal from the human based on the bee's lack of intelligence, the bee is now employed as an agent of intelligence gathering.
 10. These original observations were tested in a much larger way after the Chernobyl disaster. For the original article in *Science*, see Bromenshenk and colleagues 1995.
 11. The Stealthy Insect Sensor Project was initially funded largely by DARPA but later began to draw from internal funding sources at Los Alamos.
 12. From interview with Dr. Amit Lal. Also see DARPA micro systems technology office program descriptions.
 13. This may appear as pure fantasy and it is not clear to what extent this has been achieved in classified research. However, unclassified research has taken impressive leaps, such as the Radio Control Cyborg Beetles at UC Berkeley. See Sato and colleagues 2010. See also Johnson 2007. The Hi-mem efforts funded by DARPA are supporting both the military and U.S. universities to carry out this work. This research falls under what DARPA calls "Bio-Revolution," which is a program designed to reengineer living organisms to improve DOD capabilities. DARPA's Bio-Revolution programs are focused on four thrust areas: Protecting Human Assets, Maintaining Human Combat Performance, Biology to Enhance Military Systems, and Restoring Combat Capabilities after Severe Injury. All of DARPA's Bio-Revolution programs have one mission in mind: to use the life sciences to benefit the U.S. military.
 14. New breeds of bees are being created. In light of what happened when a Brazilian crossbreeding experiment resulted in "Africanized killer bees," these breeding experiments are proceeding slowly and cautiously. As Anna Tsing argues, invading swarms of "killer bees" became a projection screen for deep-seated racism and fears about immigrants penetrating the national body politic in the United States (Tsing 1995). However, now that the bee genome has been mapped, there are new efforts in military research labs to restart breeding to make a more useful militarized bee (interview, Kirsten McCabe, 2008).
 15. For a critical take on Deleuze and Guattari's treatment of the animal human, see Haraway 2008:27–35. As the previous section of this essay should demonstrate, I agree with Haraway's

- critique of Deleuze and Guattari's "distain for the daily, the ordinary, the affectional . . . [and the] profound absence of curiosity about and respect for and with actual animals" (2008:29).
16. Here the vampire and the werewolf are part human, part nonhuman becomings that result from the contagion of the battlefields. This is not simply a process of imitating animals, as Massumi (1992:93) makes clear, but a "contamination" that combines affects from abstract bodies and incarnates them as human matter. These reincarnations are incomplete, partial formations—part human, part animal, werewolves and vampires. The "war machine" is a form of social subjection where animals, in this case bees, become constitutive pieces or working parts of a human animal form.
 17. See Sauter and colleagues 2005.
 18. See Axe 2007.
 19. See Windrem et al. 2009. See also Wikipedia n.d.
 20. See Kaplan 2009.

Editors Note: *Cultural Anthropology* has published other essays on militarization and its cultural and technological effects. See, for example, Joseph Masco's "'Survival Is Your Business': Engineering Ruins and Affect in Nuclear America" (2008); Daniel Hoffman's "The City as Barracks: Freetown, Monrovia, and the Organization of Violence in Postcolonial African Cities" (2007); Joseph Masco's "Mutant Ecologies: Radioactive Life in Post-Cold War New Mexico" (2004); and Lesley Gill's "Creating Citizens, Making Men: The Military and Masculinity in Bolivia" (1997).

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