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CONTENTS

Special Issue: Multispecies Ethnography

Guest Editors: S. Eben Kirksey and Stefan Helmreich

- 545 The Emergence of Multispecies Ethnography
S. EBEN KIRKSEY AND STEFAN HELMREICH
- 577 Fingeryeyes: Impressions of Cup Corals
EVA HAYWARD
- 600 Naturalcultural Encounters in Bali: Monkeys, Temples, Tourists,
and Ethnoprimateology
AGUSTÍN FUENTES
- 625 Viral Clouds: Becoming H5N1 in Indonesia
CELIA LOWE
- 650 Ecologies of Empire: On the New Uses of the Honeybee
JAKE KOSEK

BOOK REVIEWS

- 679 *What is Posthumanism?* by Cary Wolfe
*Singing to the Plants: A Guide to Mestizo Shamanism in the
Upper Amazon*, by Stephan V. Beyer
Reviewed by RICHARD DOYLE
- 684 *Day of the Dead in the USA: The Migration and Transformation
of a Cultural Phenomenon*, by Regina M. Marchi
Reviewed by WALTER E. LITTLE

On the cover: "Twins" by Marnia Johnston; porcelain, 2005. See the essay by Kirksey and Helmreich.



THE EMERGENCE OF MULTISPECIES ETHNOGRAPHY

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A new genre of writing and mode of research has arrived on the anthropological stage: multispecies ethnography. Creatures previously appearing on the margins of anthropology—as part of the landscape, as food for humans, as symbols—have been pressed into the foreground in recent ethnographies. Animals, plants, fungi, and microbes once confined in anthropological accounts to the realm of *zoe* or “bare life”—that which is killable—have started to appear alongside humans in the realm of *bios*, with legibly biographical and political lives (cf. Agamben 1998). Amid apocalyptic tales about environmental destruction (Harding 2010), anthropologists are beginning to find modest examples of biocultural hope—writing of insect love (Raffles 2010), of delectable mushrooms that flourish in the aftermath of ecological destruction (Tsing, for the Matsutake Worlds Research Group 2009), and of microbial cultures enlivening the politics and value of food (Paxson 2008).

Multispecies ethnographers are studying the host of organisms whose lives and deaths are linked to human social worlds. A project allied with Eduardo Kohn’s “anthropology of life”—“an anthropology that is not just confined to the human but is concerned with the effects of our entanglements with other kinds of living selves” (2007:4)—multispecies ethnography centers on how a multitude of organisms’ livelihoods shape and are shaped by political, economic, and cultural forces. Such ethnography also follows Susan Leigh Star, who suggests “it is both more analytically

interesting and more politically just to begin with the question, *cui bono?* than to begin with a celebration of the fact of human/non-human mingling" (1991:43).

The adjective "multispecies" already travels in biological and ecological research worlds, referring to patterns of multispecies grazing, the coconstruction of niches, and wildlife management (e.g., de Ruiter et al. 2005). What can it do—what is it doing—in anthropology? Essays in this issue of *Cultural Anthropology* offer some answers. The present essay locates the discussion within contemporary debates about the "human"; in the history of anthropologies of animals, plants, and other organisms; and with respect to conceptual questions about the definition of "culture" and "species."

"Becomings"—new kinds of relations emerging from nonhierarchical alliances, symbiotic attachments, and the mingling of creative agents (cf. Deleuze and Guattari 1987:241–242)—abound in this chronicle of the emergence of multispecies ethnography, and in the essays in this collection. "The idea of *becoming* transforms types into events, objects into actions," writes contributor Celia Lowe (this issue). The work of Donna Haraway provides one key starting point for the "species turn" in anthropology: "If we appreciate the foolishness of human exceptionalism," she writes in *When Species Meet*, "then we know that becoming is always becoming *with*—in a contact zone where the outcome, where who is in the world, is at stake" (2008:244). Departing from Deleuze and Guattari, whose ideas about "becoming animal" Haraway has critiqued for misogyny, fear of aging, and an incuriosity about actual animals (2008:28–30), multispecies ethnographers are studying contact zones where lines separating nature from culture have broken down, where encounters between *Homo sapiens* and other beings generate mutual ecologies and coproduced niches (Fuentes this issue).

Multispecies ethnography has emerged with the activity of a *swarm*, a network with no center to dictate order, populated by "a multitude of different creative agents" (Hardt and Negri 2004:92). The Multispecies Salon—a series of panels, round tables, and events in art galleries held at the Annual Meetings of the American Anthropological Association (in 2006, 2008, and 2010)—was one place, among many others, where this swarm alighted. The salon became a "para-site" (Marcus 2000)—a paraethnographic field site where anthropologists and their interlocutors came together to discuss matters of common concern (see Figure 1, a poster for the 2008 event).¹ Art served as a companion and catalyst practice for thinking through and against nature–culture dichotomies (see also Kac 2007; da Costa and Philip 2008).² In this essay, we interweave an introduction of essays in this issue

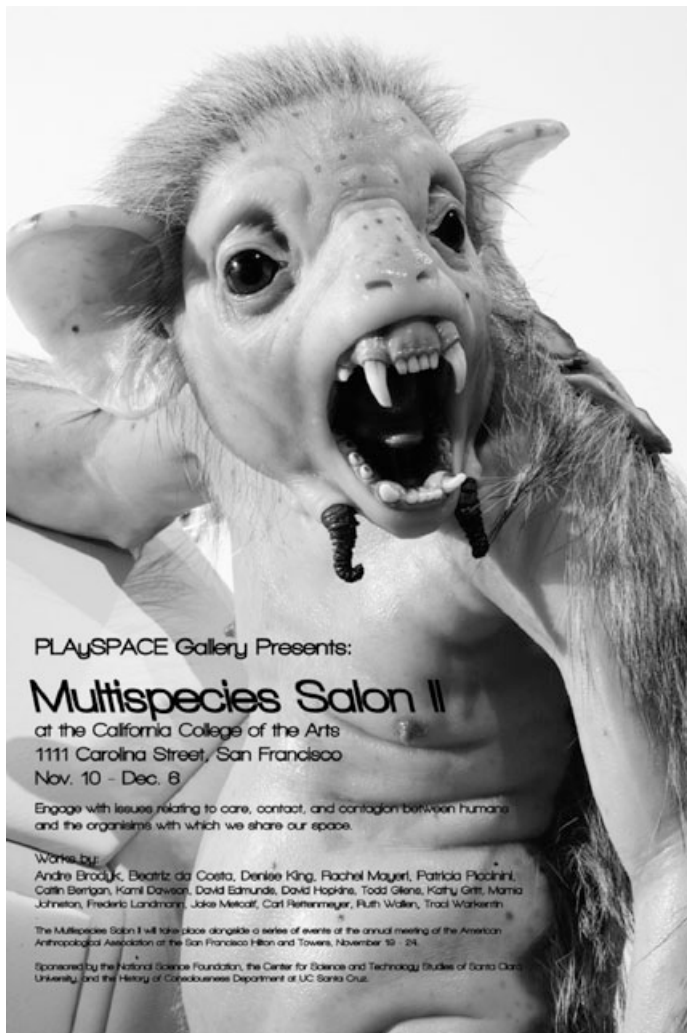


FIGURE 1. “The Bodyguard for the Golden Helmeted Honeyeater.” The bodyguard, a poster child for the Multispecies Salon, is a lively fiction made out of silicone by Australian sculptor Patricia Piccinini. This fantastic creature was invented to protect a real organism—the golden helmeted honeyeater, a small colorful bird of Victoria, Australia, whose breeding population consists of just 15 pairs. Piccinini describes this creature as “genetically engineered” with large teeth that have a dual function: “He will protect [the honeyeater] from exotic predators, and he has powerful jaws that allow him to bite into trees, to provide the birds with sap” (2004). These teeth are also a reminder that animals are not just good to think with, or play with, but that they might bite. This potentially dangerous humanoid figure illustrates the lively potentials and deadly consequences, the high stakes in the mix, when species meet. Donna Haraway, who presented a paper about Piccinini at the Multispecies Salon in 2008, suggests that her sculptures are “unsettling but oddly familiar critters who turn out to be simultaneously near kin and alien colonists” (2007). Piccinini’s art mixes science fiction and fact, illuminating actual naturalcultural problems in Australia as well as possible solutions. Moving past the “soporific seductions of a return to Eden [and] the palpitating frisson of a jeremiad warning of the coming technological Apocalypse” (Haraway 2007), Piccinini’s work embodies a mandate to protect endangered organisms, while offering an opportunity for reflecting on the ambivalent nature of the technoscientific interventions that have been mobilized to save them.

of *Cultural Anthropology* with a theoretical discussion and with gleanings from this para-site.

WRITING CULTURE IN THE ANTHROPOCENE

Anthropos—the ethical and reasoning being that Enlightenment Europeans conjured as their inheritance from classical Greece (Herzfeld 2002)—has been the subject of renewed attention among anthropologists. In its classical articulation, Michael M. J. Fischer reminds us, *anthropos* was an entity sited between the divine and bestial, a being that self-reflexively fashioned itself as a member of the polis (2009:xv–xvi). After Foucault, *anthropos* has also become a figure fashioned by the modern sciences of life, labor, and language—that is, by biology, political economy, and linguistics (see Rabinow 2003, 2008). And in the contemporary moment, what counts as living, working, and communicating are under radical revision in the biosciences.³ In this context, anthropologists have begun to ask: What is *anthropos* becoming?

Attention to *anthropos* has generated more instability in conceptions of “ethics” and “culture” than it has directed attention to anything like a changing organic “human nature.”⁴ Such a displacement of foundational discourse about biology indexes a conviction among many cultural anthropologists that anthropology has outgrown its U.S. four-field form (cultural, biological, linguistic, and archaeological) and that the sciences of human biology have little to say to cultural analysis. Dan Segal and Sylvia Yanagisako’s 2005 collection, *Unwrapping the Sacred Bundle: Reflections on the Disciplining of Anthropology*, is just one text calling for cultural anthropologists to unbind themselves from the objects and epistemologies of biological anthropology. That text can also be read as an echo of the 1990s “science wars”—debates about what mix of empiricism and interpretation ought ground positive knowledge claims, and about who has the authority to make that call (see Fujimura 1998). Segal and Yanagisako’s book was one result of heated debates that took place in anthropology in the United States at the end of the 20th century, resulting in sometimes stark institutional divides—splits of departments into cultural and biological wings, or into interpretative and evolutionist sections.

Even as fault lines in the discipline have widened, something new has begun to emerge. Ethnographers are exploring naturalcultural borderlands and situating their work within ecological concerns. They have involved themselves with an array of organisms and ecologies, and have been open to the methodological challenges these present. The work presented here, in this special issue, is exemplary.

Such work also illustrates how concerns in cultural anthropology overlap with concerns in different but companion communities and intellectual niches. Atmospheric chemist Paul Crutzen and biologist Eugene Stoermer coined the term *Anthropocene* to describe a new epoch in Earth's history. In their view, a key transformation in the life of the planet began some two hundred years ago, around the time the steam engine was invented, when human activity "gradually grew into a significant geological, morphological force" (2000:17). Crutzen and Stoermer argue that the Holocene, the geological epoch that began about 12,000 years ago, has now phased into the Anthropocene. In this frame of reference, anthropos has become an ambivalent figure, possessed of an agency scaled up to embrace—and endanger—the whole planet. Humans have come widely to be regarded as the primary agents driving climate change, mass extinctions, and the large-scale destruction of ecological communities (cf. Masco 2004 on the "mutant ecologies" created by nuclear testing). With this in mind, Deborah Bird Rose has recently called for "writing in the anthropocene," petitioning for renewed attention to "situated connectivities that bind us into multi-species communities" (2009:87). Multispecies ethnography involves writing culture in the anthropocene, attending to the remaking of anthropos as well as its companion and stranger species on planet Earth.

THE SPECIES TURN: ROOTS AND FUTURES

Exploring ways of bringing other species (and intellectual modes) back into anthropology, multispecies ethnographers have found inspiration in the work of scholars who helped found the discipline. Studies of animals have a long lineage in anthropology, traveling back canonically to texts such as Lewis Henry Morgan's 1868 *The American Beaver and His Works*. Here, Morgan studied the "acquired knowledge" of lodge, dam, and canal building transmitted among beavers. Drawing parallels between the engineering knowledge of people and of beavers, one among many species of what he thought of as clever animal "mutes," Morgan articulated an argument for animal rights: "The present attitude of man toward the mutes is not such, in all respects, as befits his superior wisdom. We deny them all rights, and ravage their ranks with wanton and unmerciful cruelty" (1868:281–282; and see Feeley-Harnik 2001). In the late 19th century, at a moment when anthropology was a field of natural history, scholars like Morgan worked across boundaries later secured against traffic between the social and natural sciences.

Many of Morgan's contemporaries engaged in what might be regarded as comparative multispecies ethnology. Take, for example, naturalist A. T. de

Rochebrune, who in 1882 launched the field of “ethnographic conchology,” a subject devoted to studying “the use of Mollusks [snails, clams, and octopus], whether as objects of adornment or industry, or as substances used for food, dyeing, textile fabrics, etc. among ancient and modern peoples” (Clement 1998:175). Among a diversity of related interdisciplinary formations emerging in the late 19th century, only a few, like ethnobotany and ethnozoology, have endured.

Studies of hunting, husbandry, and the role of animals in systems of totem and taboo featured prominently in classic 20th-century ethnographies. Evans-Pritchard, Douglas, Lévi-Strauss, Radcliffe-Brown, and Leach are only the best known and most influential in this literature (see also Ingold 1988; Tambiah 1969). Such work grew out of long-standing interests in anthropology with systems of animal and natural classification (e.g., Bulmer 1967). Gregory Bateson—who worked across the disciplines of anthropology, psychology, linguistics, and epistemology—offered a cybernetic framework for understanding human–animal interactions, and wrote famously of human–dolphin communication (Bateson 1972, 1979). His theory of play and fantasy, and criteria of mental processes, broke down essentialized differences between human and nonhuman minds (Bateson 1972).

In the decades after midcentury, many cultural anthropologists worked to denaturalize intrahuman differences established along the lines of gender, race, class, nation, caste, sexuality, and ability. In the late 20th century, developments within the discipline of biology itself began to trouble assumptions that biotic “nature” could be a stable foundation on which forms of human social and cultural life might be built. The “facts of life” became highly malleable. Feminist scholars of kinship, gender, and reproductive technology—for example, Emily Martin (1987), Verena Stolcke, (1988), Marilyn Strathern (1992a, 1992b), Cori Hayden (1995), Lynn Morgan and Meredith Michaels (1999), Rayna Rapp (1999), and Sarah Franklin (2001)—were among the first to realize that the discipline should turn its attention to the making and remaking of biological knowledge and substance, particularly as it impinged on notions of relatedness. The new biologies transformed ideas about race, too. The “biology” of race migrated from population genetics to genomes, both reinforcing and undoing earlier understandings of human taxonomy (Fullwiley 2007; Haraway 1995; Montoya 2007; Nelson 2008; Reardon 2005; TallBear 2007). Anthropologists also attended to how new kinds of identities built around genetic and genomic knowledge and conditions—what Paul Rabinow in 1992 called “biosocialities”—came to organize novel political and social affiliations and communities (see Epstein 2008; Gibbon and Novas 2008; Pálsson 2007; Rose 2007; Taussig et al. 2003).

With the turn of the 21st century, *Homo sapiens* reappeared on the disciplinary stage, along with animal others and familiars. In conversations turning less to etymological reexaminations of ancient Greek or to continental philosophy, critical evolutionary and molecular anthropologists began to reexamine issues of race and gender in the context of new genetic technologies (e.g., Marks 2002, 2008). Lively conversations between biological and cultural anthropologists resulted in edited collections such as *Genetic Nature/Culture* (Goodman et al. 2003; for an earlier meditation on such convergence, see Ingold 1990), which featured chapters about gender, genealogy, race, and animals. *Genetic Nature/Culture* zeroed in on the changing contours of the “nature” wriggling within whatever “human nature” might mean now. The book’s various authors—especially those writing on apes, sheep, and dogs—would not be surprised to hear Anna Tsing’s suggestion that, “Human nature is an interspecies relationship” (Tsing n.d.; see Haraway 2008:19).⁵

New brands of animal anthropology twist the old, as more anthropologists have become curious about the lives of animals in labs, on farms, in agricultural production, as food, in rapidly changing ecosystems (for one review of recent work, see Fischer 2009:141–153). As a new generation of anthropologists began to attend to the remaking of human nature, others began to follow related logics of remaking at work in nonhuman natures. Celia Lowe (2006) described how the macaque, introduced to Indonesia’s Togean Islands in the 1920s, was transformed from a feral “hybrid swarm” into to an “endemic species” by Indonesian scientists savvy at engaging with powerful international conservation agendas. Sarah Franklin’s *Dolly Mixtures* (2007) brought old questions about kinship into dialogue with high-tech animal husbandry. Examining the technique of somatic cell nuclear transfer, famously used to produce the lamb clone Dolly, Franklin demonstrated biotech’s potential to reorder what might count as the “nature” of reproduction and genealogy. Hugh Raffles, in his writings on insects, innovatively fused entomology with anthropology as he wrote genre-crossing meditations on butterfly collecting, cricket fighting, bee language, and the racialization of lice (Raffles 2001, 2010). Eduardo Kohn, taking up questions of cross-species communication, argued for a new theory of semiosis; his ethnography among the Runa in the Amazon sought to account for the communicative worlds Runa shared with their dogs (2007).

The new animal anthropology joined established, ongoing conversations in human–animal studies in the pages of such journals as *Animals and Society* and *Anthrozoös* and in the work of such historians as Harriet Ritvo, author of *The Animal Estate* (1989) and *The Platypus and the Mermaid* (1998), and Virginia

DeJohn Anderson, author of *Creatures of Empire: How Domestic Animals Transformed Early America* (2004). As Molly Mullin pointed out in her 2002 review essay, “Animals and Anthropology,” the fusion of animal studies with anthropology would now ask anthropologists to revisit long-standing interests in evolution and domestication but also to craft new tools for understanding such phenomena as transgenic creatures and patented organisms (cf. Fuentes and Wolfe 2002; Ritvo 2002; see also *Where the Wild Things Are Now: Domestication Reconsidered*, edited by Cassidy and Mullin 2007). No longer, it seems, were animals simply “windows and mirrors” (Mullin 1999) into and of symbolic concerns (see, canonically, Leach 1964. See also Shanklin 1985). Their material entanglements increasingly require anthropologists to engage with biotic materiality and process, apprehended both through everyday experience and through technoscience (see also Benson 2010; Vivanco 2001). Donna Haraway’s 2008 *When Species Meet* gathered up this emerging sensibility, arguing that animals are not just “good to think” (as Lévi-Strauss had it), or more instrumentally, “good to eat” (as Marvin Harris countered), but were also entities, and agents, “to live with.”⁶

That “living with,” of course, takes a variety of forms. It might be as companion species (Haraway 2003). It might be as “unloved others” (Rose and van Dooren in press). It might be as creatures with simultaneously parallel and entangled biographies, like the primates studied by ethnoprimateologists. In the words of Erin Riley, ethnoprimateology offers grounds for “reconciliation of biological and cultural anthropology” through the study of interconnections amongst primates—among *Homo sapiens* and other species (2006:75). Using the *ethno-* prefix, suggests primateologist Agustín Fuentes, “marks the inclusion of anthropogenic elements, including social, economic, and political histories and contexts as a core component of primateological inquiry” (this issue). In an allied move, Haraway (2010) has lately experimented with another arrangement of prefixes, calling the new animal anthropology “zooethnography.”

“Living with” may mean deep engagement with particular animals. Alternatively, as Matei Candea suggests about human–meerkat relations, it may mean cultivating a mutual “detachment” as a mode of interaction—or, better, a mode of “interpatience” (Candea 2010). Animals may act as anthropologists themselves, studying the behavior of humans who feed, shepherd, and breed them (Paxson 2010). In zoos, captive apes have come to know the personalities and hierarchies of their human keepers as well as they know their own kin and kind. In some cases, human keepers even share antianxiety medications with the captive allo-primates in their care (Braitman 2010).

Animals may fuse, refuse, and confuse nature–culture categories and ontologies. Among the Siberian Yukaghirs, humans, animals, and spirits are seen as “endless mimetic doubles of one another” (Willerslev 2007; see also Nadasdy 2007). In a related mix of natureculture, Eduardo Viveiros de Castro draws on ethnographic studies of Amerindian cosmologies in the Amazon to advance a notion of “perspectival multinaturalism” (1998). He posits that humans, animals, and spirits participate in the same world, although with different sensory apparati, with the effect of generating only partially overlapping ontologies. If mononaturalism, the prevailing ontology of Occidental science was “blown to pieces” by multinaturalism, as Bruno Latour has it, then a multispecies approach to ethnography must engage with the alterworlds of other beings. Following Viveiros de Castro, we might accept Latour’s claim that “No one can bear to be just one culture ‘among others’ watched with interest and indifference by the gaze of the naturalizers. Reality is once again becoming the issue at stake” (2002:21).

Displacing studies of animal behavior used by social conservatives and sociobiologists to naturalize autocratic and militaristic ideologies, Anna Tsing began studying mushrooms to imagine a human nature that shifted historically along with varied webs of interspecies dependence. Searching familiar places in the parklands of northern California for mushrooms—looking for the orange folds of chanterelles or the warm muffins of king boletes—she discovered a world of mutually flourishing companions (Tsing n.d.). Aspiring to mimic the “rhizomic sociality” of mushrooms, Tsing formed the Matsutake Worlds Research Group—an ethnographic research team centered on matsutake, an aromatic gourmet mushroom in the genus *Tricholoma*, a “species cluster.” Following the matsutake mushroom through commodity chains in Europe, North America, and East Asia, this group has experimented with new modes of collaborative ethnographic research while studying scale-making and multispecies relations (Choy et al. 2009:380).

If we accept Tsing’s notion that “human nature is an interspecies relationship” (n.d.; see also Haraway 2008:19), plants must be key players, too. One anchor point for plant ethnography is ethnobotany, the study of styles of knowledge and belief about plant life. Ethnobotanists and ethnobiologists have long been engaged in joint research and publication efforts with people often relegated in other studies to the role of ethnographic object (see Hunn 2007). Although some ethnobotanists have sometimes exploited the “savage slot,” garnering media attention and professional accolades for accounts of their “wild odysseys” with shamans (Plotkin 1993), others have assumed the role of public intellectuals drawing on insights from cultural theory and ecology alike. Take, for example, the diverse corpus of

writing by Gary Nabhan on topics ranging from the roots of plants and people along Arab American routes (2008) to the natural and cultural history of tequila on U.S.–Mexico borderlands (Valenzuela-Zapata and Nabhan 2004). A new generation of ethnobotanists sees plants as social beings with agentic efficacy. Virginia Nazarea, in a 2006 *Annual Review of Anthropology* article about ethnobotany, writes: “Recent developments in anthropological thought, particularly in the areas of sensory memory or sensuous scholarship, marginality and mimesis, and landscape or place offer a way out of misplaced essentialism, which demands strict adherence to what does or does not count as biodiversity, knowledge, and memory” (2006:319). Cori Hayden, in her study of bioprospecting in Mexico (2003) brings ethnobotany firmly into the territory of political economy. Classic work on “plant teachers” in anthropology has also recently been taken up in poststructuralist literary theory (e.g., Doyle 2005, 2006).

With critical assessments of biodiversity discourse emerging from anthropologies of science and from political ecology (e.g., Helmreich 2009; Lowe 2006; West 2006), several scholars also began venturing away from animals and plants—toward microbiota that rarely figure in discussions of biodiversity. Astrid Schrader (2010) examines *Pfiesteria piscicida*, a “phantom dinoflagellate” with a “ghostly undecidability,” its agency only revealed by the massive fish kills it leaves in its wake. Ethnographers are turning to microbes as social agents, on land, in the sea, and in food (Dunn 2007; Helmreich 2009; Hird 2009; Paxson 2008). Even as “the human” moves a bit to the edge of this work, the discussion remains legibly anthropological—addressing questions of relatedness, exchange, governmentality, and signification. Paul Rabinow’s *biosociality*, Marilyn Strathern’s call to think “after nature,” and various permutations of *biocapital* (Franklin and Lock 2003; Helmreich 2008; Sunder Rajan 2006) all lend themselves to multispecies inquiry.

Ethnographic studies of biocapital, biodiversity, and biosociality must all grapple with problems of representation. How can or should or do anthropologists speak with and for nonhuman others? That question pages back to a canonical anthropological problematic articulated by Arjun Appadurai in *Cultural Anthropology*: “The problem of voice (‘speaking for’ and ‘speaking to’) intersects with the problem of place (speaking ‘from’ and speaking ‘of’)” (1988:17). Appadurai writes, “anthropology survives by its claim to capture other places (and other voices) through its special brand of ventriloquism. It is this claim that needs constant examination” (1988:20). This reflexive examination should be redoubled when anthropologists speak with biologists, nature lovers, or land managers—and for the species that these agents, along with anthropologists, represent.

The work of Bruno Latour, who employed the phrase “nature-culture” to articulate relations among humans and nonhumans that sustain modernity, has been influential in thinking about such reflexivity (1993:7–11; and see Latour 1988 on microbes). Latour sees parallels between politicians who speak for other people and biologists who speak for nonhumans (2004). Latour’s model for bringing democracy to nature involves consensus building among human “spokespeople.” But questioning the ability of nonhumans to hold their representatives accountable, one might ask, “Can the non-human speak?” (cf. Spivak 1988; Mitchell 2002)—although this is not the right question either. “Non-human is like non-white,” Susan Leigh Star said in a response to a presentation about the Multispecies Salon, “it implies a lack of something” (personal communication, September 12, 2008). The category of “non-human” is also grounded in human exceptionalism—the foolish notion that Haraway pushes us to move beyond.

An awareness of new microbiological facts of life suggests that fundamental boundaries between organisms, between species, are blurrier than previously thought. A close look at human skins, guts, and genomes reveals that human beings are a consortium of sorts, a medley of microbial becomings (Haraway 2008:31). By the late 20th century, biologists were beginning to find that viruses and other microbes transfer genes across species lines as well as higher level taxonomic categories like families or even phyla—spreading genetic material laterally among living creatures, rather than vertically down generations (Helmreich 2003). Evolutionary theorists began to rethink their mappings of interspecies relationships, challenging prevailing Darwinian orthodoxies about linear descent (Margulis and Sagan 2002; see also Hird 2009). In the words of Giles Deleuze and Felix Guattari: “Evolutionary schemas would no longer follow models of arborescent descent going from the least to the most differentiated, but instead a rhizome. . . . We form a rhizome with our viruses, or rather our viruses cause us to form a rhizome with other animals” (1987:11).

A rhizomorphic zeitgeist infects many branches of biology. And anthropology has been infected, too. Fusing Margulis’s *symbiogenesis* (the coming into being of new creatures through symbiosis) and Foucault’s *biopolitics*, Stefan Helmreich (2009) suggests that we think of the governance of entangled living things as a question of *symbiopolitics*. A symbiopolitical multispecies ethnography turns out to have a good deal in common with the traveling methods of multisited ethnography (Marcus 1995). With animals, invasive plants, and microbes on the move, anthropological accounts ramify across places and spaces, entangling bodies, politics, and ecologies. Multispecies ethnographers, like multisited ethnographers, are starting to follow

genes, cells, and organisms across landscapes and seascapes, tracing how elements of *Homo sapiens* are creating becomings in the bodies of other species, and vice versa (Hayward and Kelley 2010).

Constantly morphing visions of natureculture have long been the humdrum stuff of bioengineering. Witness creatures such as OncoMouse™, a patented organism hosting human breast cancer genes (Haraway 1997). As naturalcultural hybrids proliferate, *Homo*, the conventional subject of anthropological concern, is no longer a clearly bounded biological subject. A multitude of literal human chimera—genetic hybrids named after the figural fire-breathing monsters of Greek mythology with a lion’s head, a goat’s body, and a serpent’s tail—are turning human beings and becomings into things that are increasingly difficult to contain. Human genes are being incorporated into a diversity of common laboratory organisms—from rats and mice, to fruit flies, to *Escherichia coli*, to nematode worms.

The Multispecies Salon, the art exhibit staged in parallel with the AAA Annual Meeting of 2008, was one opportunity for anthropologists to revisit how human nature is now enmeshed with interspecies, transgenic, and multinatural worlds. Art forms have proved good to think with about “living with” in a multispecies world.

THE MULTISPECIES SALON

The Multispecies Salon art exhibit in the PLAYSPACE Gallery of the California College of Arts—alongside the 2008 AAA Annual Meeting—explored how artists might be allies in thinking about biological beings and becomings in anthropology. Curators Eben Kirksey and artist Marnia Johnston distributed a “Call for Organisms” that was expressly experimental, “We are conducting a biodiversity survey of sorts that will bring together organisms living in the greater San Francisco Bay Area. We seek to represent creatures that are thriving in our yards, greenhouses, laboratories, and aquariums as well as those that are failing to flourish in our built landscapes” (Kirksey and Johnston 2008). This survey turned up a multitude of agents—endangered species of butterflies, rodents, and frogs—that already occupied the realm of “bios” and enjoyed the ambiguous benefits of biographical or political lives in human worlds. It also yielded parasites, weeds, and laboratory animals—creatures usually confined to the realm of “zoe,” “bare life” that is killable. “One of the strengths of the show is that it is a big overturning of the pot,” observed Todd Gilens, an ecoartist who participated in the Multispecies Salon, showcasing plans to wrap San Francisco buses with images of the Salt Marsh Harvest Mouse.

“You’ve gathered some things into a bowl called a ‘gallery’ and you’ve turned it over. And things are mixing, categories are mixing.” The Multispecies Salon sought to blur the boundaries between bioart and ecoart—two traditions already difficult to distinguish, not least because the categories themselves are contested (see Catts and Zurr 2008:134–135).

Bioart is a “tactical biopolitics” (da Costa and Philip 2008:xviii). If Foucault understood biopolitics as disciplinary forms for optimization, coercion, and control of biology, then bioart is organized around attempts to detour, derail, or expose these regimes of domination and systems for managing “life.” In 2000, bioart burst into the popular imagination when Eduardo Kac announced the birth of Alba, a rabbit that glowed green as a result of transgenically introduced jellyfish genes. These same genes illuminated one submission to the Multispecies Salon—a series of paintings with transgenic *E. coli* bacteria on Petri dishes by French artist Andre Brodyk. Many bioartworks, like Brodyk’s, are novel organisms that have been created by artists or are dependent on humans for their continued survival (Bureaud 2002:39; Zurr 2004:402; see Kac and Ronell 2007).

In a foundational text of the ecoart movement, Suzi Gablik writes: “The ecological perspective connects art to its integrative role in the larger whole and the web of relationships in which art exists” (1991:7). Ecoart takes “art for non-humans seriously” (Bower 2009). In contrast to the living media used in bioart, ecoart usually involves the traditional materials of sculpture, photography, and painting. At the salon, work by professional bioartists and ecoartists appeared alongside submissions from other participants—biologists, anthropologists, and schoolchildren. The curators extended Joseph Beuys’s famous decree—“You are all artists”—beyond human realms (cf. Bishop 2004:61). For anthropologists accustomed to thinking about the agency of nonhumans (cf. Gell 1998; Latour 1993), it was hardly surprising to find living microbes, insects, and plants framed as creative agents.

Approaching the Multispecies Salon, visitors could hear the twitter of live cockroaches mingling with recorded sounds of chimpanzees screeching for meat. A video installation juxtaposed images of whooping cranes following ultralight aircraft on annual migrations with footage of humans playing with dolphins in captivity. Experimental organisms, fruit flies, and pictures of transgenic *E. coli* bacteria shared the space with apparently everyday household artifacts. One installation featured milk cartons and junk mail picturing missing amphibians in the place of missing children—creatures such as the golden toad of Monte Verde, Costa Rica, now presumed extinct. The piece asked, “Have You Seen Me?”



FIGURE 2. Frederic Landmann's "Wolbachia and Drosophila."

Previous collaborations between anthropologists and artists (i.e., Marcus and Calzadilla 2005) set the stage for transforming the art gallery into a site where the common interests and preoccupations of multiple disciplines could be explored. The gallery became a "para-ethnographic" site, a place where the boundaries between academic conference and traditional field site dissolved, generating conversation among anthropologists, biological scientists, and artists—encounters that generated ethnographic data and ethnographic analysis at the same time (cf. Marcus 2000; <http://www.culanth.org/?q=node>). The salon also hosted living parasites: symbiotic associations as well as human pathogens (see Figure 2). In French, *parasite* is polysemic, signifying "noise, static, or interference" in addition to a biological or social freeloader (Serres 2007). With 17 artists exhibiting and swarms of anthropologists passing through, there was an abundance of noise, interference, and crosstalk.

If the curators of the Multispecies Salon began by gathering together art and artifacts to illustrate conditions of life in the anthropocene—exploring the question of which species flourish and which fail in the shadows of human worlds—the profusion of subvisible organisms in the gallery left them wondering if the notion of "the anthropocene" was perhaps a bit too anthropocentric. Frederic Landmann, a postdoctoral scholar at the University of California, Santa Cruz, displayed vials from his lab filled with live fruit flies (*Drosophila* sp.), yeast to feed the flies, and thousands if not millions of *Wolbachia* bacteria living in the cells of the flies. "Long before our time, there were the insects," Hugh Raffles reminds us. "For as long as we've been here, they've been here too. Wherever we've traveled, they've been there too. . . . Not just deeply present in the world but deeply there,

creating it, too" (2010:3). *Wolbachia* are old, too, having been around at least 100 million years (Stouthamer et al. 1999). They are one of the most abundant microbes on earth—infecting over 75 percent of studied invertebrates, including spiders, mites, crustaceans, nematode worms, and insects (Jeyaparakash and Hoy 2000).

Eva Hayward (this issue) suggests that “inverts”—the kind without backbones as well as the sort who transpose gender roles—interrupt heteronormativity. *Wolbachia* are agents of invert becomings, with millennia of experience in forming what Hayward and Lindsay Kelley call “tranimals”—enmeshments of *trans* and *animals*, critters that cross or queer normative sex and gender configurations. Because *Wolbachia* bacteria are too big to fit into the sperm of invertebrates, they are usually only transmitted from invert mothers to children. If classic biomedical textbooks contain tales about human sperm and eggs that naturalize patriarchal stereotypes about productive men and wasteful women (Martin 1991), the *Wolbachia* literature refracts related tales through the bacteria’s imagined point of view: “Because males are not transmitters of such symbionts, they are ‘waste’ from the perspective of the symbiont” (Stouthamer et al. 1999:82). To spread in subsequent generations, *Wolbachia* transform the bodies and the reproductive dynamics of their invert hosts. When female wasps of certain species are infected with the bacterium they become parthenogenic—meaning that they no longer need to have sex with males to produce viable offspring. *Wolbachia* perform a sex-bending trick in some crustaceans and in at least one insect species—changing genetic males into reproductively viable females. Regarding *Wolbachia* as a transanimal-forming agent is not a naturalizing move but an attempt to trace sexualized alterities and alternative imaginaries (Hayward this issue), uncanny microbial becomings at work all around *H. sapiens*.

Playing with popular anxiety surrounding microbial becomings, performance artist Caitlin Berrigan created a series of sentimental objects in an attempt to “befriend a virus.” Growing tired of the rhetoric of war commonly used by health care workers to describe her illness, hepatitis C, Berrigan, who carries the virus in her blood, performed what she called a “nurturing gesture,” at the Multispecies Salon. Drawing her own blood, she offered it to a dandelion plant as a nitrogen-rich fertilizer: “Blood containing human pathogens is still a good fertilizer for plants,” she argued, “I can give to the dandelions what would be a danger to any human” (see Figure 3). Enacting a relation of shared suffering, of mutual care and violence (cf. Haraway 2008), Berrigan told audience members that she takes dandelion root as medicine to help her liver cope with viral infections.



FIGURE 3. "Lifecycle of a Common Weed" by Caitlin Berrigan.

Noting that the recipient of her nurturing gesture is regarded as a "weed," Berrigan worked to give the dandelion biographical and political life (*bios*), elevating it from the realm of bare life. "The dandelion actually has a lot to offer us even though they grow everywhere, and are killed with herbicides," she later told us (see also Berrigan 2009). Berrigan's art and personal medical regimen might be understood as a "microbiopolitical" intervention, calling attention to how living with microorganisms (in this case, a pathogenic virus) is caught up in discourses about how humans ought live with one another (Paxson 2008:16). Appropriating tools of biotechnology and syncretic medical traditions, she worked to create a symbolic cycle of nutrients in urban environments, on a micro local scale, in opposition to dominant institutionalized practices and global commodity chains (cf. Paxson 2008:40).

Marnia Johnston's "Twins," is a ceramic piece, a chimerical pair of grubs with wings (see Figure 4). Only adult insects have wings. Their juvenile forms, larvae, do not. "Humans are acquiring adult characteristics, such as breasts, at an early age," Johnston told us. "Endocrine disrupting chemicals, like Bovine Growth Hormone," she continued, "are working on the bodies of humans and multiple other species. I want people to think about how our chemical dependencies change us and the world we live in."



FIGURE 4. "Twins" by Marnia Johnston.

The Twins are littermates of Paranoia Bugs, ceramic sculptures that Johnston began to make in 2005 after the U.S. invasion of Afghanistan. "The paranoia of the U.S. was a kind of swarm," Johnston said, "where fears fed and bred upon each other, crawling and overtaking everything in their path." This terrifying spirit infects the military strategists, mathematicians, and entomologists who informed Jake Kosek's ethnographic account of drone aircraft in the hills of Afghanistan and Pakistan, programmed with algorithms modeled on bee behavior to adopt "swarming" tactics (Kosek this issue). Perhaps these flying insectoid-machines, and the Paranoia Bugs, embody the nightmares of Hugh Raffles: "There is the nightmare of fecundity and the nightmare of the multitude. . . . There is the nightmare of knowing and the nightmare of non-recognition. . . . Nightmare begets nightmare. Swarm begets swarm. Dreams beget dreams. Terror begets terror" (2010:201–203).

Johnston gave paranoia a dark body and spindly legs. Initially, she held back, not completing a full swarm, just making a single Paranoia Bug. She began to dabble in bioart—to learn new laboratory techniques so that she could start working with living matter. This dabbling attracted the attention of "Mills Gurman" (name changed by request), an employee of Monitor 360 who was working for the CIA to study "biohacking" and bioterrorism. Johnston agreed to meet with Gurman, hoping to convince him that her artistic practice, and bioart in general, was benign, posing no public health risks. "The meeting left me wanting to know more about

what he would report back to the CIA,” Johnston said, “especially now that the government had my name and associated me with a possible threat.” This attention from a CIA contract employee, and later from the FBI Weapons of Mass Destruction Directorate, had a chilling effect on Johnston’s bioart. She turned back to her old ceramic projects—kneading clay, carefully attending the kiln, layering on colorful glaze, creating a multitude of figurines that embodied her concerns. The paranoia of U.S. government agents gave the Paranoia Bugs new life. The second generation of the bugs had a fleshier appearance and were less steady on their legs than the prototype. “They are stem cells gone wild,” she told us. “Some have mouths and cannibalize their brethren, others have wings but still can’t fly. Fearing their own kin, and suspicious of the motives of others, Paranoia Bugs are always on the lookout—to make sure they don’t get eaten.” Johnston’s sculpture gave a material form to anxiety, frustration, and fear—fusing the speculative fabulations of biocapitalism with specters of bioterror.

Reappropriating the tactic of swarming from U.S. government security forces, Johnston has helped form a curatorial collective that will stage a new art exhibit, the Multispecies Salon 3: SWARM, alongside the 2010 AAA Annual Meeting in New Orleans. The Paranoia Bugs will make an appearance in the mix with work by local artists and community activists—for example, who will do a “seed bomb” installation piece throughout the city, inviting visitors to the art gallery to engage in “guerilla bioremediation” by throwing these bombs over fences to seed toxic sites that have been abandoned by owners and regulatory agencies. If the Multispecies Salon started as a biodiversity survey, an attempt to account for the multiple beings living along with humans in the city of San Francisco, it was opened to a multitude of agents who created a becoming that was increasingly difficult to contain.

MULTISPECIES BEINGS AND BECOMINGS

The reader may worry that the above survey, taking us from humans to animals to plants to fungi to microbes, risks reinstalling the “human” as a central reference point, and even offers a kind of great chain of being as an organizing principle. We agree with Eduardo Kohn that,

If we take otherness to be the privileged vantage from which we defamiliarize our “nature,” we risk making our forays into the nonhuman a search for ever-stranger positions from which to carry out this project. Nature begins to function like an “exotic” culture. The goal in multi-species ethnography should not just be to give voice, agency or subjectivity to the nonhuman—to

recognize them as others, visible in their difference—but to force us to radically rethink these categories of our analysis as they pertain to all beings” [personal communication, March 29, 2010]

It is for this reason that, in what follows, we and the other authors take aim at a hidden ontology in the frame of “multispecies”—that of “species.” Wrangling with species (and genus, family, order, class, phylum, kingdom, domain, when possible) means that we need to take natural and cultural categories as we receive them and try simultaneously to rethink and undo them.

Karl Marx saw human “species being” as essentially creative, essentially forward looking. He contrasted human species being to the being of the bee, writing “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). Here, human species being is a sort of being that has consciousness of itself as a species. Marx’s species being, then, is a variety of *anthropos* in the classical sense, a being that can reflect on itself. But this “species” phrasing, read a century and a half after Darwin, also opens it up to a materialist query from the evolutionary biological sciences.

The gender specific binomial *Homo sapiens*, after Linnaeus’s foundational 18th-century nomenclature, translates as “man the knowing,” placing thinking at the core of human nature. Thinking becomes the measure next to which other species are to be judged. There have been attempts to reroute this common sense. Terms such as *Homo faber* (“man the maker”—championed by Karl Marx, Henri Bergson, and Hannah Arendt) and *Homo ludens* (“playing man”—articulated by Johan Huizinga [1949] in his 1938 book of that title) offer differently inflected species beings.⁷ Valences of *homo* from Latin that have fallen out of fashion in the last several hundred years of popular and technical usage—“fellow” or “creature” (Wade and Kidd 1997)—might be revived even as the stability of *Homo sapiens*, the biological species, is being unmade by bioengineering.

If anthropology has in the last 25 years accelerated its querying of what we might mean by “culture” (Abu-Lughod 1991; Clifford 1986; Gupta and Ferguson 1992), authors in this issue take aim at “species” as a grounding concept for articulating biological difference and similarity. This project has a precedent in the philosophy of biology, which has examined the coherence and limits of the species concept (see, e.g., Dupré 1992). In *When Species Meet*, Haraway notes that the very notion of species itself is unsteady, “inherently oxymoronic,” referring at once to logical types as well as to that which is relentlessly specific.

How have the authors assembled in this issue's thematic cluster—originating as members of the swarm that materialized at the Multispecies Salon—enacted multispecies ethnography?

Eva Hayward's ethnography of cup coral encounters at the Long Marine Laboratory in Santa Cruz, California, advances the notion that species are "impressions"; they carry the traces—structural, behavioral, and textural—of those others with whom they have shared past contiguities and intimacies, in both evolutionary and biographical time. Reporting on her work as a lay technician working with *Balanophyllia elegans*, Hayward writes of the sensuous interplay of vision and touch in her encounters with coral, and she develops an analytic she calls *fingeryeyes* to articulate the palpability of cross-species encounter. She is interested in the overlay of sensoriums and the inter- and intrachange of sensations across species boundaries. Taking the Long Marine Lab's research into coral sex and reproduction as one focus, Hayward employs feminist and queer theory to think anew about how corals generate generations.

Agustín Fuentes is also interested in what happens when species overlap—not with respect so much to their sensoria as with respect to their positions in ecologies. In his essay, Fuentes elaborates on the concept of "niche construction" to understand the copresence of humans and Rhesus macaques at Balinese temples. Fuentes suggests that the niche concept can be rearticulated to understand natural-cultural contact zones (cf. Haraway 2008)—incorporating present-day ecological interactions as well as historical, political, and economic forces. Fuentes deploys a hybrid methodological tool kit, using the observational techniques of primatology in conjunction with ethnographic practice to study the lives of monkeys at Balinese temples—creatures that subsist on ritual offerings of food, handouts from tourists, as well as plants and animals acquired from riverine forest corridors between temples. He reproduces wry comments from Balinese tour guides, who see themselves as occupying a similar social niche as the monkeys in the geopolitical economy: waiting for tourists to arrive.

Staying in Indonesia, Celia Lowe takes as her subject the avian influenza virus H5N1, examining how in the early 2000s this "quasi-species" generated fear and speculation about its possible becomings, locally, nationally, internationally, globally. Using the technical notion of a "cloud" of viral genomes as a rhetorical device to understand the proliferation of plans and narratives around H5N1, Lowe enfolds humans, chickens, and viruses into an account of an event that never quite came to be—a global pandemic of avian influenza. Gaining access to the security cultures surrounding the lives of elite expatriates who live in Indonesia, and dwelling

in the enclaves of the urban poor, she reports on the gassing, burning, and burying alive of chickens, during what some have called “a global avian genocide.”

Finally—and staying with the theme of security—Jake Kosek zeroes in on the bees Marx used as a foil for humans, examining the militarization of honeybees and the use of “the swarm” as a metaphor by the U.S. military in the “war on terror.” Grounding his ethnographic practice in his hobby of bee keeping, Kosek follows bees and mathematical swarming algorithms from public debates in the U.S. Congress to DARPA-funded projects at the Los Alamos National Laboratory to the battlefields of Afghanistan. Engaging with clouds of ideas about swarming, Kosek departs from literal descriptions of bee behavior to wrangle with critical theory on the topic (by Deleuze and Guattari, among others) to describe how swarms have found a place to flourish within the modern militarized state. Teasing out the mimetic logic of Pentagon officials, Kosek finds abundant evidence of terrifying animal becomings. The U.S. government is assembling legions of insectoid robots and commanding soldiers to embody the form and tactics of the swarm. Like Hayward, Kosek centers his attention on the sensory differences his subject organisms exhibit from humans—and he shows how these are being exploited and rebuilt for human purposes. A multisensory approach—grappling with unfamiliar sensoriums, with different kinds of touch, smell, taste, and vision—characterizes this multispecies ethnography.

All this work suggests that *Homo sapiens faber ludens* has, as Haraway puts it, “never been human,” or at least never only.⁸ Humans have always been what Haraway calls “messmates,” and what Sarah Franklin (2008) calls “mixmates.” How then might multispecies ethnography mix with cultural anthropology more broadly?

Cultural Anthropology was chartered to bring anthropology into dialogue with articulations of the culture concept issuing from other fields and disciplines, notably cultural studies (see Marcus 1986). The early decades of the journal were keenly interested, too, in literary theory, postmodernism, feminism, and in provincializing dominant traditions. Multispecies ethnography asks cultural anthropologists to reengage with biological anthropology and to take a look at eco- and bioart (as both allied practices and objects of study)—to craft new genres of naturalcultural criticism. Multispecies ethnographers follow Dan Segal’s observation that “whether or not anthropology passes muster as ‘real science,’ it today operates from a position *in* the sciences broadly construed, and, beyond this, that this is something we must learn to negotiate if we wish to participate in more fruitful dialogues with other disciplines and diverse publics” (2001:452; see also Fischer 2007).

Multispecies ethnography is a site for such dialogue. It encourages anthropologists to ask, ethnographically, what happens when *Homo sapiens* and its interspecies, multispecies, and quasi-species familiars, burrow into the biology that animates anthropos?

ABSTRACT

Anthropologists have been committed, at least since Franz Boas, to investigating relationships between nature and culture. At the dawn of the 21st century, this enduring interest was inflected with some new twists. An emergent cohort of “multispecies ethnographers” began to place a fresh emphasis on the subjectivity and agency of organisms whose lives are entangled with humans. Multispecies ethnography emerged at the intersection of three interdisciplinary strands of inquiry: environmental studies, science and technology studies (STS), and animal studies. Departing from classically ethnobiological subjects, useful plants and charismatic animals, multispecies ethnographers also brought understudied organisms—such as insects, fungi, and microbes—into anthropological conversations. Anthropologists gathered together at the Multispecies Salon, an art exhibit, where the boundaries of an emerging interdiscipline were probed amidst a collection of living organisms, artifacts from the biological sciences, and surprising biopolitical interventions.

Keywords: multispecies ethnography, animal studies, nature/culture, bioart

NOTES

1. The phrase “Multispecies Salon” emerged over dinner conversation among Rosa Ficek, Heather Swanson, and Eben Kirksey in 2006 when they were all graduate students at the University of California (UC), Santa Cruz. Later that year, in conjunction with the AAA Annual Meeting in San Jose, Eben Kirksey staged the first Multispecies Salon at Oakes College with support from the UC Santa Cruz Center for Cultural Studies and the Science Studies Cluster. The Multispecies Salon 2 art exhibit was organized in 2008 by Eben Kirksey, Marnia Johnston, Craig Schuetze, Patricia Alvarez, and Christopher Newman with funding from the National Science Foundation (Award number 750722), the History of Consciousness Program of UC Santa Cruz, the Anthropology Program at New College of Florida, and Anthropology at the Massachusetts Institute of Technology. Seventeen artists and intellectuals submitted work to the Multispecies Salon art exhibit: Andre Brodyk, Traci Warkentin, Caitlin Berrigan, Carl Rettenmeyer, David Edmunds, Denise King, Frederic Landmann, Jake Metcalf, Kamil Dawson, Kathy Gritt, Luke Santore, Marnia Johnston, Patricia Piccinini, Rachel Mayeri, Ruth Wallen, Todd Gilens, and Eben Kirksey. Other creative agents included Donna Haraway, Agustín Fuentes, Eben Kirksey, Sarah Franklin, Jake Kosek, Geoffrey Bowker, Susan Leigh Star, Karen Barad, Bill Maurer, Astrid Schrader, Kim TallBear, Paige West, Susan Harding, Heather Swanson, Rusten Hogness, Traci Warkentin, Heather Paxson, Mogu Mogu (Timothy Choy and Shiho Satsuka), Jonathan Marks, and Eduardo Kohn. This article is testimony to, and a product of, this collective and collaborative work. We thank all of these scholars—as well as several more who commented on this essay, including Etienne Benson, Laurel Braitman, and Matei Candea. We thank Mike and Kim Fortun as well as anonymous reviewers for *Cultural Anthropology*.
2. One recent bioart show has centered on Deleuze and Guattari’s ideas about “becoming animal” (Thompson 2005). Deleuze and Guattari distinguish individuated “Oedipal animals” from pack animals that form a multiplicity and a becoming. “Anyone who likes cats or dogs is a fool,”

they write. Deleuze and Guattari then celebrate the social forms of pack animals, like wolves, that “grip every animal in a becoming” (1987:265). We join Donna Haraway in only going halfway with Deleuze and Guattari. In the work of Deleuze and Guattari, Donna Haraway writes, “patrilineal thinking, which sees all the world as a tree of filiations ruled by genealogy and identity, wars with rhizomatic thinking, which is open to nonhierarchical becomings” (2008:28). “So far, so good. . . . But the wolf/dog opposition is not funny. . . . I am not sure I can find in philosophy a clearer display of misogyny, fear of aging, incuriosity about animals, and horror at the ordinariness of flesh, here covered by the alibi of an anti-Oedipal and anticapitalist project” (Haraway 2008:28–30). We side with Haraway in rejecting Deleuze and Guattari’s wolf–dog opposition. Still, we join Deleuze and Guattari in departing from individuated subjects of becoming to explore the possibilities that arise with a swarming multitude (cf. Hardt and Negri 2004:92).

3. On “life,” see, for example, Bamford 2007, Beihl 2005, Franklin and Lock 2003, Hartouni 1997, Helmreich 2009, Landecker 2007, Petryna 2002, Rabinow 1992, and Taylor and colleagues 1997; on labor and (bio)capitalism, see Cooper 2008; Fortun 2001, 2008; Franklin and Lock 2003; Sunder Rajan 2006; Thompson 2005; and Waldby and Mitchell 2006; on language, see Haraway 1991, 1997, and Downey et al. 1995.
4. Although see Fischer, in which “nature” and especially human “nature” is an “ambivalent term” (2009:114), an “odd job word,” or a “covering label for the paradoxical ambiguity” of “that which is both our other and our ‘essential’ self,” with multiple natures—first, second, reengineered—interacting. As “our knowledge expands and reconfigures itself (biochemistry, neuroscience, comparative genomics, etc.) this ambiguity also expands” (Fischer 2009:156).
5. Compare Clifford Geertz’s 1962 essay, “The Growth of Culture and the Evolution of Mind,” which recounts human evolution from Australopithecines forward. In that tale, human nature—defined as culture, argued to be the result of increased brain size and complexification—is more biogeographically driven than it is by “other” species. Compare, too, to Tsing’s claim, Helmreich’s suggestion at the end of *Alien Ocean*, an ethnography of new imaginations of the relation of ocean microbes to human life, that we are witnessing “the saturation of human nature by other natures” (2009:284).
6. For innovative uses of animals to “think with,” see Haraway 1989 (see Strum and Fedigan 2000 for a response), Tsing 1995 (on bees and national identity), Maurer 2000 (on fish and money), and Subramaniam 2001 (on “invasive species” and xenophobia).
7. Tom Boellstorff’s *Homo cyber* (2008) posits that “the human” is an entity characterized by its fashioning as virtual—as always potential. Such forms as *Gyno sapien* or the more linguistically analogous *Femina sapien*, although vanishingly rare, play with and query the gender specificity here.
8. Helmreich (2009:284) suggests the possibility that we are becoming *Homo alienus*.

Editors Note: *Cultural Anthropology* has published a number of essay that map new directions in anthropology, including George Marcus’s “The End(s) of Ethnography: Social/Cultural Anthropology’s Signature Form of Producing Knowledge in Transition” (2008); Daniel Segal’s “Editor’s Note: On Anthropology and/in/of Science” (2001); Michael M. J. Fischer’s “Four Genealogies for a Recombinant Anthropology of Science and Technology” (2007); and Gary Lee Downey, Joseph Dumit, and Sarah Williams’s “Cyborg Anthropology” (1995).

Cultural Anthropology has also published essays on art and/as cultural analysis. See Kenneth George’s “Ethics, Iconoclasm, and Qur’anic Art in Indonesia” (2009), and Liam Buckley’s “Objects of Love and Decay: Colonial Photographs in a Postcolonial Archive” (2005).

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CULTURAL ANTHROPOLOGY



FIGURE 1. Cup Corals, *Balanophyllia elegans*. Long Marine Laboratory, Santa Cruz, California, photograph by author, 2003.

Balanophyllia elegans: gorgeous, tentacular corals: the tips of their knobbed (capitate) tentacles catch the light, making each polyp appear as a miniature display of fiber optics. They belong to phylum Cnidaria, class Anthozoa, order Scleractinia. Through photo/chemo receptive tissue these corals reach into nutrient rich currents with stinging cells (nematocysts) waiting to immobilize prey and pull it into their stomachs. Their forms tremble and deform in the movements of the water generated in a saltwater lab in Santa Cruz, California. My own experimenting fingers grope, manipulate, and reach. Cup corals seem full of touch, of sensing, or rather of being literally tact, touch; their tentacular sense—their fingeryeyes—respond to surface effects, caressing. Their totalizing hapticity evokes the kind of sensorial-ontology that Karen Barad has described in her accounts of brittlestars, unrelated organisms in phylum Echinodermata: “Brittlestars don’t have eyes; they are eyes. That is, it is not merely the case that its visual system is embodied; its very being is a visualizing apparatus” (2008: 324). If Barad’s brittlestars are “living breathing metamorphosing optical systems,” the very being of cup corals is a haptic-sensory apparatus. They “touch,” therefore they are. It is not the site of contact, of copresence and conflation, but rather the effects of passing excitation that produces this ontology.



FINGERYEYES: Impressions of Cup Corals

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The self-misrecognitions of marine invertebrates undergoing metamorphosis—as arrays of light-sensitive pigment spots and neural nets glimpse and process bodily reflections from the undersides of watery surfaces—could hardly engender foundational illusions of single, well-organized subjects. But the multiply diffracted and refracted rays of light coursing through salty oceans power the lively practices of connection and communicative commerce just as surely as the straight-arrow rays of extra-terrestrial optics drive more single-minded projects of cosmic clarification.

—Donna Haraway (1995:xi)

IMPRESSIONS OF SCIENCE, SENSE, AND SPECIES AT LONG MARINE LAB

The Long Marine Laboratory is located on the outskirts of Santa Cruz, a beach town in California. Driving through the main gate, across a browning field, I approach the Pacific Ocean, at the edge of the Monterey Bay. The glare from the seawater on this September day in 2004 is blinding. I recall Gaston Bachelard's *Water and Dreams: An Essay on the Imagination of Matter*, in which he instructs readers to look beyond their own image reflected back to them, to begin to see the world gazing inward: "The world wants to see itself. . . . Water reveals. . . . Water is a large tranquil eye" (1983:15). For Bachelard, water is imagination made material. Through this medium, he seeks to show the thickness and thingyness of knowledge; it is not so much that water has intentionality, but that the effects of water can be felt everywhere. On the Northern California coast, the pulse of water is palpable.

Simple in architecture and color, the Long Marine Laboratory blends into its setting with large green sheds. From the lab the land rolls out flat, only to fall away at a high cliff that fronts onto the water. At the base, the ocean roars aloud its own wet substance, its own poetics, its own modes of contact: saturating, shimmering, sonic. Here, human perception is refracted, textured by the encounter of shoreline and ocean. At the mixing point of water–air–earth, the interface of sea sciences and ecosystems, and the nexus of ocean policy and materiality, the scene is both adamant and fluid. Marine scientists and managers focus multiple optics, zooming in on tiny microorganisms or charting large-scale migration patterns of whales. Among the phenomena coming into view for scientists at the lab: the underwater falling of marine snow (detritus generated in the productive surface, the photic zone), the lives of elephant seal pups, environmental pressures on California squid, and massive blooms of *Velella velella* (By-the-Wind Sailor, a jellyfish-like siphonophore composed of masses of mobile hydroids that travel at the water's surface). Whether scientists focus near or far, marine organisms everywhere come to matter as actors in the multiple areas they inhabit. As Donna Haraway would have it, things are “Never purely themselves,” but are, rather, “compound . . . made up of combinations of other things coordinated to magnify power, to make something happen, to engage the world, to risk fleshly acts of interpretation” (2008:250). At Long Marine Laboratory, where compounded things are made concrete, I found myself entangled in “moist threads” (cf. Puig de la Bellacasa 2009). The lifeways and labors of marine animals are the coralline reefs of this lab; I helped build knowledge on their “zoontologies” (Wolfe 2003).

Over 130 UC Santa Cruz principal investigators, postdoctoral researchers, visiting scientists, graduate students, and undergraduate students use the facilities at Long Marine Laboratory each year. It is a well-established site for research in areas such as diving physiology, physiological ecology, bioacoustics, and cognition. Attention to senses and sensing for both humans and animals subtends these research activities. Some tanks have been designed to control noise, while others offer underwater viewing, providing researchers with aquatic vantage points that also enable marine mammals to look at their captors—much like the animals in Natalie Jeremijenko's Ooz art installation, in which *zoo* is spelled backward to frame an “architecture of reciprocity.”¹

At first blush it seems that information at Long Marine Laboratory flows one way—to humans, to scientists. High-speed video cameras retool time, seizing on details of organismic life. Kreisel tanks create circular currents for pelagic forms like jellyfish medusae or ctenophores with diffracting cilia, making each of

their drifter locomotions observable. Hydrophones transduce sound waves into stimuli for terrestrial eardrums. Compound microscopes protract eyes into the unseeable, while expanded frequency tape recorders hold marine sounds for further investigation. Oxygen and blood–gas analyzers give accounts of bodily labor, and specialized cages for transporting pinnipeds and cetaceans are but one way through which ocean creatures out there are forced to work, play, signify, and, most likely, die in here. Insides become outsides and exteriorities become interiorities; sensoria and sensations are made and unmade. The power of who observes and who is observed is tentacled through machines and expertise at ever-changing scales and grains of resolution.

But all these forces are quite literally impressed on organisms such that bodies (human, animal, machine) carry the markings, the fleshly and instrumental inscriptions, of the other. I am reminded of *Sensory Exotica* by Howard C. Hughes (1999). Working through the biomechanics of animal senses, Hughes maintains that technologies such as sonar and electroreception bespeak a human envy of nonhuman sensoria.² At Long Marine Laboratory, the apprehension of the other reaches across a multispecies space of transit by way of somatic stimulus and material representation. The lively character of mediation is fashioned through the unmetabolized activities of animals such that “looking” is akin to brachiating from animal, machine, motive, and organ. These residues, condensations of zoöeypresences, which impress from within the “epistemological engines” (Ihde and Selinger 2004) of marine science, are at once the source and the objects of sense making.

Through what other lenses might these engagements between human intentionality and the agency of multiple species, land and sea, ethics and knowledge production, be apprehended? How, for example, is this intertidal zone an arena where species meet not just as different critters, but also as objects and subjects of different sight, sense, sensibility, and sensuality? This arena can be usefully registered through a haptic-optic I call “fingeryeyes.” I use *fingeryeyes* to explain the tentacular viscosity of cross-species encounters and to name the synaesthetic quality of materialized sensation. Perceptions are moved (affected) by the movements and actions that they provoke in other organisms. Stirred by the ripples of investigation that emerge in the arrangement that we may touch, senses are amalgamated, superimposed, forging cross-species reticulations and sites of solid-arity. This kind of transversing is navigated by constantly accessing the medium of the meeting and the accompanying beings and things. From this point of view / touch of fingeryeyes, species are impressions, thresholds of emergence.³

The *Oxford English Dictionary* (OED) tells us that an impression is “an idea, feeling, or opinion about something or someone; an effect produced on someone; a difference made by the action or presence of someone or something; a graphic or pictorial representation of someone or something; or, a mark impressed on a surface by something.” And *species*, the OED reminds us, has as one of its meanings “A mental impression; an idea.” Impressions, then, are about how “species of all kinds, living and not, are consequent on a subject- and object-shaping dance of encounters” (Haraway 2008:4). Attending to the interplay of vision and touch, I invoke fingeryeyes to articulate the in-between of encounter, a space of movement, of potential: this haptic-optic defines the overlay of sensoriums and the inter- and intrachange of sensations. Fingeryeyes, in this instance, is the transfer of intensity, of expressivity in the simultaneity of touching and feeling.

The ways species and their constituting senses are impressed should not be understood simply as offering a cozy closeness; impressions are also traces of indigestible beings that feed on signifying practices, populating meaning with multiple kinds of matter. If species are impressions, they are also mediations. Impression registers the reciprocal nature of being touched in the act of touching, as well as the double meaning—as in “having an impression of” or “making an impression on me”—of knowing and being. What sense, then, is generated in the sensuous, and often superintending, contact of laboratory animals? How do creatures, with all their perceptual grappling hooks, transplant rousing knowledge across species divides, and how are senses, then, indices of human-animal meetings?

ENCOUNTERING *BALANOPHYLLIA ELEGANS*

To get at these questions, I conducted a multispecies ethnography of *Balanophyllia elegans* (cup corals) at the Long Marine Laboratory.⁴ These corals—with their Latin species name meaning elegant, fine, handsome (derived from the earlier word *eligere* [pick out, or choose])—make an impression: aesthetically, haptically, ontologically, and, I find, sensually, sexually. Residents along the California coast, they are locals in the lab. Solitary and temperate, they inhabit low intertidal regions, gleaning, living, spawning, and metamorphosing in the surging waters. Batteries of nematocysts, stinging cells, guard their cup-shaped external skeleton, and organelles called spirocysts anchor them to ocean floors (Kozloff 1995). Waves and oscillations of seawater and flesh texture these life forms.

B. elegans have neither fingers nor eyes, not in the same way a human might, but through their sensing tentacles they and I, they and marine biologists, share sensorial resonance with different affects (responsiveness) and percepts. Through

our mutual capacities to engage the other, we leave impressions as the residuum of our interactions. Fingeryeyes is about multispecies and multimedial sensing. And in the way that ethnomusicologist Steven Feld (1982; Feld and Basso 1996) invites us to privilege sound over sight for knowing culture or sounding-out specific locations, I suggest that an attention to texture as it is generated through the constitutive supplementarity of vision and touch can offer novel prehensions of the relationships between species.⁵

To see, to feel, to sense, and to touch—"fingeryeyes"—slide into each other, making new prepositions of observation: seeing with tact; touching by eye; feeling from vision.⁶ Fingeryeyes synaesthetically blur distinctions that Jennifer Fisher (1997), a scholar of hapticity, describes: "The haptic sense, comprising the tactile, kinesthetic and proprioceptive senses, describes aspects of engagement that are qualitatively distinct from the capabilities of the visual sense . . . where the visual sense permits a transcendent, distant and arguably disconnected, point-of-view, the haptic sense functions by contiguity, contact and resonance." Fingers register the optic, hovering not only between touch and sight but also between animal and human, incorporating these alterations into morphology and behavior. Sensing, as the coral teach me, is not so neat.

Fingers are of course not the only arbiters of the verb *to touch*; that is to say, our eyes are contiguous with—not divisible from—the body's sensorium. Embodied vision is necessarily accreted by the other senses and their amplification. In this way, sight is of the body, not just in the body, and this effects a distributed sensuousness. The kind of digit-sight vivification described here attempts to answer questions posed by Natasha Myers: "Can our visualization technologies be used to implicate our bodies, rather than alienate them? Can our bodies' tacit knowledge be brought into play to add depth to biological strategies?" (2005:262). Crossing the animating impact of nerve organs, fingeryeyes diffract seeing through touching; optical groping, or tactful eyes, haptically and visually orient the sensual body across mediums.

In what follows, I look at various mediums—lab space, microscopes, seawater, and semiotics (cf. Helmreich 2009)—and at multiply mediated cross-species compositions.⁷ In the anarchic spirit of Paul Feyerabend's *Against Method* (1975) I do not offer a programmatic approach to multispecies ethnography, opting rather for something located between phenomenological traditions (particularly those from my training in film studies [Marks 2002; Sobchack 2004]) and feminist/queer theories of embodiment (Bartkowski 2008; Halberstam 2005). Attention to bodiliness defines the terrain of my questions, along with sensitivity to philology, to the

effects of my language of description. Translating the quality of audiovisual experience into the register of words, Laura Marks argues that the critic must “make the dry words retain a trace of the wetness of encounter” (2002:x). Heeding Marks’s call for “haptic criticism,” I often enunciate the feel of motley species affiliations through partial, speculative, and perversely physical word play—which works, I hope, in its way, against method but for encounter.⁸

Although concerned with the sensuous in all its forms, I stay equally fastened on shifting the accent onto the sensitivities of these corals. As I experienced epistemological revelry the corals remained objects of biological and ethnographic research; I do not intend to downplay this fact. Animals do suffer and die. They are induced and selected under the instrumental force of experimentation, which can result in becoming disembodied, even dismembered, bodies. Even so, as important as critiques of control and captivity are, we must also recognize how laboratory practice is never a totalizing production, but is also loamy with unexpected effects (cf. Haraway 2008). Responsiveness to the textural qualities of experimentation is part of any ethical account, any nonanthropocentric record, of what happens when species touch each other in fraught zones of intercourse.

Within Long Marine Laboratory, in the lab of Donald Potts, a marine ecologist, a host of non-mammalian, spineless, non-bilaterally symmetrical entities have been pulled out of the pelagic zone and into the sediment of University of California, Santa Cruz graduate student research where they will respire, be experimented on, and probably expire. Peoples, machines, and their shared activities seem to “mimic the complex communities of marine organisms, whose traffic in sustaining nutrients and meaningful signals tie dispersed members into unquiet webs of polyspecific living tissue” (Haraway 1995:xii). The water in the lab is biting cold, pumped in directly from the bay. The interior space is fairly low-tech; limited funding for research has turned dishwashing tubs, 10-gallon aquariums, and odd plastic pieces into saltwater tanks, flow systems, and “test populations.” Moon jellies (*Aurelia aurita*), opalescent nudibranchs (*Hemissenda crassicornis*), and orange cup corals (*B. elegans*) are caught up in the practices of egg releasing, laboratory chatting, population studying, larval feeding, microscopic looking, computer calculating, and animal dying.

All this layering, digesting, and registering solicits fingereyes and brings into focus Stefan Helmreich’s reworking of Haraway’s reef metaphor for collective forms of writing and speaking. Haraway compares “the layered conversations of patterned interviews among interlocutors who are distributed in time, space, linguistic commitments, and political yearnings” with lifeways of coral ecosystems (1995:xii). “Coral reefs,” proposes Helmreich, “can attune human visitors and

inquisitors to empirical and epistemological questions of scale and context—where context, drawing upon a once-upon-a-time literal but now more figural meaning, refers us to a ‘weaving together’” (in press).

Such weaving together is why I entered the Potts lab as a research volunteer for (and ethnographer of) Cris Vaughan, a Ph.D. candidate in Marine Biology at the University of California, Santa Cruz, who has since finished her dissertation on the reproductive ecology of *B. elegans* (see Vaughan 2004; see also Gerrodette 1981). She is a fellow “easterner” (we share a distinctly New England diction) drawn to the Pacific, and she knows a great deal about genetics, conservation biology, and *Star Trek* (Cris deciphers the invertebrate-ness of *ST* extraterrestrials, showing me how inverts are already aliens among us). Unlike her, I was not a marine scientist in the making. At best, and this is what I said, “I am a student of film and photography and have an interest in how animals are studied in natural history and laboratory environments” (cf. Hayward 2005). I explained that my questions were about how representations shape the lives of animals, and about whether it is possible for these fleshy beings to intervene in their own representations (cf. Latour 2004). Rather than passive surfaces reflecting human intention, might animals act upon us in surprising and nuanced ways? I have some previous experience in biological laboratories too, which is perhaps why Cris welcomes me; during my studies at the College of the Atlantic (Bar Harbor, Maine) I worked with humpback whale conservation biologists at Allied Whale.⁹

My multispecies ethnography is only partially an ethnography of marine biologists. I found that just talking to cup coral experts—interviewing Cris and her labmates about their work—and being a participant-observer of routine laboratory tasks was not enough. I began developing my own practice—fingeryeyes—for knowing by percussing, touching, and tasting across species lines. My study of cross-species stimulations unfolded alongside Cris’s own biological investigations: we engaged in different disciplinary projects in the same space. I did not come to know the corals the way she does though I did learn from this same population of corals through my own carnal knowledges. Cris’s and my projects did not always inform one another but the laboratory was a zone of multispecies and multidisciplinary coherences. We cohered.

Cris taught me to know the milieu of corals, the way they generate their beingness in relation to other organisms and environments. Coral are a composition of faculties, a tuning with environment that can be described as inhabiting what Jakob von Uexküll called an “Umwelt” (2000), a perceptual address.¹⁰ Early on, and I did not know how to say this to Cris, I was there to understand something

about the modulations between species, the sense and sensibility of cross-species materiality. By materiality, I mean as Marshall McLuhan put it, that “the medium is the message,” such that matter is not only a dynamic becoming (Barad 2003) but is also a transmedium mediation—a mediation through which surfaces are not produced as refrains, but as lenses. Passing through creates remainders of filterings that result in texture. Boundaries remain refracted interfaces of passage, prepositional orientations. Texture is the unmetabolizable more of animate forces moving across bodies and objects.

OF SEX AND SPECIES

Cris and I commented on our different experiences with *B. elegans*. What attracts one to study corals? Why are corals compelling? What are the emotional, social, and visceral effects of working with corals for years? For Cris, these questions did not necessarily interfere in her scientific investigations, and she did find them interesting, too, an unexpected frame for stepping back from her daily routines in the laboratory. For me, this backgrounded dimension of affects gestured to a “contact zone” where intensities move between materialities (Haraway 2008). So when a coral’s tentacles reached out to eat, and it “tasted” my fingers and retracted, a moment of sensitization, this was a provisional togetherness, a pulse of possession, an instance of fingeryeyes. We did not engulf or overcome each other in this act, but we pressed against the other. Cris, the corals, and I were there in this lab, responding through our different perceptual worlds, through percepts we improvised and entwined with each other, however temporarily, producing texture, a tissue of incitement that made us with and through the world.

While a large portion of Cris’s work took place in the field, my work with her happened in a lab where she had already sex segregated 300 corals, to control their fertilization. My role was simple: I cleaned them, checked for eggs, and looked for sedentaries. In Cris’s words, sedentaries are large, “internally brooded, lecithotrophic (yolk-feeding) planula larvae that are released during winter and early spring in an annual planulation cycle” (Vaughan 2004:80). (See Figure 2.)

Cris’s attention was on gametogenesis (the formation of sperm and eggs), on the release of larvae, and on growth in these solitary cup corals. Under various environmental and endogenous (originating from within an organism) conditions, she investigated these topics using three main approaches: (1) monitoring the release of larvae in two laboratory populations exposed to different photoperiods (periods of light–dark); (2) investigating the differences made by genetic difference and maternal feeding frequency on larval release, growth, and settlement success;

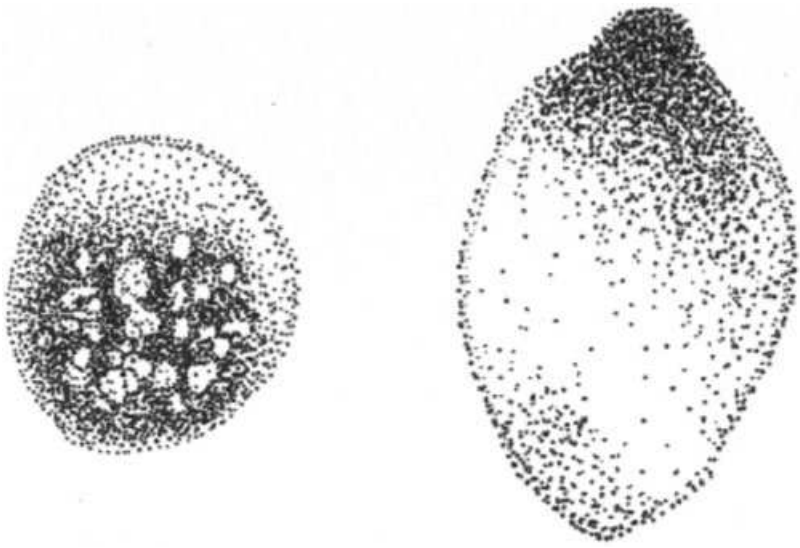


FIGURE 2. Egg and Larva. Drawing by author, 2010.

and, (3) exploring possible effects of chemical cues and sperm on larval output and coral growth by manipulating indirect exposure to members of the same species. She has two working hypotheses: (1) corals compromise their immediate reproductive fitness to increase growth, which may provide enhanced fecundity in the future; (2) changes in seawater temperature (as seen in El Niño years) affects reproductive output. Her first hypothesis invites immediate questioning: how do corals feel their futures? With what ontoepistemological apparatus do the corals assess their own “reproductive fitness”? Both her queries are anchored, like much biological thinking on sex and reproduction, in questions about gametes.

Eggs and sperm become narrative elements that provide meaning to sex and species differences (cf. Martin 1991). Positioned as oppositional forms, egg and sperm are ordered as foundational units, anchoring the expressions of sexual and social selectivities to the ruling forces of natural selection. Perhaps because I write from a queer perspective, I worried (maybe defensively?) that Cris’s experiments positioned cup coral reproduction as governed entirely by a functional selectivity, leaving little room for the random, the unpredictable, the expressive. Would it be possible to imagine a more dispersed or dynamic notion of sex? Might sex be also about behavior or life history, rather than just gametes (Roughgarden 2004)? I kept my eye on these questions as I did my work.

In the time I volunteered at the lab, Chris had moved from experiments on the effects time and temperature have on fecundity to investigating how environmental

resources alter reproduction. In laboratory experiments, corals were fed at different intervals, which affected their individual growth and investment in fecundity (Vaughan 2004:x). The reduction in larval production, Cris thought, was probably caused by a limited number of sperm and a 3–4 month brooding period rather than reabsorption or storage of embryos, which contradicted the 15-month brooding period formerly proposed for this species. “Growth rate was negatively related to reproductive output among conspecific exposure treatments: corals exposed to males produced more larvae but grew less than corals isolated from males,” she wrote in her dissertation (2004:xi).

Cris collected corals from two geographically distinct populations: Breakwater Cove in Monterey, and the Hopkins Marine Life Refuge in Pacific Grove, California. She assigned corals from each population to two feeding-frequency treatments in the laboratory to assess “their relative fitness (based on settlement rate and size), and then analyzed the data for geographic, maternal, or direct nutritional effects that may be correlated with larval success” (2004:82). I groomed these corals when they arrived in the lab, removing all of the organisms encrusted on their skin. Attaching them to PVC with superglue, I gave them each a random number. We sexed all the corals before male spawning occurred, by “extracting gut contents with a Pasteur pipette and examining them for sperm under a compound microscope; corals without sperm were assumed to be female” (2004:83).

Attending to gametes (asking who produced sperm, and who larvae) permitted Cris to assume who was “female” and who “male”—even though some individuals remained in flux throughout the experiment, suggesting that these corals may have asexual (clonal) ways for generating generations, which would challenge the assumption that these corals reproduce sexually (cf. Fadlallah and Pearse 1982; Jackson 1986). Although asexuality might be a possibility for *B. elegans*, Cris felt certain that these corals relied mostly on sexual reproduction (see also Ayre and Resing 1986; Hellberg 1994; Hellberg and Taylor 2002), and that variation in access to populations of the “opposite” sex “appears to shift energy allocation towards growth rather than reproduction” (Vaughan 2004:180). Cup corals reproduce by releasing eggs into the parents’ gastrovascular cavity (see Figure 3) where they are fertilized and undergo development to the planula stage before release. Presumably, then, the isolated “females” in our lab would stop producing larvae. However, this assumption was not supported by the results—some of the indeterminate individuals in Cris’s laboratory continued to produce larvae. Cris accounted for this as measured error, but in our discussions she considered the possibility that

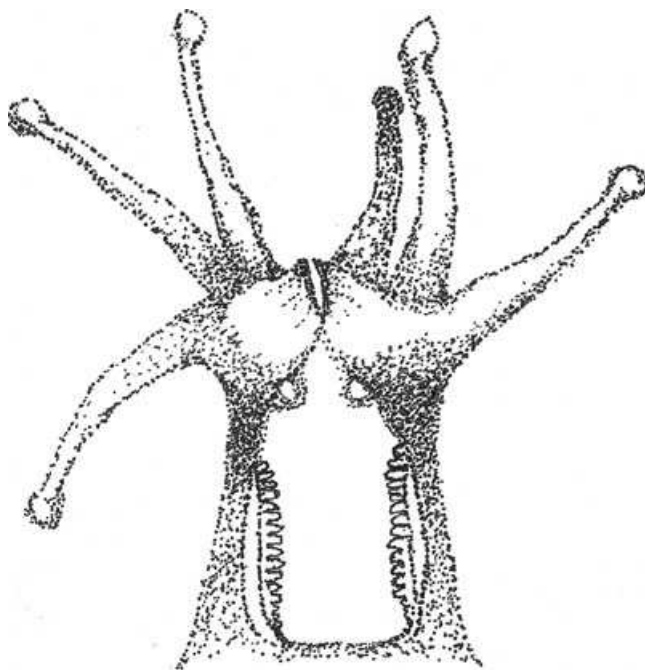


FIGURE 3. Polyp. Drawing by author, 2010.

corals might adopt parthenogenetic (perhaps through an ability to store sperm) or even clonal modes of reproduction.

INVERT, PERVERT

While Cris's work opened up intriguing questions about coral ecology, what about "reproductive strategies" and their subtending functionalist assumptions regarding adaptation (cf. Haraway 1989)? How did sex-assumptions drawn from intuitions about human and mammalian reproduction possibly enriddle corals with anthropocentric and even Euro-American-centric intentionality? How was a self-contained teleology scripted into these projects? I responded with critical hives to the ontological substrate of these experiments (and it is not that Cris did not also have her own critical response but, rather, the forces of funding, institutions, verifiability, seniority, and support are unavoidable). "Sex," as Monique Wittig has argued, refers to both bodily activity and identity, but under the sign of heteronormativity, has been conflated with reproductive activity, which has in turn led to the hypostatization of "sexes," identities defined by their relation to this activity. Wittig points out that this metonymic making of sex—which takes parts for wholes—naturalizes sexual difference and normalizes heterosexuality.

"Heterosexuality is a cultural construct designed to justify the whole system of social domination based on the obligatory reproductive function of women and the appropriation of that reproduction" (1979:119). My sensual, sexy, fingeryeye involvement with *B. elegans* led me phenomenologically, perversely, similarly to disarticulate sex, sexuality, and reproduction—to consider Vaughan's investigation of coral "reproductive strategies" as only one way to configure what it might mean to "sex" corals.¹¹

All this critical thinking through sex and sexuality became explicit in my conversations with Cris one day when she remarked "Inverts are so cool!" In a wry-ironic tone, playing with the politics of identity, I say, "Yes, 'my people' are pretty fantastic." Cris and I talked across disciplines, often with tricky mistranslations; here she used "inverts" to mean critters without backbones such as the invertebrates in our tanks, while my friends in queer theory speak about "inverts" who are neither temperate nor solitary! I cannot resist reading the etymological interlacing of "pervert" and "invert" (see Wilson 2002:284). Perverting meaning, inverting power, gendered perversions, coralline inversions: inverts and pervers ask us what the world could resemble if we saw the borders separating selves—others as receptive, magnetic to "those others whom we resemble though we may be inclined to insist that we do not recognize them as our coevals, our co-evils" (Bartowski 2008:3). Two parallel worlds that are not, in fact, incommunicable. Perhaps both species of "inverts," the kind without backbones and the sort who transpose gender roles, interrupt heteronormativity, although not for the same reasons, but because of a shared activity of making bodies pliable, mobile, transposable. What does the "in" prefix mean in invertebrates and inverts? For invertebrates "in" would be from the OED's in- prefix 3, "to express negation or privation." And for inverts that "in" would be from the OED's in- prefix 1, "to turn, change." The "in" means different things in invertebrate and invert. The false cognate produces a pun, but puns are often potent precisely because of the way they misbehave etymologically, how they bring differences close.¹²

The linking of pervers and inverts—what Lindsay Kelley and I call "trani-imals"¹³—is not a naturalizing move, nor a hostile conflation of queers and animals, but an attempt to trace sexualized alterities that rework "culture" and "nature."¹⁴ Even the etymology of "inverts" (and the punning that it evokes) alludes to inclusions, hinges, dependencies. Different kinds of inverts are substantively related in practice and history, and are, to varying degrees, transumptions, tropes of a trope, in which differences are produced not through distinctions but through what Karen Barad (2008) might call "differential becoming."

Cris responds to my anecdotes, saying, “After studying invertebrates, you have to believe that every animal tends toward some kind of polymorphous sexuality.” She tells me about species of starfish who reproduce themselves from a broken limb; about the range of simultaneous hermaphroditism and sex-changing in gastropods; and about the “inventive” reproductive practices of marine worms. Far from being “inherent” or “predetermined,” sexuality is more a matrix in what Judith Butler (1993:15) calls “a reiterative or rearticulatory practice, immanent to power,” of environmental and cultural forces that impress themselves into the build of flesh and bones. The relay of meaning between human–animal sexuality, particularly with regard to nonheteronormative modes—I think here of Elizabeth Wilson (2002) and Myra Hird’s (2004) scholarship—should not be an essentializing move, as in “animals are queer so then queerness is natural,” but an opportunity to see the ways “natural perversity reorganize[s] our culture-centric theories of difference, embodiment and identity” (Wilson 2002:284).

Cris offers that animals exceed the illusionary absolutes of heteronormativity, monogamy, and sex. She explains that rather than make direct correlations between reproduction and sex, we could see that much of what sexual selection produces is excess, profusion, surplus. In the words of Richard Doyle “sexual selection excels at the momentary breakdown of inside/outside topologies” and thereby generates “not fitness but entanglement” (2007:80). Loosening the bond between sexuality and reproduction not only undoes an necessary functionalist argument but also performs a sort of surgical reorientation that allows for the bioaesthetic, the exaggerated and nonteleological.¹⁵

SYNAESTHESIA AND THE SUBSTANCE OF SPECIES

Flushing out cup coral gastrovascular cavities with a plastic dropper, I cleaned them of food debris (bits of brine shrimp), the particles that would usually be rinsed away in the water’s rush. So much mud and muck! When they spawned, in a grouping of twenty individuals, I relocated them from their tubs to plastic cups for a short time. My fingers crossed the air–saltwater threshold. The overhead light was refracted, bending corals and human digits into different spatial registers. My fingeeyes feel their orange bodies as firm, but spongy, their substance slick, but pebbly toward the bottom of their stock. They consist of skin with a single orifice that is simultaneously “mouth,” “anus,” and “vagina,” and, for males, a site for sperm production. (See Figure 4.)

Their tentacles reached out as my digits and tools reached toward them. The thickness of the skin on my hands protected me from their sting, but even still

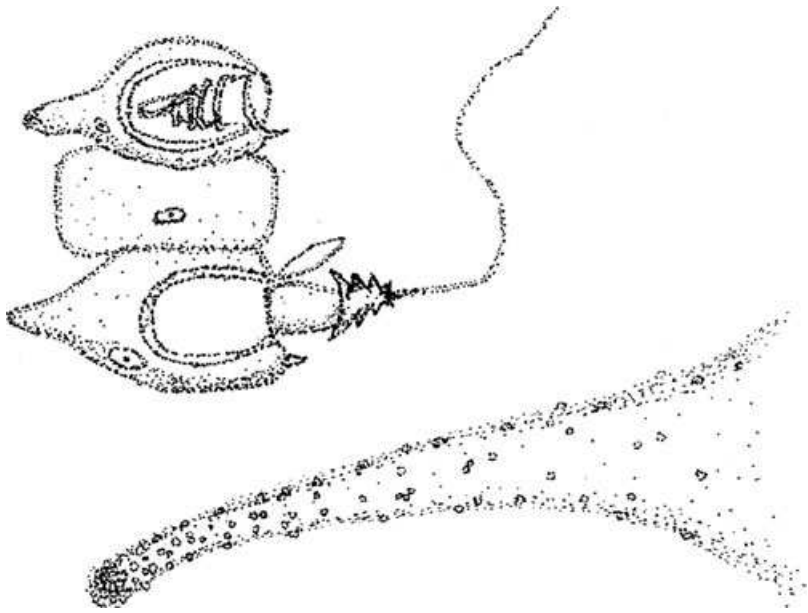


FIGURE 4. Tentacle and nematocyst cells (released and unreleased). Drawing by author, 2010.

I felt a slight tingling at points of contact. For a moment, we, the corals and I, enfolded elements of each other within ourselves. With surprising speed, they retracted their fringes in response to my prodding. There is no question that they are responding to predator/prey impulses; the power is decidedly asymmetrical. Perhaps they do not suffer these handlings, if “suffer” is the right word, but it is clear that attempts to acquire knowledge is not without “response-ability” for both humans and corals (Haraway 2008).

Knowing that these inverts emerge from a “dynamic, environmentally dependent process that integrates ontogeny with habitat selection” (Bishop et al. 2006:662), I wonder how the generations in this lab are modifying their ontology to our work. I know that they don’t have “eyes” or “fingers,” even if I must know them through my own fingeryeyes. Their sensory capacities are decidedly their own, with chemoreceptors (which transduce a chemical signal into potential action) and mechanoreceptors (which react to mechanical pressure or distortion) measuring the flow of water and the presence of prey or potential predators around them. It is tempting to translate their senses through my own—a “tasting touch” or a (c)orality—but what is at work in the intersections of species and senses might more approximate a synaesthetic multispecies reach, exchange, thrill, a transmission among sensing bodies.

David Howes, in the introduction of *In The Empire of the Senses*, offers the trope of “emplacement” as different to embodiment. He writes, “While the paradigm of ‘embodiment’ implies an integration of mind and body, the emergent paradigm of emplacement suggests the sensuous interrelationship of body-mind-environment” (2005:7). With *fingeryeyes*, we might boost emplacement with an attention to texture, animation, galvanizing drives, such that emplacing is defined by the quality of invigoration and its transfiguration of future emergings, of senses and species that may yet emerge. We are embodied in relation to the world, or better said, we are enfleshed through affections with an animating world. Steven Connor reminds us that, in French, “sens” means sense and direction; the senses are ways, corridors, venues through which we experience worldliness (2005b). Connor conjectures that “the body is the work of transforming mere sensitiveness into sense and sensibility both: the body is its work of transformation.” And indeed, “There is no chance of getting back to the body, since it is the nature of the human body to be self-organizing and therefore self-surpassing” (2005b:331). To qualify Connor’s point: although we never get “back to the body,” we proliferate bodiliness rather than self-surpass our flesh. We deterritorialize the body through our “island of senses,” the conditions of corporeal enunciation.

The coralogical impressions of *fingeryeyes* that I have described cannot be agnostic about animal well-being because ontology is what is at stake. Cross-species sensations are always mediated by power that leaves impressions, which leaves bodies imprinted and furrowed with consequences. Animal bodies—the coral’s and mine—carry forms of domination, communion, and activation into the folds of being. As we look for multispecies manifestations we must not ignore the repercussions that these unions have for all actors. In the effort to touch corals, to make sense of their biomechanics, I have also aided in the death of the corals I describe here; this species-sensing is not easily refused by the animals.

B. elegans, elegantly moving through tentacling senses, teaches me—just as I study them with my *fingeryeyes*—that the relationships between senses and species are unruly. They are in somatic cross-mutation. This is about how “species of all kinds, living and not, are consequent on a subject- and object-shaping dance of encounters” (Haraway 2008:4). Impressions. About this zoo-indexicality of perceptual instruments, Connor has written, “Increasingly, the animal realm has come to seem like a sensory resource, enabling us not just to hitchhike on the sensory capacities of other species, but also to develop new kinds of perception.” He goes on to say, “Even where the animal is not literally present, the mediation of the animal is retained, in idiom and metaphor, as well as in the subsidiary organs

we develop to inform our sensory technologies” (2005a). In the case of *B. elegans*, the tentacularity of its own body informs—impresses upon me—the way I produce knowledge through my body, the way I know because of my fingeryeyes. The laboratory is a teeming site in which humans and animals live—die, touch—see, and know—be. Bodies are not only substantively solicited by the otherness of the world but are also invoked through this otherness.

Corals, here, are everywhere impressions in what at first appears to be purely anthropocentric effort. Texture and sensation are the energetic forces, coextensive overlappings, shared milieus that make species. Species are sensuous responses. The OED tells us that a species is an “emission or emanation from outward things.” Rather than bodies as direct products of environments, I suggest that an organism’s responsiveness with an environment are the conditions of its emergence. The organism is a transitional response to its sensorial limits, which are always an incitement rather than a determinant; that is to say, through its corporeal and sensorial capacities it attempts to coordinate with its own specified environment. An organism is not a reaction to an environment, but rather through its senses it manifests with and of an environment as an improvisation. And in this saltwater lab, between the corals and me, our capacities become syncopated, we improvise (not necessarily a question of intentionality): I reattune my primate senses as they pass into water; the dissonance of scale refines my sense of vision with touch; my body builds out a sensory sphere that attempts to harmonize with the corals. As for corals, they too adjust to their environment: they feed differently in the nontidal zone of the laboratory; they respond to the segregation of sexes; their bodies strive varyingly in artificial darkness—lightness. So, species are not only relationships, nor are species ever directly in relationship with other species, we are resonances and dissonances of intensification, energetic cadences of one another. Even in the temporary space of the lab where primates and corals are more likely to “touch” than out in Monterey Bay, where corals grapple for food while humans reach for them with curiosity, where spawning is confined to sink trays rather than open water, there is expressive inter- and intra-change between us. We constitute a sensorial ensemble, becoming more than ourselves.

ABSTRACT

In When Species Meet (2008) Donna Haraway proposes that creatures’ identities and affinities emerge through their encounters, their relationships. Following Haraway’s lead, I attend to how different species sense and apprehend one another, leaving impressions—concretenesses of perceptual data, or texture. This essay reports on fieldwork

alongside marine biologists and with a population of cup corals (B. elegans) housed at the Long Marine Laboratory, Santa Cruz, California. While I assisted researchers who were studying metabolic rates and reproductive strategies in coral communities, these cup corals simultaneously taught me that being and sensing are inextricably enfolded. We were variously situated—corals generating generations, me interpretations. We met through a material-semiotic apparatus I call “fingeryeyes.” As an act of sensuous manifesting, fingeryeyes offers a queer reading of how making sense and sensual meaning are produced through determinable and permeable species boundaries.

Keywords: laboratory studies, anthropology of the senses, animal studies, coral

NOTES

Acknowledgments. I am grateful for the editorial guidance that Stefan Helmreich and S. Eben Kirksey gave me through the writing of this article. Without their generosity and patience this essay would never have happened. I also thank Donna Haraway for commenting on early versions. I presented this material at two conferences, Animals: Past, Present, Future, Michigan State University, 2009, and 7th European Feminist Research Conference, Utrecht, 2009, and received many excellent questions that helped define my arguments.

1. Jeremijenko's (2002) “amphibious architecture” offers an artistic critique of the species divide created by architectural forms. Exploiting the poetics of the water–air threshold, she suggests deployments of refractions and immersions to unsettle distinctions between humans and other species.
2. Bioenvy followed by biomimicry, has, according to Steven Connor, turned the compounding eye of flies into the figure of the lens; he writes, “Mechanisms of various kinds take over the role previously assigned to animals. The canary which detected dangerous levels of gas in mines is replaced by a chemically sensing device. The development of sonar equipment is made possible by the understanding of echo-location in bats and other creatures” (2005a). In *Anthropological Futures*, Michael M. J. Fischer suggests that transducing vision with the capacities of other species has made it possible to extend the placement of the human eye. “*Drosophila* genetics allow eyes to be multiplied or placed in novel positions . . . assemble multiple fragmented views” (2009:167).
3. In *The Companion Species Manifesto: Dogs, People, and Significant Otherness*, Haraway defines species as a resonance of “four tones”: 1, a biological category shaped by evolutionary forces; 2, a philosophical category used to connote difference; 3, an alternate representational unit that joins semiotics to materiality; and 4, “dubious etymologies” that link species to “filthy lucre, specie, gold, shit, filth, wealth” (2003:14–16).
4. S. Eben Kirksey and Stefan Helmreich employ “multispecies ethnography” to denote a mode of ethnographic investigation that “centers on how a multitude of organisms’ livelihoods shape and are shaped by political, economic, and cultural forces” (this issue). This approach isn’t about “simply celebrating the fact of multispecies mingling” (this issue) but also, following Susan Leigh Star, attending to power, to who benefits (Star 1991).
5. Compare the work of Geerat Vermeij, a blind marine biologist at UC Davis who taxonomizes shellfish based on the feel of their shells (Costa and Cutkosky 1995).
6. Anyone who has attended a Donna Haraway talk, or sat in her classroom, or chatted with her, knows that signature finger wiggling of hers used to emphasize layered concatenations of actors, networks, and knowledges. My invention of “fingeryeyes” comes from an advisory meeting in which we discussed an essay that I had written about cephalopods and film (2005). In talking to me about research directions, she described a moment of watching cuttlefish tentacling, limbing, and illuminating in the throes of sexual display. She described, with her hands signaling intra- and interchange, her joy in watching them as “cuttlefish envy.”

7. This article was originally developed in dialogue with a panel held at the 2008 meetings of the American Anthropological Association in San Francisco. "Species at Sea: Aqueous Anthropologies of Nonhuman Strangers and Companions," organized by Stefan Helmreich, asked participants to take the animal turn, underwater—as well as across phyla, kingdoms, and domains—entangling ethnological investigations with such beings as brittlestars, extremophilic marine microbes, sea cucumbers, cowries, and dinoflagellates. Differences between life and death, time and space, land and sea, individual and dividual are set in motion by heterogeneous collections of marine organisms, creatures united less by taxonomy than by their common medium, water.
8. In *Touch: Sensuous Theory and Multisensory Media*, Marks defines "haptic criticism" as a methodology of interpreting images that is "mimetic . . . presses up to the object" creating a robust movement between "sensuous closeness and symbolic distance" (2002:xiii).
9. In another effort at writing multispecies ethnography, I discuss my experience of doing photo identification at Allied Whale, examining the phenomenology of photography and whale-human encounters in a forthcoming article, "Sounding Out the Light: Whale Migrations and Photographs" (Hayward in press).
10. The notion that an organism is a musical composition, an orchestration between itself, its "island of the senses" or *Umwelt*, and its environment is taken up by Jakob von Uexküll (2000). He uses music not as a metaphor for beings and living systems but, rather, as a vibrational accounting of becoming. Living things are symphonies of responses and responsiveness. To survive, an organism must harmonize to the tone or theme of its *Umwelt*, enabling it to exist within an environment.
11. For Wittig, sex is a knowledge regime that disallows multiple sexes, multiple genders. Wittig proposes a rival associative logic of sexual "near-nesses" and "same-nesses" rooted in political resistance that displaces the sexual frame of reference such that one of the central axes of humanism is disoriented. Kath Weston (2002) cautions that binary ontologies of sex—gender are not necessarily destabilized by the addition of a third—or even a fourth or fifth. The very enumeration of sexes or genders, the placing of them on a continuum-like number line can reinforce the ontologies feminist scholars seek to denaturalize. Myra Hird's argument, in *The Origins of Sociable Life* (2009) that "gender" should refer to "features that bring organisms together to share DNA and/or reproduce"—which leads her to such claims as "The mushroom *Schizophyllum commune* has 27,000 genders, encoded by 'incompatibility genes' that come in many versions (alleles) on different chromosomes" (2009:100–101)—reifies both sex and gender.
12. I thank Stefan Helmreich for these etymological reminders.
13. I coorganized a panel on "tranimals" with Lindsay Kelley: TRANimalS: Theorizing The Trans- in Zootology. 23rd SLISA, November 5–8, 2009, Atlanta, Georgia. Panelists: Prema Prabhakar, "Do Not Rest in Peace: The Obsessional Mediumship of Diamanda Galas"; Katie King, "Distributed Animality"; Mel Chen, "The Animacy of Toxins"; and Natalie Hansen, "Trans-Species Embodiment: Becoming Human with Horses."
14. Tranimals, an enmeshment of "trans" and "animals," is a synecdochically imagined correspondence written as a portmanteau word (a blending of sound and meaning) rather than a metonymically formed "transanimals" (as with "Japanimals" [see Pflugfelder and Walker 2005]). Hybrid forms and liminal states of tranimals represent subtle or even explosive changes in our understanding of bodily transformation. These are instances within which we can see more closely the appearing and disappearing boundaries between the human, the postanimal (human and non-human), the in-un-human, and the animal. This is not necessarily about cross-species identifications but is rather a somatic and semiotic synthesis that manifests synecdochically (an assembling relationship of connection such that elements "form an ensemble, a physical or metaphysical whole, the existence or idea of one being included in the existence or idea of another" [Ricoeur 1977:56]), rather than metaphorically.
15. If sexual differences and sexuality are exuberances (Bagemihl 1999), contingencies, then sex is a profuse happening, a view might swim against some biological species concepts—that, as Ernst Mayr (1942:86) had it, "species are groups of interbreeding natural populations that are reproductively isolated from other such groups." That definition has "sex" as a stable entity,

a kind of police force securing the boundaries of species. But for *B. elegans* the dynamism of coral (polyp) sociality—what Cris sees as the selective force in coral fecundity, the ability to read for conspecific inhabitants and other environmental presences—already layers sex with connectivities. For a continued discussion on deontologizing sex and species, see my essay “More Lessons from a Starfish” (2008).

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NATURALCULTURAL ENCOUNTERS IN BALI: Monkeys, Temples, Tourists, and Ethnoprimateology

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Humans are animals and members of a global ecology. This is a view widely accepted not only in biology and in many philosophical circles (e.g., Derrida 2008; Haraway 2003), but also in such social scientific enterprises as ecological and environmental anthropology (Rose 2004; Vivieros de Castro 1998). Eben Kirksey and Stefan Helmreich (this volume) suggest that anthropological knowledge, produced through multispecies ethnography, can be developed as a mode of naturalcultural criticism and may contribute to new kinds of biological, and other, anthropologies. Here I offer an example of an integrated and multispecies anthropology that offers a fresh kind of biological anthropology (see also Fuentes 2009; Marks 2009; Schultz 2009). In this essay, drawing on Donna Haraway (2003), I use the term “natureculture” to reflect upon a particular multispecies interface—that between humans and monkeys in Bali, Indonesia—in which the two species are simultaneously actors and participants in sharing and shaping mutual ecologies.

Mutual ecologies involve an interweaving of structural and social ecologies. “Structural ecology” involves the study of the biotic landscape and physical environment in which creatures such as humans and macaques live. “Social ecology” asks after how different agents navigate and create social networks, sometimes across species lines (cf. Latour 1993; see also Popielarz and Neal 2007); it keeps the forces of history, political economy, interindividual relationships, and culture clearly in view. To explore and explain entanglements of structural and social ecologies in the case from my fieldwork in Bali, I employ the notion of *niche construction* (Fuentes 2009; Odling-Smee et al. 2003), which I suggest can be of broader use in studies

of natureculture. I am also influenced by Popielarz and Neal's (2007) description of niche as a theoretical tool for explaining what social entities are and do (for a metaphorical use of the niche concept in social studies of medicine, see Hacking 1998).

Understanding the interactions of organisms within mutual ecologies—how they coproduce and coconstruct each other's niches in behavioral, ecological and physiological senses can help social scientists describe this moment in history, when humans have become major agents of environmental changes, in a time that has lately been dubbed the epoch of the Anthropocene (Crutzen and Stoermer 2000; Rose 2009). Such social–ecological approaches can make examinations of the Anthropocene just a little less anthropocentric (Kirksey and Helmreich this issue). Such work can also advance emerging investigations in multispecies ethnography and an “anthropology of life,” an inquiry concerned with the integration, engagement and interface between humans and other kinds of living things (Kohn 2007).

As humans, we are literal and figurative kin to the alloprimates (those primates that are not also humans), and a transdisciplinary anthropology of the interface of humans and alloprimates is already emerging. Biological anthropologists and primatologists are responding to Donna Haraway's argument in *Primate Visions* that “primatology is about an Order, a taxonomic and therefore political order that works by negotiation of boundaries achieved through ordering differences” (1989:10). A different kind of intellectual order is now forming, rejecting previous epistemological boundaries, employing a revised primatological practice—an inclusive view that places humans and alloprimates in an integrated, shared, ecological, and social space: a space that opens biological anthropology to input from other types of anthropology. That space is ethnoprimateology.¹ In this usage, the “ethno” prefix marks the inclusion of anthropogenic elements, including social, economic, and political histories and contexts as a core component of primatological inquiry (Fuentes and Hockings 2010; Fuentes and Wolfe 2002; Riley 2006). Such use must be distinguished from the deployment of the “ethno” prefix in such forms as *ethnobotany* or *ethnomathematics*, in which the “ethno” usually marks some cultural difference from unmarked Western scientific knowledges, which are implicitly taken to be universal.

Methodologically, ethnoprimateology attempts to integrate models of behavioral and ecological data collection from primatology, ethnographic practice (formal and informal) from social anthropology, and demographic, sociostructural and community-based assessments from geography, sociology, and a broader anthropology. Most ethnoprimateology is conducted by teams, not lone investigators.

This is especially true for the Bali project I discuss below, which involved numerous researchers from various cultures and disciplines. Throughout the project my Balinese colleagues—primatologists and other sorts of collaborators—taught me that the human–macaque interface is a complex fabric of perception and action. In alliance with these, and other, scholars, ethnoprimateology moves away from dominant views of primatology that prioritize the study of primates in seemingly pristine sites in order to assess the baseline for natural behavior—or even human nature (see Fuentes and Hockings 2010; Haraway 1989; Strum and Fedigan 2000).

Unlike many of the traditional views in primate studies (emerging from biology and psychology) ethnoprimateology accepts nature as a constructed, constructive process in which humans and others are core contributors. Rather than assert a privileged perspective of scientific objectivity, ethnoprimateology seeks to move primate studies toward a scientific and ethnographic integration, one that is comfortable dealing in primatological data as well as social, political, and economic interpretation. For example, Leslie Sponsel and colleagues show that the coconut-picking macaques of Thailand are integral members of the human communities in which they live. Their labor forms a core part of local economies, shifts the structural ecology of coconut picking, and creates a long-term multispecies bond across economic and social lines (Sponsel 1997; Sponsel et al. 2002). Rather than limiting the research focus to primate behavior and ecology, as in mainstream primatology, or to symbolic interpretations—uses of primates, as in much cultural anthropology, ethnoprimateology merges these two approaches. However, this view does not necessarily sit well within the dominant paradigm in primatology, one that seeks to maintain focus on adaptationist explanations for “natural” primate behavior.

While ethnoprimateology is becoming increasingly popular amongst Ph.D. students and some established primatologists, there remains some skepticism of the ethnoprimateological approach. To date I have coorganized one edited volume (*Primates Face to Face*, Fuentes and Wolf 2002) and two special journal issues (*Ecological and Evolutionary Anthropology* 2006; *American Journal of Primatology* 2010) that focus on ethnoprimateological themes. Some reviewers met the chapters and essays submitted with suspicion. Typical critiques included “These groups are in unnatural environments, you cannot truly test established ecological and behavioral hypothesis” and “There is a lack of theory and hypothesis testing here. Where is the science?” This is the conundrum facing those attempting to publish ethnoprimateological work: one is forced to navigate an opposition between nature and culture that emerges from the strict adaptationist/reductionist worldview typifying much of dominant primatology. However, given the recent grant success by Ph.D.

students embarking on ethnoprimateological efforts and the increasing presence of ethnoprimateological articles in mainstream journals, there is evidence that the methodological and philosophical orientation of ethnoprimateology is impinging on mainstream primatology. Importantly, it is impossible to deny that the majority of primate populations now interact regularly and consistently with humans.

OF NICHE AND NICHE CONSTRUCTION

Ethnoprimateology views humans and other primates (alloprimates) as co-participants in active, inclusive ecosystems, ecosystems made of interacting niches. The coproduced and coconstructed *niche*, the lynchpin of what I call mutual ecologies, is the dynamic N-dimensional space that an organism lives in and creates interactively with multiple other species (cf. Hutchinson 1957; Wake et al. 2009). This conceptual tool might help us understand emerging relationships in the Anthropocene, involving the entanglement of human social, political, and economic forces (Popielarz and Neal 2007) with the behavioral and ecological lives of alloprimates and other organisms.

The concept of the niche came to prominence in the work of the naturalist Joseph Grinnel in 1910, and was elaborated by biologists C. E. Elton and G. E. Hutchinson later in the 20th century (Griesemer 1992; Hutchinson 1957, 1978; Wake et al. 2009). The initial conceptualization of niche was rooted in the concept of “life zones” and species’ distributions in relation to their biotic and abiotic requirements (Wake et al. 2009). Some scholars saw the connections between organism and their local ecologies as so tight that they might undermine analysts’ abilities (and organisms’ own abilities) to distinguish individual creatures from their spatial/ecological surroundings (see Caillois 1984). The perception that organisms assimilate their environment through their body and that their bodies “environmentalize” their local ecologies was present in the early 20th century and was elegantly conceptualized by the Japanese scholar Kinji Imanishi (2002). Unfortunately, Imanishi’s main theoretical works have only appeared in English in the past two decades and, thus, had little effect on the Anglophone 20th-century construction of the living niche concept. However, during the period of 1950–70 innovations in North American and European niche theory began to converge on similar conceptualizations.

By the 1950s, Hutchinson described the niche as a multidimensional hypervolume reflecting consumable resources available to an organism. He divided the bioecological conception of niches into a “fundamental niche” and a “realized niche” (Hutchinson 1957; Wake et al. 2009). The fundamental niche is a heuristic

concept used to represent the basic requirements of a species: space, nutrients, and other physical factors. The realized niche is the same set of conditions as in the fundamental niche, but restructured and altered by a reality occupied not only by the organism but also shaped by the presence of competitors and other agents in a shared environment. The application of the niche concept in studies of social organization originates with Lazarsfeld and Merton's (1954) use of homophily and its relation to social networks and recruitment into social organizations. This was expanded via Blau's (1977) multidimensional spatial conception for social structure and later McPherson's (1983) depiction of a social organization's niches as a multidimensional space defined by the range of its member's sociodemographic characteristics (Popielarz and Neal 2007). The contemporary concept of niche includes notions of fundamental and realized niches that are neither static nor passive but, rather, malleable and mutually interactive with the species that exist within them. This extends to both the strict ecological use of niche and the application of a niche concept to the analyses of social organizations and structure (Popielarz and Neal 2007).

The critical concept of "niche construction"—the building, modifying, and altering of ecological niches and the concomitant pressures that play back on organisms (Odling-Smee et al. 2003)—emerged in dialog with evolutionary theorists (e.g., Bateson 1962; Lewontin 1983; Waddington 1959). Niche construction, widely understood to be an important factor in human evolution, also provides an important tool for understanding the relevance of a simultaneous examination of humans and alloprimates. The ability of humans radically to modify global ecology (a key factor of the Anthropocene) should be central to any explanation of human behavior, and the way that humans do this is farther reaching and more comprehensive than that of most other animals. As our surroundings include the social, biotic, and abiotic components of the ecology, understanding human behavior requires assessing the interactive and mutable relationship humans and other animals have with social and structural ecologies. One can envision an interface with humans and other animals as a form of niche construction, involving transformations during social interactions in the historical present as well as evolutionary changes over longer periods of time (Fuentes 2009).

Humans and alloprimates can be important partners in the construction of social and ecological niches (Fuentes 2006a, 2007). Usually described along the wild vs. domesticated continuum, the actual relationships between human primates and alloprimates are much more complex. Assessing this relationship, and its potential for shaping niches, requires the incorporation of meth-

ods that cross the boundaries between ethnography, ecology, and biology (at least). Shared histories from long-term sympatry (geographic overlap) can result in coecologies. Shared ecological pressures might impact humans and alloprimates such that they share similar physiological adaptations and behavioral-cultural responses; these can be considered overlapping niches (e.g., Fuentes 2006b, 2007, 2009).

Behavioral observations, physiological measurements, and descriptive analyses of habitat partitioning—use enable us to examine these possibilities and characterize the niches as they change over time. This overlap can also impact human conceptualizations of, and the way they interact with, alloprimates. Ethnographic investigation, interviews, and participant observation are required to examine and attempt to understand these factors of the relationship. Taken as a whole the multifaceted set of relationships between macaques and humans can be viewed as a suite of ecological, biological, and social processes that act as niche construction mechanisms. This interface connects humans and alloprimates in systems of mutual connectivity at social, ecological, and physiological levels. This in turn can affect the phenomenological structuring of human perceptions—views of nature, disease, food, pests, and pets—as ecological and physiological variables translate/affect our perceptions of worlds around us (Kohn 2007). Using the ethnoprimateological perspective we are not seeking to explain “fitness” as in a traditional adaptationist paradigm but are rather seeking to discern processes, patterns, and relationships within mutual ecologies and shared niches. While not excluding more traditional evolutionary explanations, examining the humans and macaques under this rubric can offer up alternative (or additional) explanations that would not emerge if we limited our investigations to a functionalist framework.

Humans and alloprimates share intertwined histories across Indonesia and their interface is a rich arena for multiple types of anthropological inquiry, especially in primatological and political ecologies (Lowe 2004; Riley 2006; Riley and Fuentes *in press*). Bali, Indonesia, long a focus for ethnographic fieldwork (e.g., Bateson and Mead 1978; Geertz and Geertz 1975; Lansing 1991), also turns out to be an important locale for primatological inquiry and an excellent site to think through the analytic of niche construction (Fuentes et al. 2005; Lane et al. 2010; Wheatley 1999).

LIVES AND NICHES AT PADANGTEGAL TEMPLE

In 1989, I visited the temple forest complex at Padangtegal (Ubud), Bali, Indonesia, for the first time—a place called the Ubud Monkey Forest in most

guides for tourists. This was one of my first encounters with long-tailed macaques (*Macaca fascicularis*). These monkeys have one of the largest distributions of the primates (along with humans, rhesus macaques, and baboons), and are ubiquitous across much of Southeast Asia, preferring habitats on the edge of forests and fields over primary forest. Their spatial and ecological overlap with humans is substantial. They live in groups usually consisting of between 20 and 50 individuals, with young adult males leaving their natal groups and seeking to integrate themselves into neighboring ones. Females spend their entire lives in their natal group, surrounded by female relatives, forming tight matrifocal clusters of two to four generations of females and their offspring. Clusters of youngsters spend much of the day playing and foraging while adults navigate through a complex series of conflictual and cooperative social relationships. Adult males are substantially larger than females and usually supersede them in access to favored resources. On average, with larger matrifocal clusters comes greater dominance of females in the group. It is quite common to see coalitions among the higher ranking males and the main females of the larger matrifocal clusters. With each adult macaque maintaining multiple social relationships of varying intensity and quality, the daily life of the macaques embodies a dynamic social ecology.

At Padangtegal, macaque monkeys and humans coexist and interact on a daily basis; humans and monkeys share the space and place and have done so for centuries (Wheatley 1999). The patterns of social interaction amongst the monkey groups ebb and flow in relation to the presence and activity of the local Balinese as well as the many tourists meandering through the temple complex and forest. Humans and long-tailed macaques are involved in daily rhythms of activity within the social and structural ecologies of this site. Human–monkey interfaces are often described in terms of the shared use of space or conflict over resources. But these naturalcultural contact zones are instead characterized by subtle behavioral and ecological interactions against the backdrop of the longue durée of human histories and paleohistories.

In Bali there are over ten thousand macaques and nearly four million humans, with populations of both species having inhabited the island for millennia. Bali is often represented as an island paradise, a place of endemic multispecies mingling (Robinson 1995). But over the last eight centuries increasing human populations and intensifying agricultural systems have heavily modified the ecosystems of Bali. During this period many large mammals decreased in number, including silver leaf monkeys and some deer species. Other species, like the Bali tiger—the smallest of the tiger subspecies—went extinct (Whitten et al. 1996). Periodic

catastrophes—paleohistories of volcanic eruptions and earthquakes and episodes of state violence—haunt human memories and have helped structure the landscape and patterns of human–alloprimate interaction. Following centuries of Dutch colonial excesses, some 80,000 Balinese residents, suspected of communist sympathies, were murdered after a CIA-backed Indonesian military coup in 1965 (Robinson 1995). However, Bali enters the 21st century as a resilient Indonesian province and dominant tourist mecca. The contingencies introduced by centuries of habitat alteration, decades of modernization, the green revolution, political change, and the tourist industry structure the raw materials and social contexts of the niches shared and shaped by monkeys and humans on Bali today. Against this background, I have found subtle day-to-day conflicts among humans and primates but also sites of naturecultural hope in Bali.

Macaque monkeys continue to thrive on Bali, especially in and around human villages and temple complexes, where many humans provide them with food. Some Balinese hunt and trap monkeys, a fact that foils any attempt to suggest that the species live in harmony or peaceful coexistence. Spending a number of years watching the macaques and humans interact, working with local researchers, priests, and villagers, I reject the view that there is a simple relationship between humans and alloprimates and propose that there is neither a strict competitive nor a purely reciprocal association between humans and alloprimates. Following critiques of ideologies of exchange that regard individuals as free partners who engage and disengage at will (Clifford 1997; Pratt 1992), I argue that the interface between species constructs mutual ecologies that structure their relationships. In these zones of contact there is an entanglement of economies, bodies, and daily practice that leads to the construction and coproduction of niches (see also Fuentes 2006b; Jones-Engel et al. 2005; Lane et al. 2010). These entanglements affect the size of macaque populations, their group compositions, and behavior (Fuentes et al. 2005).

Since 1998 my collaborators and I conducted landscape and population surveys mixed with behavioral observations and ethnographic interviews at over 40 of the more than 63 locales where macaque populations reside on Bali (Fuentes et al. 2005; Lane et al. 2010). Nearly seventy percent of these sites are associated with Balinese Hindu religiously demarcated spaces, ranging from simple shrines in forested patches to elaborate temple complexes with associated forests, heavily used by Balinese and in some cases foreign tourists. These sites, often called monkey forests, are naturalcultural contact zones (cf. Haraway 2003) between macaques and a diverse array of humans.

Ritual cycles are core structuring facets of Balinese lives, constitutive of their social niches. In these temple complexes resident monkey groups are participants in ritual practice. A central component of Balinese Hinduism is the daily placement of offerings at temples, shaping the dietary ecologies of the macaques and the social and economic ecologies of the Balinese. These offerings are given in all ceremonial events—from daily rituals to household festivals every 15 days; from local family events like weddings and tooth filings, to Galungan, the ten day long annual festival of Bali (Bateson and Mead 1942; Belo 1953). The daily offerings can be small, consisting of incense, flowers, rice, and fruit. Once placed appropriately (“offered”) the Balinese see them as having served their purpose and the macaques are free to consume them. During the frequent temple ceremonies and larger celebrations the offerings are much more substantial (Belo 1953). For the larger festivals the offerings consist of a wide array of fruits, rice based foods, meats, and other edible items. These larger offerings are often redistributed to the attendees or destroyed as part of funeral rites alongside human bodies rather than left behind for the monkeys. The portions of offerings that return to festival attendees and other villagers are called *lungsuran*, meaning literally “what is asked back” (Belo 1953). Conflicts arise between the macaques and humans in these events if the monkeys attempt to play their part prior to the humans.

In practice, many portions of the large offerings are eaten by macaques. During rituals it is common to see clusters of macaques in the trees and on the ground a few meters away from the celebrants. They follow the ceremonies with their eyes, ears, and noses, seemingly reading the human response and reacting with the occasional grab at offerings, but largely waiting for the ritual to run its course. When asked about this behavior, many Balinese respond either that the macaques are just a part of the environment (and occasionally a nuisance) or that the macaques can be seen as emissaries of the spiritual-natural forces—the Gods, spirits, souls, or bodies of the dead (Bateson and Mead 1978)—moving the offerings across from the human world into the locally coexistent but distinct spirit world (Fuentes et al. 2005; Wheatley 1999). For the Balinese, these spirits and the relationship between all actors in this scenario are part of a natural ecology. The distinctions between material and nonmaterial agents are not clearcut. Animals and plants, as with humans and spirits, are potential agents of positive and negative physical and spiritual influence (Boehmer and Wickham 1995; Hobart 1990). As Geertz once put it (if in a somewhat romantic register), to the Balinese “the world is still enchanted” (1973:175), in that natural and supernatural worlds (and niches) coexist, equally and simultaneously.

It is also the case that at these monkey forests, thousands of tourists, domestic and foreign, are part of the ecology, drawn by globally distributed advertisements featuring the monkeys of Bali.² Income from tourists can be a major part of the household economies for many Balinese and many monkey forests support rings of souvenir stands, restaurants, and vendors selling Bali-related, and monkey-related, goods. This human–macaque interface at the monkey temples is a niche shaped by the interplay of economic dynamics and hybrid cultures. To assess this niche I employed a mixed methodology, one that incorporates structural assessment of the landscape and human and macaque behavior combined with formal and informal interviews and observations of daily life, economic patterns, and local and touristic beliefs.

RIVERINE FOREST CORRIDORS

The temple sites are connected by naturecultural corridors to wider agro-ecological systems. Land-use patterns and wet-rice agriculture, combined with the complex temple and irrigation systems of the Balinese (Lansing 1991), creates, manages, and maintains a mosaic of riverine forest corridors and small forest islands throughout much of the island (Fuentes et al. 2005). This landscape is in many ways ideal for macaques, who prefer riverine pathways, mixed edge and secondary forests, and are highly flexible in their diets. The landscape has been formed over at least the last millennium and the pattern of distribution of macaque populations across the island suggests that the macaques are exploiting it (Fuentes et al. 2005).

Through noninvasive sampling of macaque feces across many of the temple sites my colleagues and I have been able to extract genetic signatures. Preliminary genetic analyses of the Bali macaque population support the proposal of riverine pathways, with Y-chromosome data showing that male macaques exploit the protection of managed riverine forest stretches to move safely around the island and mitochondrial data showing that females spend their lives in their natal groups (Lane et al. 2010). The human alteration of the landscape combined with macaque social patterns has shaped macaque population genetics, producing clusters of related macaque females with males moving across groups and subpopulations acting as units of gene flow. This flow appears to be channeled along the riverine corridors facilitated and maintained by the Balinese agricultural system. This is a vivid example of niche coconstruction and coproduction by actions and bodies of humans and macaques. In Bali, human place-making acts to shape the niche of macaques—the spaces they inhabit and the structure of their populations (Lane et al. 2010).

Any deep understanding of these riverine pathways, and the temple forests they connect, requires that we include a cultural analysis of the landscape and the human forces and processes that shape it. I follow Paige West's (2005) assertions that some academic/intellectual translation of the beliefs and meanings of peoples' relationships with animals and their ecology sometimes fail to acknowledge (or recognize) that environments (writ large) are both materially and symbolically created. One needs to be with, and speak with, people to identify and engage with the symbolically and socially constructed aspects of local ecologies. Here I deviate in part from the adaptive analytic frame used by Stephen Lansing (1991) in his examination of water temples and agrarian systems in Bali (see also Lansing 2000). Stefan Helmreich points out that Lansing's model of Balinese temple networks as complex adaptive systems "mutes politics" and collapses "cultural and historical processes into an evolutionary language" that sometimes silences human agency (Helmreich 1999, 2000). Building on Helmreich, and departing from Lansing's functionalism, I suggest that the traditional language of evolutionary adaptation is, by itself, inadequate to explain the macaques' exploitation of human institutions and engineering projects. An ethnoprimateological approach places the ecology of the sites, the behavior of the humans and macaques, as well as historical and economic forces, into dynamic interaction. Actions and interactions by and between the macaques and humans are shaping and reshaping, constructing and coproducing, the shared components of ecological and social niches—and are doing so in ways that must be understood simultaneously through ethnographic, behavioral, and epidemiological lenses.

Macaque bodies do more than occupy Balinese temples and riverine forest corridors. They coproduce and coconstruct human epidemiological landscapes and even genomes (physiological niches). Recent analyses of viral pathogens in macaques and in Balinese who have frequent contact with them demonstrates that some pathogens, such as simian foamy virus (SFV), are shared, exchanged across species boundaries, with potentially more regularity than previously thought (Jones-Engel et al. 2008). SFV is a retrovirus, meaning that it inserts viral code into the DNA of host cells. Many nonhuman primates carry this virus, but it can infect humans as well. The virus can kill cells *in vitro*, though there is no indication of any disease associated with SFV infection in any primates (including humans). SFV infections are lifelong and the vast majority of macaques have acquired SFV infection by adulthood. SFV infection in humans is very rare, but the few non-laboratory instances recorded recently involve people from Bali, and other parts of Southeast Asia, who are in frequent contact with macaques, especially in and around monkey

forests—temple complexes (Jones-Engel et al. 2008). Simultaneously, we also know that human viruses, such as measles, can be found in the bodies of Bali macaques (although, interestingly, macaques do not appear to become ill from this infection). Common gut parasites, such as the worm *Ascaris* or the protozoan *Entamoeba*, are also found in both monkeys and humans on Bali. So in addition to sharing space and place, macaques and humans have entangled epidemiologies, influencing one another's niches as part of a multispecies relationship.

INTERSPECIES TOLERANCE AND VIOLENCE

Formal and informal discussions with informants and research collaborators over the past decade indicate that the Balinese see the macaques inhabiting a range of roles: from crop raiding pests, to tolerated coresidents and household pets, to participants in the Balinese Hindu mythos, to tourist attractions. In these conversations about macaques, the Balinese paint pictures of tolerance in most circumstances, express anger in issues of crop damage and vendor stall raiding in others, and, in the case of many temple workers who interact daily with the macaques, a sense of affection or admiration. At the same time, our observations of the macaques show that they can often interact with, or avoid, humans by altering their use of space, that they preferentially overlap with people in certain times and places (frequently associated with access to food) and that overall, a lack of macaque initiated direct physical or behavioral interaction characterizes a majority of the coexistence. To study and describe these relationships we can heed Matei Candea's call for researchers to avoid viewing animal–human relations along the dichotomous engagement–detachment continuum (Candea 2010). Rather than seeking to identify and be with the macaques or to disengage from seeing them as participating in the anthropogenic niche, we need perceive these interfaces as dynamic, incorporating and constructing multiple modes of relation.

The parking area adjacent to the southern end of the monkey forest at Padan-tegal is a good place to watch macaques and Balinese engaged in casual interactions. On a slow tourism day one might see a smattering of small tour busses, a few private cars, and a number of minibuses parked in between the entrance to the temple forest area and a small *warung* (food stall) at the southern end of the parking area. Sitting in the various areas of shade one can find a number of Balinese drivers (usually men) drinking coffee and smoking cigarettes waiting for their passengers to return. Among and around these humans, in the same highly valued shade, one will frequently see 5 or 10 young macaques (mostly males) sitting or moving about at a relaxed pace. Interactions between the two species here are calm and range

from ignoring one another to the occasional tossing of food by human to monkey or approach, touch, and run away play by a young monkey to a human. When asked about this relationship one older driver in his fifties said (translated from Indonesian) to me, “they are here, we are here, as long as they do not damage the (side) mirrors on my minivan, we both wait together.”

At the monkey forest temple site of Alas Kedaton (also central Bali) nearly all of the tour guides are young women. On a slow day you will see them sitting in groups in the shade waiting for tourists to arrive. Above them in the trees and alongside them on the ground you can also find clusters of female and male macaques, along with their young, resting and playing within meters of the humans. Little overt interaction occurs, but both species are aware of one another and their sharing of that particular structural and social space. When asked in summer 2000 about the lack of conflict or aggression in this context one young tour guide responded (translated from Indonesian), “we are both are waiting for tourists, we’ll both go to work soon.” Here the monkeys and the Balinese are occupying a similar social niche in the geopolitical economy: waiting for the tourists to arrive.

Crop damage and vendor shop—stall raiding creates a different dynamic between the Balinese and the macaques. One of the most extreme cases of aggression I ever observed between macaques and a human was at the monkey forest temple site of Sangeh in 1994. A colleague and I were following a group of monkeys, about 24 males, females, and young, as they moved through a series of dry crop gardens adjacent to the southern end of the forest. We were standing just north of the macaque group when an adult female screamed an alarm call and ran past us. The group was immediately all around us calling and scrambling over the ground toward the forest. At that point we saw an elderly Balinese farmer chasing the macaques from his field with a large scythe, which he swung, nicking a female carrying a young infant. She screamed and the entire group turned and ran past us again, charging the farmer. Six females and a male attacked the farmer, drawing blood. He ran off. At this point, the group turned and slowly made their way back to the forest (completely ignoring me and my colleague). Tracking down the farmer we discovered that his wounds were relatively minor.

Asking the local temple workers later if this was a common occurrence and how local farmers feel about it, I was advised that the farmers do not steal from the monkeys in their forest. Farmers feel that the monkeys should know that if they try to steal crops the farmers will fight them. These perspectives—of tolerance in shared non-conflict areas, aggression in areas of contested resources, and

assumptions about shared understanding of spatial boundaries between species—were found in the majority of responses by Balinese in a cross-island series of interviews about monkeys conducted in 2003 (Loudon et al. 2006). This assumption about an “understanding” of space and behavior between Balinese and the macaques is reinforced by the much more frequent conflicts between foreign tourists and macaques relative to Balinese and macaques.

Foreign tourists are much more likely to be bitten by macaques (Fuentes et al. 2005), largely owing to the tourists’ high likelihood of initiating a conflict. Unlike the Balinese, who share their space and place with the macaques, conversations with tourists from the United States, Europe, and northern Asia reveal a penchant for seeing the macaques as furry almost-people, as naughty comedians, jesters of the animal kingdom. It is as if our similarities in bodies and physiologies create a false sense of understanding and identification (for a related situation of identification between television audiences and meerkats, see Candea 2010). Many of these tourists display a desire to interact, and a degree of carelessness, around the macaques (Fuentes 2006c). They imagine themselves as part of a social niche where they are in a relationship of touching and intermingling with fellow primates. However, the tourists do not occupy the same place in this multispecies relationship as the Balinese, and the macaques recognize this. The most dramatic instance of this was in 2001, when a young Swiss woman approached a young female macaque carrying an infant that was a few days old. Cooing and baby talking, she took the infant from its mother in a quick grab and was immediately attacked by five adult females and one adult male. She needed over 140 stitches in seven places across her body. The workers, and priest, at the monkey forest where this occurred offered to pay the woman’s medical bill, but held no ill will toward the macaques. In the words of my Balinese associate at that site, “The monkeys were only doing what they saw as right, protecting the baby. That girl should not have behaved the way she did in the forest.”

Interestingly, the number of Balinese reporting fearful views of the macaques—a response nearly absent from Loudon and colleagues’ 2003 survey—may be increasing. This sentiment, previously limited to areas with fewer tourists that did not derive direct economic benefits from the monkeys, has spread over the course of the last decade. Perspectives, and types of conflicts, may be changing. A recently published study indicated that even in the central Bali areas where the monkey forests are economically quite important and most monkeys live in around temple sites, 8 of 91 macaques x-rayed had air rifle pellets lodged in their bodies (Schillaci et al. 2010).

Many Balinese living around monkey forests see the macaques as income generators. In well-known sites, such as Padangtegal and Alas Kedaton, over 100,000 tourists visit per year, paying entrance fees of \$1.00–\$2.50 and contributing to local economies at restaurants, hotels, and gift shops. In Padangtegal, revenue generated from monkey tourism can result in tens of thousands of U.S. dollars equivalent annually, much of which is funneled back into village community building, temple enhancement and restoration, and agricultural projects. In this case the activity of the macaques facilitates an economic benefit that in turn alters the structural and social ecologies of the Balinese villages and towns associated with them. This can result in human expansion of macaque habitat, again an example of mutually shaping their ecologies and modifying their interfaced niches.

For example, beginning in 1999 the village of Padangtegal initiated a management scheme for the monkey forest that included reinvestment of some tourist income generated from entrance tickets into reforestation, litter removal, and provisioning of the monkeys. In the last ten years this approach resulted in a 25 percent expansion of a forested area. This substantially increased the vertical and three-dimensional area used by the macaques, enabling an increase in the population size without substantial conflict between the resident groups (there were three in 1999 and five in 2009). This investment of increased tourist revenue also led to a 200 percent increase in the quantity of the food provided by the management staff to the monkeys which, coupled with the expanded ranging area and the protection offered by the temple complex, enabled a doubling of the monkey population size in the last decade.

Changes to this system of interaction emerge from the interaction of Balinese beliefs about what is good for the monkeys and the views of primatologists or ecologists about what is good for the monkeys. The dominant view of primatologists and ecologists is that healthy monkeys are good but increasing the population size so dramatically is dangerous. For the Balinese, larger macaque families mean an increased number of young and thus more active macaque movement and play behavior. These are good things as they reflect what the temple manager calls a more “aman” (relaxed, secure, or peaceful) way of living for the monkeys. Many international researchers began to worry about the increased population and the concomitant risk of increased conflicts and aggression between monkey groups and between monkeys and humans. Conventional primatologists wanted to control the population and the macaque ranging behavior to minimize potential conflicts (solutions such as birth control, culling, and building complex arboreal pathways to keep macaques and people apart). The Balinese at Padangtegal agreed

with those outcomes (minimization of conflict), but used a largely non-Western approach: they simply hired more local villagers to feed monkeys, to monitor the boundaries between the forest and crop fields and to assist the tourists in and around the temple. This plan emerged from the already established set of relationships between humans and macaques at Padangtegal, and in fact worked very well. A recent report from Padangtegal (March 2010) has the monkey population above 500 individuals and the rate of human–macaque aggression below what it was ten years ago with 200 individuals. The Balinese are teaching international primatologists unexpected lessons about the structures and behaviors surrounding the human–monkey interface. This ethnoprimateological endeavor emerges from different knowledge systems intermingling to coproduce new ways of describing and navigating this multispecies relationship.

It is clear that the behavior of the macaques is tied to the actions of the local humans, influenced by the economic and social impact of the macaques via tourism. This is a malleable relationship. Viewing it only through an adaptive or ecological lens (as in a traditional primatological approach) is incomplete, as cultural elements are also at play in building and reshaping the local niches of the humans and macaques. For example, the *Ramayana*, a corpus of Hindu myths that are a central focus for much Balinese art and dance, informs interpretations of Balinese folklore as well as the macaques' pattern of inhabiting temples. Dances and other performances associated with the *Ramayana* are central to Balinese festivals and temple celebrations (Belo 1953), and monkeys, specifically as core agents via their association with the god Hanuman, are common and popular characters. Hanuman plays a major role in many dance and puppet performances of the *Ramayana*, and his comical behavior and interactions with the audience are popular facets of such performances. Temple macaques and monkeys in general, are associated with Hanuman, and specifically with his monkey minions, a relevant facet of our understanding of the social organization of the macaque–human interface if we consider Popielarz and Neal's (2007) notion of a social organization's niche as a multidimensional space defined by the range of its member's sociodemographic characteristics.

Macaques are considered residents of temples and other religiously marked places, coparticipants in Balinese place. As noted above during significant ceremonies at temple complexes, enormous amounts of offerings are provided for ritual activities. Hundreds of attendees are fed. This creates an explosion of food for the macaques. However, the actual interactions are not as straightforward as monkeys taking food. The macaques move away or into the trees when the large

processions enter and remain on the periphery of the proceedings. As the event unfolds and the offerings are made and pyres ignited the macaques begin to move in and around the Balinese, feeding and resting in close proximity. Unless macaques attempt to grab offerings or food that has not yet fulfilled its ritual or gustatory purpose, they are tolerated and their presence as peripheral participants acknowledged. This is a relationship of tolerance, not reverence, and it lays a particular basis for understanding the interactions between humans and macaques on Bali. The fact that macaques appear frequently in popular theater and dance, and that they are also potential economic boons, means that they are often represented in tourist masks and paintings (Hanuman is among the popular subject in these media). Here there is a melding of social, symbolic, economic, and even dietary facets of their shared niches.

INTERCULTURAL MONKEY MANAGEMENT

My initial Balinese collaborators, Dr. Gede Komang Suaryana (former director of the Primate Research Institute at Udayana University) and Mr.³ Wayan Selamet (long-term manager of the Padangtegal [Ubud] monkey forest and a central colleague and interlocutor for my work), drove this integrative perspective on primate research in Bali home. Celia Lowe (2004) notes that Indonesian primatologists are simultaneously elite (within their nation) and subaltern (within transnational science). Residing inside and outside of primatology's mainstream tradition and having a multilevel relationship with their own subjects of study enables them to see this interface in an ethnoprimateological perspective. Both Dr. Komang and Mr. Selamet positioned their approach to primate studies and management simultaneously in primatological, societal, economic, and historical terms. The web of interconnectivity between these areas was a baseline, not a post hoc, conglomeration of only loosely related arenas.

Since 1999 Mr. Selamet has been a central force in the management and modification of the monkey forest at Padangtegal (Ubud) and by extension many other monkey forests on Bali that seek to emulate his extremely successful programs. Both he and Dr. Komang (along with Dr. Bruce Wheatley and Dr. I. D. K. Harya Putra, see also Boehmer and Wickham 1995; Budihardjo 1990) suggest that we can look to the principle of the Tri Hita Karana (considered by some Balinese to be a focal point for Balinese Hindu natural theology) to help us understand core symbolic and sociocultural perspectives of these relationships between monkeys and humans. It posits that happiness (balance) is dependent on three harmonious relationships:

Parhyangan—People should live in harmony with God(s), the Creator

Pawongan—People should live in harmony with other peoples and other creatures

Palemahan—People should maintain the environment where they live

Dr. Komang, explaining the relationships of monkeys and people to the students of my 1998 field school in Bali, stated that harmony is an active process. He noted that the Balinese and monkeys are coparticipants in their environment (in my terms, in social and structural ecologies). And that “we both use the same land and God(s) help us decide how to live together in this space.” Dr. Komang and Dr. I. D. K. Harya Putra (currently a dean at Universitas Udayana in Bali) stressed that the Tri Hita Karena is not so much a mandate, but rather a way to think about, or perceive, relationships (Budihardjo 1990).

The notion that the Tri Hita Karena might be relevant to our analyses of the factors involved in niche construction at the macaque–human interface is supported by the way that particular species of trees and structural aspects of the environment are viewed in and around temples. For example, at the site of Padangtegal, the building of a much-needed new parking area was held up for over seven months (with concomitant loss of tourist revenue) because no one in the cluster of local villages in the area would act to cut down the large dead tree that resided on the spot. Mr. Selamat eventually had to hire a team from outside of the regency to come in and remove the tree. When asked as to why this was such a problem, the nearly uniform answer was that for the local Balinese in the area the tree was part of the temple site and thus the symbolic risk of being the one to remove it weighed very heavily on them (see also Couteau 1990). Symbol and perception influenced action, which impacted the structural ecology at the site. This is a simple example but should make us cognizant that such events are ongoing and multifarious at Padangtegal (and other similar locations) and play active roles in the dynamism of local ecologies.

Dr. Komang and Mr. Selamat, while fully aware of the economic and social contexts of the macaques (and not always in positive terms), have convinced me that this particular Balinese view lays a baseline for the possibility of a type of generosity between humans and macaques on Bali: a sort of multispecies niche that involves cultural, historical, physiological, and ecological factors. They have urged me, as well as other primatologists and anthropologists, to work with Balinese people and landscapes—exploring novel approaches and using new toolkits in our attempts to effectively characterize this coproductive, naturalcultural relationship.

For over a decade the insights of Dr. Komang and Mr. Selamat drove significant portions of the research and publications of the Bali macaque project. Many of our research foci for projects at Padangtegal were on the physical and behavioral impacts of monkeys and humans interacting and the subsequent social, physiological, and economic outcomes. This was, in part, at the request of Mr. Selamat as his interest lay in the management of the monkey populations, the tourist experience, and the relationships between his charges (macaques, temple forests, and associated sites), the priests and the staff of the temples themselves, and his community (residents of Padangtegal and Ubud). The hybrid methodological and conceptual toolkit of ethnoprimatology—integrating the social, mythical, economic, and historical alongside the ecological and behavioral—thus offers a way to grapple with countervailing forces and agents in this multispecies system.

CONCLUSION

Opening our perceptions and paradigms to include the human–alloprimate interface can lead to a new wave of cultural and of primate anthropology. Employing an ethnoprimatology that incorporates niche construction can facilitate our move towards a more effective investigation of the landscapes where species meet.

I borrow from my own work (2006b, in response to Coetzee's [2003] *Elizabeth Costello*) to close this essay: Sometimes I feel like an ape because I am an ape and other apes will see that in me. I am a primate, an anthropoid primate, and I have no doubt that the anthropoid primates I have worked with see me as something quite different than a seagull or a cat and are fully cognizant of my gaze upon them and our interactions. Our shared “nakedness” (what connects our mutual gaze/interconnectivity, to paraphrase Derrida 2008) is that of mutual physiologies, ecologies, social-experiential contexts, leading in some cases to shared niches. If we share niches, we coparticipate in their construction, alteration, and destruction. Humans and alloprimates participate in a greater set of naturecultural linkages than many (but not all) organisms. We need to reject domesticated versus wild, natural versus unnatural, and engagement versus detachment dichotomies in the study of human–alloprimate interfaces. We should move past the notion of definitive discrete distinctions in favor of fluid and reciprocating interfaces that change over time creating spaces, bodies, and niches of relevance to our understanding of human animal and the other animal experiences.

Here I have suggested that looking to the human/alloprimate interface in Bali and thinking about the possibilities of niche construction urges us to retrain our gaze to include other beings, and their diverse sets of physio-behavioral-ecological

realities, as part of our questions about humans being with other beings. As Paige West notes, we need to accept “the fact that human relations with the natural world are aesthetic, poetic, social, and moral” (2005:633), as well as directly ecological, and that they can shape environments and niches. We humans are altering global and local ecologies at a rate beyond that of any time in history. Recognizing that we are participants in a diversity of multispecies relationships and incorporating this view into our studies, especially in an ethnoprimateological approach, might open up a space of naturecultural hope, helping us achieve in some way an integrated and more inclusive anthropology.

ABSTRACT

Examining the interface between humans and other primates can illuminate how interspecies relationships create and maintain complex social and ecological spaces. Humans and macaque monkeys share ecologies that include cultural, historical, and physiological dimensions. In this essay, I examine such ecologies while undertaking an ethnoprimateological project in Bali, Indonesia. This multispecies ethnography of humans and macaques demonstrates that human perceptions and land use intertwine with macaque social behavior and pathogen physiologies to affect local ecologies and economies for both species. In these contact zones where any clear boundary separating nature/culture is difficult to discern, I use the concept of “niche construction” and an ethnoprimateological lens to explore and understand these relationships. This article also serves as an invitation to move an ethnoprimateological approach away from the periphery and into a broader primateological and anthropological engagement with naturalcultural relations.

Keywords: Bali, humans, macaques, natureculture, niche, niche construction, ethnoprimateology

NOTES

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1. The ecological anthropologist Leslie Sponsel (1997) is generally associated with coining the term “ethnoprimateology” and Bruce Wheatley contributed the first book-length exploration on

- the subject (1999). See also the work of cultural anthropologist Loretta Cormier (2003) and a core group of ethnoprimateological publications: Fuentes 2006a, 2007; Fuentes and Hockings in press; Fuentes and Wolfe 2002; Jones-Engel et al. 2005; Paterson and Wallis 2005; Riley 2006; Riley and Fuentes in press.
2. The global attraction of Bali monkeys is quite substantial and a vast majority of advertisements for Bali tourism use monkeys images in their brochures and Web pages. For example, the search term *Bali-monkey* generates more than 250,000 hits on Google, and nearly 8,000 images, and the term *Ubud-monkey-forest* (referring to the Padangtegal temple complex) alone merits 62,000 hits and has its own Wikipedia page.
 3. I translate the Bahasa Indonesian term of respectful address for men, *Pak*, to "Mr."

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VIRAL CLOUDS: Becoming H5N1 in Indonesia

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Philosophy is not simply a tribunal of reason; it is also a battleground of infections and sicknesses.

—Keith Ansell Pearson, 1997

This essay is an ethnography of a virus—H5N1 (avian influenza)—a cloud of particles, uncertain ontologies, multiplying narratives, and apocalyptic dreams that spread from mainland Southeast Asia to Indonesia in 2003. Contagious viral agents infected a multitude of living beings—domestic poultry, humans, wild birds, and other creatures—at the same time as millions of Indonesian citizens and scores of organizations were scripted into national and international concerns about pandemic preparedness, biosecurity, and sovereignty.

Microbiologists describe influenza viruses as *quasi-species*. As an RNA virus, influenza lacks the “proofreading ability” of DNA to find and repair damaged genetic material. RNA viruses copy themselves unfaithfully, making difficult the determination of any “original” form as well as precise foreknowledge about future forms; the copy is unfaithful to the original (cf. Benjamin 1968; Taussig 1993). The high rate of genetic mutation in RNA viruses therefore make influenzas difficult to cordon off into “species.” Rather than existing in well-bounded populations, these biotic entities organize into clusters of genomes with unstable group boundaries—into clusters that biologists call “mutant swarms” or “clouds” (Davis 2005; Eigen 1996).

In Indonesia the avian flu virus was not only a quasi-species but also, I maintain, a *species multiple* or, better, *species multiplier*—forming and enacting its identity with others (cf. Mol 2003). Multiple ontologies were transformed amid encounters among viruses, the immune systems of animal hosts, and the human institutions that struggled to reckon with the specter of a terrifying pandemic. One can think, then, not only of quasi-species clouds but also of what I call “multispecies clouds,” collections of species transforming together in both ordinary and surprising ways. Following the vector of the virus, this essay traces a cloud of uncertain *reassortments* (the mixing of genes from two distinct viral strains infecting the same cell) of identity.

Clouds are a material feature of influenza’s epidemiology: viral particles, droplets of spittle, and water in the form of rain and humidity were floating all around as I conducted my research in Indonesia. As the news media was abuzz with prophecies about a global influenza pandemic, an epistemological cloud also emerged. Cloudy insecurities implicated specific social and biological forms in speculation about future possibilities. Was a new “global” pandemic like the influenza pandemic of 1918 on the horizon? If so, via what pathways and mechanisms, and through what inter- or intraspecies interactions? Moreover, who precisely was responsible for responding to it, in what ways, with whose money, and relying on what expertise? Uncertainty about what influenza was and what it could become, disrupted existing arrangements among species, peoples, institutions, and nations—remaking biological and political relations along the way.

Years ago, I had studied the rise and use of “biodiversity” discourse and practice in Indonesia (Lowe 2006), seeking to figure out what, if anything, might be particular to biodiversity in its Indonesian inflection. Now, conducting multisited fieldwork in the worlds of microbiology, security, and agriculture over a series of research trips from 2006 through 2010, I found myself chasing after another “bio” form: biosecurity. How might “biosecurity” look different in Indonesia? How might it be distinct from its appearance in other locales (see Lakoff and Collier 2008)? Would Indonesia’s postcoloniality continue to matter? How might H5N1, or avian flu, format the particularities of whatever counted as “biosecurity”?

In fact, a variety of security practices—corporate security, state security, “vital systems security” (Collier and Lakoff 2008), and farm biosecurity—for example, simultaneously came into focus with Indonesian H5N1. Out of the viral cloud, other emergences impressed themselves on me too. Along with security, scale became important. The pandemic threat of this influenza was conceived by international and biomedical communities at the global scale while Indonesia was asked to intervene

at the most intimate of local scales (cf. Tsing 2007). The outbreak of H5N1 in Indonesia also prompted me to examine the role of speculation, because much of the activity around the disease was designed to forestall something that turned out only to ever have existed as a potentiality—a state not so different from, and partly based on, the quasi-species cloud, which also exists in a state of indeterminacy with respect to the future forms it may produce.

Taking the viral quasi-species cloud as an analytic prompt, I here use the cloud—quasi-species, multispecies—as the organizing metaphor for my analysis of H5N1 in Indonesia to indicate the clusters of biosocialities in play and at work with H5N1 in Indonesia. My account begins in July 2005, when a man named Iwan and his two daughters developed severe breathing difficulties in the intensive care unit of Siloam Gleneagles hospital in West Java. Their pulmonologist asked the hospital's lab to test for SARS—the “severe acute respiratory syndrome” that fueled the specter of a pandemic in November 2002 and July 2003. The lab's director, recalling an earlier training session with NAMRU-2 (the U.S. Naval Medical Research Unit-2), asked this Indonesian and U.S. research team based in Jakarta to conduct the test.

When the SARS test turned up negative, this U.S. military lab asked for permission to test for a virus known as H5N1 influenza. When the sample tested positive it was shared with researchers in the Indonesian Ministry of Health, the agency overseeing U.S. naval health surveillance operations in Indonesia. Ministry officials confirmed that the test was positive for H5N1. These were the first “enactments”¹ (Mol 2003) in Indonesia of a human case of the H5N1 virus, a deadly “avian” influenza that had sporadically taken both human and poultry lives across Southeast and Eastern Asia since 1997, and would soon engage ornithologists, medical doctors, poultry farmers, epidemiologists, and a wide range of other human and nonhuman actors across Indonesia.

Just as the collection of genomes that may appear in the rapidly mutating swarm technically known as a quasi-species cloud are heterogeneous and unpredictable, so, too, I found were the bodies, narratives, and politics that appeared in the multispecies cloud surrounding the naturalcultural event known as H5N1.

H5N1 INFLUENZA IN A CLOUD OF UNCERTAINTY

The strain of influenza that infected Iwan and his two daughters was a relatively new disease for humans, jumping the species barrier from poultry only in the mid-1990s when an outbreak struck Hong Kong, killing first a three-year-old boy and then more than a dozen others. Authorities in Guangdong, mainland China (the



FIGURE 1. Influenza patient on the way to Reference Hospital for avian influenza in Yogyakarta. (Author's photograph)

apparent source of the virus) launched a massive poultry cull amid an international blockade on imports from their province. The spread of the disease was apparently stayed, but just a few years later, poultry outbreaks began appearing across Asia: first Korea, Thailand, then Vietnam, with rarer human cases emerging soon thereafter. Indonesia was not far behind, and it began to seem as if Indonesia, with its large population, highest incidence of human cases, and fewest agricultural controls in place was a likely location for the emergence of a deadly human influenza pandemic that could “circle the globe” (Barry 2004).² The Indonesian H5N1 outbreak appears to have started in commercial poultry, spread to backyard poultry and, then, two years later, to humans. By 2006, Indonesia was the country with the largest number of human deaths from the virus (Lange 2007). (See Figure 1.)

Were the virus to mutate and acquire the easy transmissibility of seasonal flu, the consequences could be devastating. While the disease proceeded to tear through poultry flocks, making its way west from Southeast Asia to Africa and Europe, becoming the most extensive influenza panzootic in known history (Sims and Brown 2008), human cases remained limited although also deeply troubling. Like the common cold, which does not have a cure, H5N1 is a virtually untreatable disease. With an apparent 80 percent human mortality rate in Indonesia, the potential risks were amplified to become a frightening global specter indeed, even though under actual “pandemic” conditions the mortality rate would drop dramatically.

Anna Tsing (2007) argues that the “global scale” is always a construction and not a self-evident frame. Constructing a global frame around H5N1 raised the status of the problem and made targeted groups of people responsible for the health and well-being of other, far-flung humans on the planet. The desire to prepare for, and even to stop the epidemic before it materialized, initiated a massive response within Indonesia on the part of the global health community, eclipsing other Indonesian scientific, health care, and aid agendas. Indonesians, at times, believed international interventions to arrest H5N1 violated Indonesian sovereignty. Preparedness initiatives did not align with national public health goals, which were oriented around endemic and treatable diseases such as malaria. It would often appear to me, too, that this was an attempt to protect the security of the United States by intervening “there” before the problem came “here”—in other words it seemed not unlike the global war on terror.

Although Indonesia did contribute greatly to pandemic preparedness, outcomes seem to justify a certain skepticism toward the international intervention. As of 2010, there have been only 489 worldwide cases of human H5N1 influenza, with 289 fatalities officially confirmed by the WHO. And the 80 percent mortality rate cited by the Indonesian Ministry of Health and others may have as much to do with sampling techniques as with the ratio of deaths to cases.³ These low numbers might alternatively be understood as a result of preparedness. Even so, many Indonesians I consulted felt that they were caught in an epistemological haze, a cloud of speculative possibility that made specific demands on them as a national population.

Clusters of nonhuman identities, of course, were likewise at play in the multispecies cloud. Giles Deleuze and Felix Guattari write: “We form a rhizome with our viruses, or rather our viruses cause us to form a rhizome with other animals” (1988:11). Working to get beyond the human exceptionalism underlying much scholarship in anthropology and the humanities (Haraway 2008; Kirksey and Helmreich this volume), I observed that H5N1 influenza brought together humans of diverse types (epidemiologists, chicken farmers, virologists, ornithologists, public health workers, government ministers) and equally diverse animals and strains of microbes.

In the mutating connections among humans, chickens, and wild birds that I focus on below, H5N1 was translated into multiple species registers, at different scales. It became visible through processes such as infection, lab identification, public awareness, or security campaigns. Clouds of viral becomings also spread materially but invisibly—quietly burrowing into the bodies of pet dogs and cats,

civets, stone martens, zoo tigers, among multiple other species (Sims and Brown 2008)—evading detection by health authorities, threatening to suddenly emerge, rupturing established biopolitical relations, and assuming novel forms (Deleuze and Guattari 1983:10).

H5N1 is an “avian” influenza because it is a strain adapted to birds, and does not cause observable illnesses in most waterfowl, the common reservoir of all influenza viruses. The form of a single molecule, hemagglutinin, usually restricts this strain to birds because of the specificity of receptors in host animal cells. Hemagglutinin-receptor interfaces put up a “species barrier” that usually prevents the avian influenzas from infecting mammals, like pigs or humans. Individual hosts, however, can become viral “environments” where mutations can accumulate. Thus, hemagglutinin incompatibility turns out not to be an ultimate barrier to transmission, and cross-species transmission has the potential to transform the virus as well as the host.

This permeable “species barrier” is one thing that keeps H5N1 in the realm of a virtual specter (a panzootic restricted to certain human companion species), rather than a human pandemic. Influenza viruses can evolve through reassortment or mutation (genetic drift) of the original strain. The randomness of these processes adds to the cloudiness of viral futures. Virologists studying influenza have speculated that pigs, if coinfecting by human and avian viruses, might become “mixing vessels” in which seasonal influenza could reassort with avian influenza to create a strain with the virulence of H5N1 and the transmissibility of ordinary flu (Suarez 2008). Animal bodies, then, become media for the production of further mutation, further “cloudiness,” a material relay for producing more quasi-species blurriness.

The names of influenza viruses also circulate in a kind of multispecies cloud, where legibility depends on affixing an animal host species name—bird, pig, horse, human—to the designation of the virus. Influenza nomenclature contains traces of multispecies connections and also links particular strains to the laboratories and locales in which they were first described. In the naming system set up by the WHO, influenza strains are defined by their antigenic type (A, B, C); the host from which the strain was first isolated (avian, swine, etc.); the geographic origin of the isolate (city, state, province, country); a laboratory reference number; the year of isolation; and subtypes of hemagglutinin (HA) and neuraminidase (NA) glycoproteins found on the surface of the virus: “For example, an Influenza virus isolated from turkeys in Missouri would be A/turkey/Missouri/24093/1999 (H1N1)” (Suarez 2008:4). Types of influenza virus (many strains constitute a type) are referred to by the shorthand of their HA and NA subtype: H5N1 contains the fifth HA subtype

and the first NA subtype.⁴ These names, which enact provisional stabilities for viral clouds, are thus the result of encounters between viral antigens and animal hosts in laboratories (themselves networked collecting sites).

Until three-year-old Lam Hoi-ka died of the disease in Hong Kong in 1997, all subtypes of influenza with the H5 hemagglutinin were believed to only affect birds, strictly confining the virus to avian hosts. Its leap to humans required only slight changes to the hemagglutinin molecule. After these subtle molecular transformations the virus proved capable of infecting a limited number of people who seemed to have some unique constellations of genes that made them susceptible.⁵ If the H5N1 virus were to suddenly mutate again, and generate a H5 hemagglutinin molecule that was fully compatible with human cellular receptors, the disease could suddenly become as infectious as a garden-variety flu. When viruses jump species boundaries the new animal hosts do not have antibodies to newly evolved strains of influenza. In a cloudy future, humans would have no preexisting immunity to H5N1 if it suddenly jumped from the worlds of birds to those of people.

WILD BIRDS: FROM BIODIVERSITY TO BIOSECURITY

Susanti had come to love birds while writing her undergraduate thesis in the mid-2000s on the swallows of Prambanan temple, a famous tourist pilgrimage site near her university in Yogyakarta. As a master's degree student in biology in 2008, she was hired as a lab technician by the Indonesian Ornithologists' Union to sample wild birds at a beach on the south coast of Java. As she poked a long cotton swab into the cloaca of the sandpiper grasped in her blue rubber gloves, Susanti was hoping she could help answer the question of whether wild birds, either resident or migrant, were a significant transmission vector for H5N1 in Indonesia (see Figure 2). Her research was part of a larger surveillance study conducted on behalf of NAMRU-2, the U.S. naval facility that first identified H5N1 in humans in Indonesia. Ornithologists and bird watchers were thus turned into agents of influenza surveillance. Samples would later be sent to the Naval Unit for genetic analysis.

Following this sample back to the lab, I learned that it was unclear whether it would test positive for the same avian influenza strain that had been devastating Indonesian poultry and claiming human fatalities. One thing was clear, however: The sandpiper was no longer simply the target of casual birdwatchers or of those, like Susanti, specializing in avian biodiversity. It had moved from biodiversity—the subject of my first study—to biosecurity discourse and practice. The wild bird was now part of what I would call a “multispecies cloud” of global health, transnational



FIGURE 2. Sandpiper sampling at Trisik Beachside Laboratory, Central Java. (Author's photograph)

science, industrial agriculture, Southeast Asian foodways, pandemic preparedness, and species-jumping disease emergence.

At the U.S. naval research laboratory, where the sandpiper sample would be tested for H5N1 genetic sequences, the contingent mix of human, avian, and viral beings would contribute to a set of rapidly forming knowledges about transmission patterns, viral mutations, and interspecies entanglements in a potential outbreak scenario. At the beachside lab, Susanti came out of the field and into laboratory science, acquiring new skills, scientific interests, and career possibilities, as well as a means to appreciate the microbial companion species of birds. When we look at the thoroughly sampled bird, the moment of testing enfolds the search for possible futures for humans, viruses, and birds into a potential sandpiper becoming.

As test sample, sandpipers were recognized for how they engaged H5N1 and for the possible consequences that might follow. Sandpipers might or might not become identified as disease carriers in the sampling and analysis process. The result would determine their futures in engagement with both viruses (which may or may not make them sick) and humans (who could decide to target them as carriers). These wild birds were in danger of being moved from the realm of *bios* (forms of life with biographies, part of ecological biodiversity) into the domain of *zoe*—that which is killable (cf. Kirksey and Helmreich this volume). Their biopolitical

status had the potential to mutate as they moved from the realm of biodiversity to biosecurity.

MUTATING CLOUDS OF SECURITY: PRIVATE, VITAL, VIRAL

Facing stark biological facts, and uncertainties about possible eventualities, fears about a possible H5N1 influenza pandemic spread among world leaders. Here is how Michael Greger, Director of Public Health and Animal Agriculture at the Humane Society, documented one set of reactions to a possible H5N1 pandemic:

Senator Frist has warned that H5N1 “poses an immense potential threat to American civilization.” Tara O’Toole, director of the Center for Biosecurity of the University of Pittsburgh Medical Center, agrees. “What we are talking about is not just another health issue—it is a nation-busting issue,” she added. This sentiment is expressed world-wide. “It will be the worst nightmare,” the President of Indonesia said in 2005. “This plague can be more dangerous than the tsunami which last year killed hundreds of thousands of people in a matter of minutes.” [2006:357]

Media and scientific analyses alike played up predictions of catastrophe—H5N1 became a threat to U.S. civilization, nation busting, and worse than the 2004 tsunami in Indonesia. Even critical geographer Mike Davis (2005) called the impending flu pandemic the “monster at our door,” not unlike the Food and Agriculture Organization of the United Nations (2005), which called it the “enemy at the gate.”

But to read these statements as fully grounding “biosecurity” practice and discourse (see Lakoff and Collier 2008) in Indonesia would be to miss the particularity of “security” talk and activity in the archipelago. Building on Gusterson’s idea of “securityscapes” (Gusterson 2004), I view Indonesia as shaped by a variety of security clouds that do not answer, for example, to Andrew Lakoff’s recent (2008) notion of “vital security,” which centers on the safeguarding of stable transportation, communication and public health infrastructures, many of which are lacking in Indonesia altogether or are only present for the elite. Toll roads, for example, form a visible architecture of apartheid in many cities in Java. These relatively well-maintained roads run through the center of major urban thoroughfares—allowing those who can afford to pay to whiz past traffic jams. Similar divides exist in the realm of health care. The Indonesian capital of Jakarta has state-of-the-art medical diagnostic technologies available for wealthy expatriates and citizens—facilities comparable to those available in Singapore or the United States. Most Indonesians get their health care from underfunded government clinics (*Puskesmas*), that are

only able to do basic diagnoses of common diseases, like malaria, with conventional microscopy.

If the Indonesian state has historically sought to secure its power against the people (Cheah 2003), particularly under the rule of General Suharto (President from 1967 to 1998), the question as H5N1 entered Indonesia became: Whose biosecurity was at stake? Warnings about a deadly influenza pandemic caused a great deal of anxiety in Jakarta, the capital of Indonesia, in the middle of the '00 decade. This was actually more striking among the expatriate community than among Indonesians, and traceable, in the U.S. case, to presentations set up by the U.S. Embassy for the American Chamber of Commerce in Indonesia. These presentations painted a particularly bleak scenario. "You can't underestimate how afraid everyone is," one American management consultant told me. "How will we get out? If we wait and the pandemic strikes, all air travel will be shut down and we will be stuck in Indonesia." Expatriate views of Indonesia's public health care system and always edgy politics added to foreigners' feelings of insecurity in the imagined pandemic that seemed to be on the horizon.⁶

On the trail of security discourses, clouds of narratives and practices that were proliferating in connection with avian influenza, I grounded my multispecies ethnography by visiting one of a burgeoning number of private international security firms operating in Jakarta. Lexington Security (a pseudonym) was a company run by a group of former Australian police and intelligence agents. After passing my passport under the bulletproofed glass, I was brought through a series of secure doors into the underground offices of Lexington for a tour with its president. Lexington's job is to develop strategic security plans for its clients for all kinds of threats including natural disaster and political disruption. Services include instant messages and e-mails informing clients of demonstrations, terror threats, economic issues, court trials, airline accidents, and even traffic jams. Security analyses were carried out by young male Indonesian analysts, who joked with the Australian managers as I watched them dissect virtual security data from both computer screens and TV monitors linked to cameras mounted at client facilities.

Companies like Lexington take up the task of corporate security where the Indonesian state leaves off, or is unable to follow in the postauthoritarian era. They date back only as far as the fall of President Suharto in 1998 when the uncertainty of regime change and the Asian financial crisis caused foreign corporations to look to the private sector to meet their security needs.⁷ In the case of an avian influenza outbreak, Lexington clients were directed to follow a pandemic influenza response plan that was part of a written security product provided to clients in advance.

What a security consultant could provide in such a case was early information enabling foreign workers to get a jump on leaving Asia, although I learned the cell phone network would overload in seven minutes of a catastrophe. With an outbreak of deadly influenza, Lexington would aid international clients to evacuate, while Indonesian staff would be left behind. Lexington staff were fully conscious of the racialized separation “us” and “them” in their exit scenario (I imagined the epidemiological “fall of Saigon”).

Under epidemic conditions, however, a privatized evacuation would hardly have the support of the international institutions trying to stop the spread of disease by quarantining people in place. A firm like Lexington is only able to provide “security” based on a basic level of order and infrastructure, and the worst-case scenarios described for a H5N1 pandemic would undo this basic order. Recent concerns in the United States, and to some extent Western Europe, over necessary levels of political and infrastructural order have been analyzed by Stephen Collier and Andrew Lakoff (2006; expanded in Lakoff 2008), through their concept of “vital systems security,” an emergent mode of rationality that they differentiate from “state security” and “population security.” By vital systems security Collier and Lakoff mean security designed by U.S. public health and national security establishments to protect vital infrastructures and current political-economic arrangements. They have in mind the safeguarding and management of oil pipelines, electrical grids, telecommunications systems, and plumbing infrastructures.

Clouds of pandemic disease share the attribute of being unpredictable and potentially devastating to vital systems infrastructures. H5N1 avian influenza focused “First World” attention on the effects of possible pandemics on international transportation, tourism, retail, absenteeism, manufacturing productivity, and the larger global economy.⁸ What Collier and Lakoff describe, although apt for the United States or Northern Europe is, I suggest, a particularly Euro-American form of governmentality and not the major form of security thinking in Indonesia.

Indonesian reactions to H5N1 frequently differed from the concerns of foreign governments and did not key to vital systems security or the foreign logics of pandemic preparedness. The President of Indonesia’s comparison of the pandemic potential of H5N1 with the 2004 tsunami, a natural disaster with tremendous toll on life and property, for example, indicates an ongoing concern with the normative rationality of population, rather than of vital systems.⁹ Even still, scores of Indonesian professionals were interpolated into transnational programs of H5N1 surveillance.

Amid anxieties about an emergent pandemic, Indonesian physicians were asked to respond to avian influenza to ease the anxieties of sick patients, virtually all of who had an ordinary flu. Doctors were also asked to take a position in relation to the risks of the potential pandemic as described by international health officials and the Indonesian government. During one stay in Jakarta, I spoke with an Indonesian doctor whose thoughts turned to wild birds in conjunction with the H5N1 virus. He was a general practitioner who held a degree in epidemiology from a university in southern California. He was not impressed by bird flu and imagined it as a fiction conjured up by then President George W. Bush who he viewed as obsessed by threats coming out of the Muslim world:

Maybe the reason President Bush is so worried about bird flu is because his advisers told him about a story from the Qur'an called the *Parable of the Elephant Troops*. In the Parable an elephant army is out to destroy the Prophet Mohammed and his followers. The elephants were unstoppable until God sent a flock of birds to drop stones onto the elephants from above. Could the birds be a metaphor for a pandemic? Maybe Bush is afraid of H5N1 because God once sent wild birds to save Muslims, and this could happen again.

This close coupling of security, science, and religion is an example of the kind of unexpected subject formation we might expect in the multispecies cloud. We might be able to trace a past and a present for the doctor's statements but such statements do not contain the future. Despite his status as a nonbeliever in a coming H5N1 pandemic, the physician told me that WHO influenza funding was an easy source of support and he would be applying for a grant. Influenza virus was a companion species that interpolated him in world making projects (Haraway 2008; Tsing 2004) and, of course, shaped his identity and his practice of medicine in the world. In the Parable of the Elephant Troops, the agency of birds is scaled up to eclipse the power of armies and kings. In the story of H5N1, Indonesian birds went from being the agents of history to being framed in the crosshairs of foreign military agents.

MUTANT MULTISPECIES CLOUDS: H5N1 AND CHICKEN

Joe Masco (2004) in "Mutant Ecologies," describes the radioactive landscape of the South Pacific and of northern New Mexico, irradiated by nuclear weapons tests in the mid-20th century. Like the mutant possibilities of the nuclear cloud, the multispecies cloud also has the ability to mutate species bodies and beings. And in the H5N1 cloud, no creature was so affected as the chicken.

After I (along with many Indonesians) began to feel confident (correctly or not) that I was not likely in personal danger from H5N1, I purchased a chicken and a rooster from my neighbors. After trying to keep them caged for the first month, I gave up on the cage, having a better sense of why Indonesians let their poultry roam, and why some commercial growers engage in the cruel practice of debeaking. Tired of being pecked when I cleaned the cage or fed them, and worried about how they were treating each other, I set them free. What my chickens wanted to do was to nest in a tree about three feet off the ground. There, inside the branches, they were safe from cats and other potential predators as they slept. During the day, they would strut around the yard, scratching with their feet in the dirt looking for food, and also eating my garbage if they could get at it. Like my neighbors, I also set out leftover rice and vegetables for them. Every now and then the rooster would chase the chicken around the yard in an attempt to mate. In a few months we had a small flock of tiny chicks that the hen guarded closely under her wings. Casually watching my chickens, taking field notes as an amateur ethologist, I came to think about what this creature brings to the cloud of events and specters I am describing. My multispecies ethnography fieldwork was thus also “homework” of sorts (cf. Clifford 1997:85), and I became familiar with embodied, gallacious goings-on of a nonindustrial variety.

If anything is certain in the H5N1 multispecies cloud, it is this: The chicken has been the most significant casualty. H5N1 is the worst avian influenza epizootic ever in terms of geographical extent and number of infected poultry (Sims and Brown 2008:252). For each human death from H5N1, it is estimated that a million chickens have died (Sipress 2009:327), giving an estimated death toll of 400 million birds. Culling for highly pathogenic avian influenza, with methods that have included gassing, burning, and burying alive, has produced what some have called “a global avian genocide,” although it is difficult for me to imagine an alternative response to culling once a flock is infected with H5N1. Virulent strains of influenza lead to a particularly bad death if you are a chicken. Infected birds seem to dissolve from the inside out and can die in a matter of minutes. Javanese farmers have given H5N1 the onomatopoetic name, *krirrak-plop*—one cluck and the chicken drops dead.

In Southeast Asia, the majority of poultry production is done by individuals raising diverse species of uncaged birds that scratch around searching for worms and bugs to eat. The lack of biosecurity measures (like hand washing, segregating species, preventing public access to birds, vaccination) in this poultry sector was thought to pose a high risk of bird-to-human infection (Woodrow Wilson International Center for Scholars 2006:2–5). Backyard production appeared to

hold greater risks than commercial production because the backyard cannot be made biosecure through techniques of bioexclusion and agricultural sanitation, and because these chickens have closer contact with human populations. I became interested in an H5N1 communications strategy enacted between 2006 and 2009 by a consortium involving U.S. foreign aid and expertise, the Food and Agriculture Organization of the United Nations, and a private sector educational communications firm. This consortium wanted to address the disease in Indonesian backyard poultry production by making the disease's characteristics, its potentially severe consequences, and the appropriate actions to take known to anyone involved in raising, selling, or slaughtering chickens in Indonesia.

What has been valorized in the United States as free-range chicken was transformed, through H5N1 preparedness campaigns, into an agricultural method that threatened the world with a pandemic. In associating backyard poultry production with "traditional, Asian" agricultural practices, in contrast to modern commercial poultry production, "Asian culture" itself became viewed by global health commentators as a potent source of risk (cf. Bickford and DuMont 2007; Woodrow Wilson International Center for Scholars 2006).

For contagion theorist Priscilla Wald (2008), communication about disease risk articulates communities of vulnerability and reaction. Southeast Asian cockfighters were one community that worried the consortium. Recall the cockfight made famous by Clifford Geertz, and the close physical intimacy of the cockfighter with his fighting bird:

The intimacy of men with their cocks is more than metaphorical. Balinese men, or anyway a large number of Balinese men, spend an enormous amount of time with their favorites, grooming them, feeding them, discussing them, trying them out against one another, or just gazing at them with a mixture of rapt admiration and dreamy self-absorption. [Geertz 1973:418–419]

Cockfighters also suck mucus from avian nostrils, pierce bloody wounds incurred in battle, and inhale aerosolized chicken sputum (Sipress 2009). Now, all the fluffing, petting, and bloodletting had become a cause of epidemiological attention, not only the source of cultural fascination that Geertz had identified.

Hoping to transpose a fear associated with strange dogs onto chickens, a consortium epidemiologist I interviewed wanted Indonesians raising village chickens to "think rabies" when chickens die. She was concerned about close human contact with dead chickens, including children cuddling dead pet birds, cockfighters, and ordinary families consuming and eating sick poultry. It is hard to transmit the

message that dead chickens can kill you, she felt, when H5N1 symptoms mirror many other, more common, poultry diseases, such as the nonzoonotic Newcastle disease. In response, the consortium developed seminars, trainings, and publications in a program called “Communications for Public Awareness” to disseminate one H5N1 message around which there was consensus: The disease can kill you. Report possible disease incidents, then burn and bury affected flocks.

Heather Paxson (2008) argues that insertions of microbes into the social field reflect assertions over how humans ought live with one another. She names this “microbiopolitics,” defined as “the creation of categories of microscopic biological agents; the anthropocentric evaluation of such agents; and the elaboration of appropriate human behaviors vis-à-vis microorganisms engaged in infection, inoculation, and digestion” (Paxson 2008:17). The consortium’s communications program elaborated the behaviors expected for those who kept, slaughtered, or consumed poultry across rural Indonesia. The presumptive habits of holding dead pets, cockfighting, and consuming sick birds were now not only unhealthy, they were conceived as wrong in moral terms. The consortium’s campaign was an exercise in microbiopolitical subjectification that, when it worked as desired, looked something like this:

On June 16, 2008, Mr. Sunar’s backyard poultry were wiped out by a silent killer. Alarmed, he reported the deaths to his neighborhood representative. They had learned that sudden death in poultry could signal an outbreak of deadly bird flu from a television announcement. From their sleepy neighborhood outside Medan, North Sumatra—Indonesia’s third largest city—they could have felt panicked and alone. Instead, they stayed calm because the TV message had also taught them what to do: Report the suspected outbreak to local authorities. [USAID 2008]

The consortium claimed 159 million viewers of its media campaign (USAID 2008), or three-fifth’s of the Indonesian population.

Although preparedness planners, such as the consortium I describe, attempted to produce singular narratives, the outcomes of public communication of H5N1 messages were multiple. In my periurban middle-class neighborhood of Yogyakarta, my neighbors got rid of their backyard chickens and pet songbirds in 2006 as a result of public awareness campaigns and media messages. By the end of the decade, however, these same neighbors expressed skepticism about bird flu because the predicted human pandemic never occurred. Songbirds are a symbol of being “Javanese,” and cages now hang again from roof eaves all over

Yogyakarta. One ornamental bird owner I spoke with told me with pride that H5N1 “wouldn’t dare” (*tidak berani*) to infect his birds because he took such good care of them.

Skepticism about the dangers of H5N1 became widespread in Indonesia, perhaps because of the gap between messages about H5N1 and actual occurrences of the disease. In 2007, the Association of Poultry Producers in South Sulawesi (Forum Masyarakat Komunitas Perunggasan 2007) claimed H5N1 to be a deliberate act of “bioterror” on the part of the United States. According to association spokesperson Wahyu, because the United States produces 2,500 excess tons of chicken legs a year that Americans do not want to eat, the United States wants to export these to Indonesia. The United States has deliberately used the virus to ruin Indonesian poultry production to improve its poultry export sector. Wahyu expressed disappointment that the Indonesian government succumbed to U.S. pressure to limit the transport of poultry around Indonesia (a biosecurity measure), and observed that domestic poultry producers lost money when Indonesians became scared to eat chicken.

In Pasar Demangan, the farmers’ market in Yogyakarta where I used to shop each week, Mrs. Wati sold me both backyard and commercially produced chicken. Just as Wahyu had described, she lost her livelihood at the height of the H5N1 scare, but the disease never made her sick. She buys live chickens directly from the producers and she will not buy chickens that look sick, she told me. As a customer I know I am being reassured, but I also place what she is telling me in a broader context: The intervention and public awareness campaign has been disproportionate to the amount of human illness in Indonesia. Still, in the countryside villages I have visited, women told me about chickens and even entire flocks that died suddenly. Some said it was avian influenza. Others reported that they didn’t know why their birds died. Conspiracy theories abounded, and these stories beyond ordinary reason, have to be included in our understanding of a multispecies cloud.

Wald (2008) writes of how disease becomes conventionalized in the form of an “outbreak narrative.” Comparing the consortium’s H5N1 narrative to the concept of quasi-species, what became clear from my observations and conversations with consortium participants, all kinds of bird owners, and other commentators on the disease in Indonesia is that, like the “consensus” (average) genetic sequence of the quasi-species, the consortium’s outbreak narrative represents a “consensus” thread to the H5N1 intervention. In the quasi-species viral cloud every possible base pair is represented in the consensus genome. In human worlds, H5N1 is a “consensus narrative” with a multitude of heterogeneous elements in the cloud.

Although I heard many different stories about H5N1, I rarely met a poultry owner, commercial or backyard, who said to me anything like, “The disease can kill you. Report possible disease incidents, then burn and bury affected flocks.”

Although on average the consensus among professionals combating H5N1 was that the biggest problem existed in backyard poultry, the evidence indicated that an even bigger problem might actually exist within the commercial poultry sector. One million commercially grown chickens are brought in to the capital city of Jakarta and consumed each day. They come from farms all across Java and Southern Sumatra. Although broilers are not raised in the battery cages that house layers, they receive a schedule of hormones, antibiotics, and vitamins that brings them from “day-old chick” to market in 33 days. This contrasts with the seven months that it takes to raise a village chicken (*ayam kampung*), like the pair I owned, to a fully grown size. These village chickens are generally raised without medications or enhanced feed, even when raised for commercial sale. Village chickens are also said by Indonesians to both taste better and be healthier for you. They cost twice the price, however, and so village chicken is usually consumed for special ceremonies rather than everyday fare.

For roughly the first five years of the Indonesian outbreak, pandemic preparedness planners largely left the commercial sector to regulate itself. H5N1 in commercial poultry has been, by default and by design, shielded from intervention by both the Indonesian government, and the international community. Commercial producers are widely known to have failed to report H5N1, however, and to sell off potentially infected poultry, rather than to lose profits with culling. It is not hard to find accounts that lay the cause of recent influenza epidemics and other zoonoses at the door of intensive farm animal production (Davis 2005; Greger 2006; Pew Commission 2008; Wallace et al. 2009). These accounts make a link between the intensiveness of agriculture and the proliferation of zoonotic disease, demonstrating that the conventional influenza “outbreak narrative” leaves important sources of contagion out of the picture.

Tracing the genealogy of institutional ecologies that gave rise to 21st-century viral becomings, takes us back some 40 years to the origins of a modular model of industrial agriculture, and to much earlier forms of production. In the 1970s and 1980s, U.S. models of industrial production began to be exported around the world, including to Asia. On the one hand, such factory farming has made possible increased protein consumption globally (Pew 2008). On the other hand, problems associated with export of “Concentrated Animal Feeding Operation” (CAFO) models are increasingly clear. With CAFOs, countries face new problems

of regulating waste, protecting workers, and considering animal welfare, not to mention disease. According to a Pew Commission report:

multinational corporations involved in the animal protein industry scour the world looking for countries with cheap labor and large expanses of land available to cultivate feed for food animals. When they find these areas, they bring along the production model that served them well in developed countries. [Pew 2008:9]

According to Donna Haraway, the world's first industrial egg production began during the construction of the pyramids in Egypt (2008:265), but by all accounts, everything about the raising of poultry has changed tremendously in just the last 50 years. Smith and Daniel (2000), authors of *The Chicken Book*, claim that the modern industrial chicken has been so engineered away from even its domesticated 19th-century predecessor as to be not a chicken at all. In the gallaceous future they foretold back in 1975, chickens "will not be chickens and their eggs will not be eggs" (Smith and Daniel 2000:299). Perhaps these chickens are closer to Margaret Atwood's science fiction "ChickieNobs"—meat grown without bodies—in her novel *Oryx and Crake* than we would like to think (Haraway 2008:268). One outcome of the new nonchicken chicken is its ability to proliferate disease.

There is hardly any doubt that the intensive methods of the livestock revolution are responsible for many multispecies clouds of new zoonoses. Antibiotic treatment often begins at birth in commercial animal agriculture, and there is an ongoing struggle to keep up with emerging disease. With this in mind, a significant body of research claims that backyard production is vulnerable to "spillover" of disease from commercial production, but does not generate it (Wallace et al. 2009). To the extent that intensive production in Asia has aided in its spread, and may be implicated in H5N1's mutation to virulence, we have to consider that it is not the primitiveness of traditional Asian agriculture but, rather, the so-called modern methods exported from the first world, with concomitant uptake by producers in Asia, that has created this new profile of risk. Structures of neoliberal agribusiness governmentality were obscured by clouds of H5N1 interventions.

HUMANS BECOMING WITH H5N1

In the multispecies cloud, changes in the human and its specificities were prominently at stake. In the uncertain reassortments of identities that comprised the cloud, multiple figures of the human came in to view. Backyard poultry producers, doctors and epidemiologists, patients struggling against steep odds and

security consultants seeking to improve their odds—all of these people imagined the H5N1 quasi-species as a locus of fear, identity, knowledge, resistance, ethics, and opportunity, constructing diverse clusters of knowledge and belief about spaces and substances from the global, to the national, to the human, to the microbial.

At one moment, the H5N1 outbreak narrative proposed that the world was at risk, suggesting that the disease has an egalitarian capacity to threaten us all equally. At another, the scale politics of H5N1 suggested that Indonesians, more than others, bore greatest responsibility both for creating a potential pandemic situation and for stopping it in its tracks. Initially problematized in “First World” terms as a threat to national security (“a nation-busting issue”), the desire to control H5N1 “on the ground” in Indonesia seemed to specify the will to stop the disease “there” before it came “here.”¹⁰ Indonesia weighed its own interest in protecting household-level food production schemes, maintaining tourism, and developing its own pharmaceutical and scientific capacity, against international health risks on the global scale.

Indonesia was unable to refuse the terms of massive international disease intervention, however, on any grounds that could be viewed as reasonable. And yet, more than a few Indonesians contested the scalar understanding of “global vulnerability,” “Indonesian responsibility,” taking up H5N1 as a problem of scientific collaboration, population health, and even international hegemony, in a way that reframed their relationship to H5N1. For example, Susanti, the technician who sampled sandpiper cloacae on the beach, engaged the disease as an opportunity for advancing Indonesia’s position in global health and epidemiology, whereas the spokesman for the Association of Poultry Producers in South Sulawesi, Wahyu, alternatively, understood the disease as U.S. bioterror and wanted to refuse biosecurity measures that put poultry producers at economic risk. And although the World Bank argued that H5N1 threatened something called the “global economy,” it was Mrs. Wati in Pasar Demangan who could detail the ways her own “market” economy had been affected by H5N1.

The concept of the cloud that I have developed in this essay focuses on processes of infection and reassortment. Despite the proliferation of vaccination technologies and the advent of antibiotics, infections are not under human control. Rapid rates of change are also at play as microorganisms can evolve at a much greater rate than the life forms they infect; in the multispecies cloud that results, viral and vital materials reassort, changing the taken-for-granted boundaries not only of species, but of nations, organizations, and economies.

Cloudy reassortment is thus a metaphor for processes of global exchange such as those explored through Ong and Collier's concept of "global assemblage," an "ensemble of heterogeneous elements" (2004:8) through which world-making significance is articulated. Where the cloud differs from the global assemblage, however, is that the cloud is not limited to forms of "technical, political and ethical reflection and intervention"; it does not assemble a rationality but, rather, operates through infections and reassortments that are coincidental, responsive, opportunistic, and often nonrational. The quasi-species and multispecies cloud also differs from Deleuze and Guattari's idea of "assemblage," conceived as pieces gathered into a single context. Whereas their assemblage lends stability, however fleeting, to a cluster, group boundaries in the cloud are inherently unstable. As a metaphor playing off the viral "mutant swarm" or "cloud," the multispecies cloud will always have multiple components, but also multiple contexts. In other words, the thing that is H5N1 does not gather together adherents in a single context, but rather proliferates contexts.

The cloud focuses on exchange among vital and quasi-species beings, but also queries the boundaries of species. H5N1 influenza infects a multitude of species transforming them in the process, making and remaking them in not always harmonious concert. H5N1, after all, can kill. As a killer with the ability to take life (although never purposefully or methodically), but also with the ability to remake life (as biologically immune or as socially reinvented, like *Susanti*), the H5N1 multispecies cloud holds life itself at stake. Human responses to such uncertainty over life are a key component of the multispecies cloud, but so is the remaking of the human along with viral and other (friendly and hostile, but also those in agricultural servitude) companions.

As a multispecies cloud of unstable entities, H5N1 emerged amidst a multiplicity of countervailing national, commercial, religious, and other human interests, if only to vanish again as an ephemeral unbecoming. What became of H5N1?

As of mid-2010, an H5N1 pandemic has not appeared. Midway through 2009, however, an influenza pandemic emerged in the form of a different influenza virus, a different quasi-species in the swarm: H1N1, not H5N1. This type of virus was known popularly as the swine flu. The label *swine* was later dropped to keep pigs from being wrongfully culled, indicating the powerful materiality of imposing animal species on the viral. This pandemic H1N1 virus is a reassortment of viral genes from swine, avian, and human influenza viruses. It began in Mexico early in 2009 and was first identified in April, causing Mexico City to close down schools and businesses for a week to try and stop its spread. In early June 2009, the WHO

officially declared the disease a pandemic. By all accounts this H1N1 virus is milder than even the seasonal flu, although there have been deaths.

Critical analysis of this new pandemic flu (Davis 2009; Wallace 2009) details its early emergence around a subsidiary of Smithfield Farms (one of North America's largest pork producers) in Mexico. Opened in the wake of NAFTA, Wallace writes, "if we are to impart responsibility where it should lay, North America's new influenza would be better called the NAFTA flu." He says the name *swine flu*

detracts from an obvious point: pigs have very little to do with how influenza emerges. They didn't organize themselves into cities of thousands of immunocompromised pigs. They didn't artificially select out the genetic variation that could have helped reduce the transmission rates at which the most virulent influenza strains spread. They weren't organized into livestock ghettos alongside thousands of industrial poultry. They don't ship themselves thousands of miles by truck, train or air. Pigs do not naturally fly. [Wallace 2009]

I have described how things changed for humans and their mammalian, avian, and viral multispecies partners as H5N1 in Indonesia opened up multiple species to transfected identities. In attending to their own sense of vital systems security, what pandemic preparedness planners planned for was an avian influenza of deadly virulence emerging out of Asia; what occurred was a mild swine flu coming out of the United States and Mexico for which we were relatively unprepared. The sense that past and present are tied to but do not contain the future for either humans or influenza viruses is inherent in an ontology of the multispecies cloud. Our futures lie at the junctures where forms of the human, animal, and microbe meet and where each sustains—and clouds—the limits and possibilities of the other.

ABSTRACT

Through an index case in Tangerang, West Java, the Orthomyxoviridae virus H5N1 influenza became visible in Indonesia and propagated rapidly across the archipelago. This viral event incited fears of a human influenza pandemic, disrupting existing arrangements among species, peoples, institutions, and nations, and remaking their biopolitical relations and specific ontologies along the way. On the basis of ethnographic field work in technoscientific, agricultural, and security communities in Indonesia, this essay examines how a set of strains and species—the H5N1 influenza virus, wild birds, domestic poultry, and, finally, humans—combined with one another, and with ongoing Indonesian and transnational concerns over pandemic preparedness, biosecurity, and national integrity, to create a multispecies cloud. The concept of multispecies cloud refers to the narratives and material practices floating around the H5N1 event and its multiple species companions in Indonesia. As I conceptualize the cloudiness of H5N1,

its key feature is the uncertainty of precisely what social and biological forms were interacting in the outbreak scenario or might consequently emerge as a consequence of entering into engagement with the virus. The influenza virus, as a quasi-species or cluster of genomes in any case of infection, is a potent source for exploring an array of biopolitical concerns in human communities that emerged alongside the virus. Risk, scale, and speculation are discussed in turn as rubrics for understanding the microbial and multispecies sociality of H5N1 influenza. Examples are drawn from the sciences of virology and ornithology, and the global health practice of disease communication, as well as from poultry agriculture.

Keywords: multispecies, quasi-species, chicken, H5N1 influenza, Indonesia

NOTES

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1. Through her work on atherosclerosis, Annemarie Mol (2003:32–36) tackles the thorny problem of subject–object relations by introducing the concept of “enactment.” To describe objects as “enacted,” she argues, allows us to see that “things” don’t have a life of their own independent of the practices that enliven them. As such, objects require techniques to make them tangible, visible, audible, and ultimately knowable.
2. Virologists had been predicting an epidemic of influenza based on the idea that influenza epidemics periodically appear, and this had not happened for a long time. Influenza pandemics have occurred at an average of every 27.5 years, with 39 years being the longest interval in the past 300 years. That most recent influenza pandemic was in 1968 (Greger 2006:72–93).
3. According to one skeptical microbiologist that I interviewed in Jakarta, there was no effective means of counting mild and asymptomatic cases within the H5N1 statistics in Indonesia because surveillance was based on hospital admissions.
4. There are presently 16 known HA subtypes, and nine known NA subtypes.
5. In Indonesia, human cases of H5N1 infection have frequently affected genetically related family clusters. In a well-known Sumatra cluster, for example, seven of eight family members died of H5N1 in April and May 2006. It was the first Indonesian instance in which the WHO acknowledged likely limited human-to-human (H2H) transmission and the only known probable case of human-to-human-to-human (H2H2H) transmission. The H2H2H event is especially significant for signaling the start of a pandemic; it is what would likely happen as wide transmissibility was ignited (Nature 2006b). For this reason the case was referred to as a “dry run” for a human pandemic (Nature 2006a).
6. One solution seemed to be the Roche product oseltamivir (Tamiflu), a drug that is at the front line of viral influenza treatment. Taken within two days of the onset of symptoms, it can reduce the intensity and duration of disease. According to the WHO (2005), in a pandemic situation, oseltamivir would be in critically short supply, and therefore they recommended national stockpiling programs (which Indonesia carried out) of oseltamivir, which has a five year shelf life. Expatriates who had the financial ability to buy the drug on speculation were stockpiling oseltamivir in their homes and offices.
7. Now, even some elements of the Indonesian government are clients. Thwarting graft is one of the main elements of their business profile. If, for example, a company is being extorted, the court system can be useless. A private security firm, however, can engage in counterextortion, threatening the original extortionist with, for example, pictures of him cheating on his wife. “What will his Imam and his neighbors think of that? The extortion goes away. We have to do

things here we wouldn't be able to do at home." Security firms wish to intervene in pandemic situations in a way that looks different from "home" as well.

8. The World Bank (2006) estimated that a flu pandemic could cost the global economy up to \$1.5–\$3 trillion.
9. Indonesia has maintained a focus on two forms of security not covered by Collier and Lakoff: internal state security and securitization of the international investment climate. The state, under the dictatorship of former President Suharto (1965–98), was a system of a very different order than one made up of vital infrastructure. The Suharto regime included acts, statements, and images designed to secure the state against the nation (Siegel 1998), or the apparatus of power against the nationalism of the people (Cheah 2003). In the post-Suharto era of reform (*reformasi*), the internal repressive apparatus of the state has become substantially less obvious, while corruption and terror have come to the fore as motivating securitization.
10. This is not unlike the approach to the "War on Terror," which brought the battle to the "enemy" before the enemy could reach the "homeland."

Editors Note: *Cultural Anthropology* has published a number of essays on social and political crisis in Indonesia. See, for example, Karen Strassler's "The Face of Money: Currency, Crisis, and Remediation in Post-Suharto Indonesia" (2009); Nil Bubandt's "From the Enemy's Point of View: Violence, Empathy, and the Ethnography of Fakes" (2009); and Webb Keane's "Knowing One's Place: National Language and the Idea of the Local in Eastern Indonesia" (1997).

Cultural Anthropology has also published essays on emerging forms and discourses of security, including Andrew Lakoff's "The Generic Biothreat, or, How We Became Unprepared" (2008); Joseph Masco's "'Survival Is Your Business': Engineering Ruins and Affect in Nuclear America" (2008); and Sherene Razack's "From the 'Clean Snows of Petawawa': The Violence of Canadian Peacekeepers in Somalia" (2000).

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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.

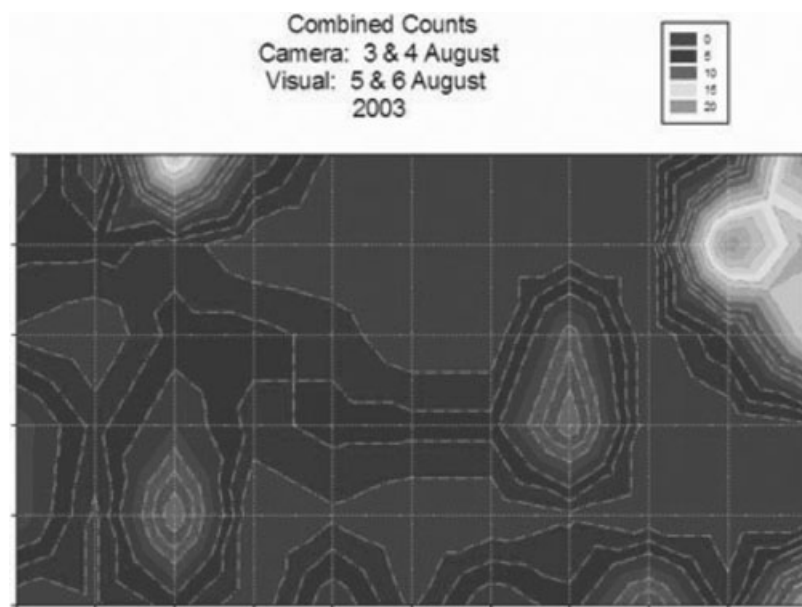


FIGURE 1. A map of landmines generated by the flight patterns of trained honeybees.

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 Ronseidl 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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BOOK REVIEWS

What Is Posthumanism? Cary Wolfe. Minneapolis: University of Minnesota Press, 2009, 392 pages.

Singing to the Plants: A Guide to Mestizo Shamanism in the Upper Amazon. Stephan V. Beyer. Albuquerque: University of New Mexico Press, 2009, 552 pages.

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It is still the quality of our meeting that matters, what we are willing to learn, whether we are willing to be taught by what we encounter, whether we will take our chances in the epistemic murk of a transformed world.

—Beyer, 2009

Observers and fans of that curious “pale blue dot” (Sagan) in tertiary orbit about a middle-aged star will have noticed that Planet Three has entered an exciting new phase of development: Already conscious of its capacity for differential self-representation—as evidenced by such practices as “Halloween” and “limited liability corporations”—participants in bardic culture and authority have begun to grok the tunable nature of the self-representation matrix. In short, many have hacked the crucial linkage between the scripts this symbolic species uses and the outcomes it displays for its growing fan base throughout the cosmos. Hence, imagine my excitement when this reporter’s fieldwork revealed that some of the participants had begun to realize that they aren’t a species at all. Indeed one of the challenges of my fieldwork in this obscure but lovely blue orb has been the difficulty of containing my laughter at some of the local propositions, such as “That’s mine!” or “This patent

details the manipulation of genetic loci responsible for. . . .” Finally, the hypothesis that this collective was on the brink of recognizing its deep and prior ecosystemic unity in the midst of an exquisite local dance of individuation would prove correct, and your reporter could file the fieldwork and move on to a long-planned magnum opus, an investigation of entropy taxonomies in the Proxima quadrant.

Alas, the epic quest has hardly begun. Symbols have indeed moved. After one of the most esteemed of the bardic primates (Foucault) declared that “man is an invention of recent date. And one perhaps nearing its end,” many investors in galactic consciousness futures overreacted and expected Singularity within months. It has been nearly four decades since this “perhaps,” and in the interim the prefix *post-* has become the linguistic habit most prominent among *Homo academicus*. Although *transhuman* escaped the notice of many observers when it was coined in the early 1950s by primates Teilhard de Chardin and Julian Huxley, the *post-* prefix has become something much more mobile. To make sense of this linguistic practice of *H. academicus*, readers may recall the widespread use of a common aesthetic item known as “refrigerator magnet poetry,” where signs can be arranged and rearranged on the most prominent household altar. “Post” sticks to a wide variety of heretofore accepted nomenclatures, indicating that “perhaps” the user of this prefix is no longer beholden to the old meanings. Perhaps, though, it is the very ease of placing the refrigerator magnet before that old polyvalent word *humanism* that has made *Posthumanism* such a disappointment. Only pages into a recent treatment *What Is Posthumanism?* we witness a territorial skirmish over ownership of the term itself:

The first time I used it (hyphenated, no less) was in an essay from 1995. . . . That project included a roundtable conversation with Niklas Luhmann and Katherine Hayles; Hayles picked up the term (with a rather different valence, as we will see in a moment) in her book *How We Became Posthuman* (1999). [Wolfe 2009:xii–xiii]

Now of course these signs and symbols beg for the scrutiny of a genealogist, and as numerous researchers have demonstrated, new concepts often live cheek by jowl with the hoariest of accepted practices, so there is no surprise and even a little interest induced by this scrum to determine the origin of *posthumanism* (devoid of hyphen, no less). But my initial ecstasy soon withered: this report in the form of a question (echoing the primate Kant’s “Was ist Aufklärung?” and its echo from the aforementioned icon of *H. academicus*, Foucault) does not keep its evolutionary aperture open to inquiry but, instead, seeks an answer! And the answer is—more of

the same: “posthumanism in my sense isn’t posthuman at all—in the sense of being ‘after’ our embodiment has been transcended—but is only *posthumanist*, in the sense that it opposes the fantasies of disembodiment and autonomy, inherited from humanism itself” (Wolfe 2009:xv). The dubious claim that all (somehow impossibly univocal) humanisms share these “fantasies of disembodiment and autonomy” becomes the foundation for yet more of the discourse that circulates with greater and greater velocity among *H. academicus*: posthumanism steps into the role not of interdiscipline but pan-discipline, complete with “*partially*” italicized words, as the deep opposition to fantasies of disembodiment and, gasp, autonomy, warrants analyses of that prolix dullard of a discourse bioethics, expert testimony concerning the separation of cognitive science from deconstruction, a studied response to contemporary art, and the declaration of a “vibrant emergent field of interdisciplinary studies called animal studies,” seeking headway on “the need to rearticulate the disciplinary system.” Then there is a small helping of Emerson plated with Cavell and Luhmann, followed by a dollop of Wallace Stevens prepared à la systems theory. In short, species is dead, long live species: Humanist, Posthumanist, *H. academicus* scribbles on.

Worse, the very historical, technological, and evolutionary context of the emergence of the question in the title is scarcely addressed. Scholar Wolfe seems unaware of the cosmic holistic perspective foreseen by an early formulator of transhumanism, Julian Huxley. Years before Foucault’s now brand name declaration, Huxley wrote of a possibly galactic awareness:

As a result of a thousand million years of evolution, the universe is becoming conscious of itself, able to understand something of its past history and its possible future. This cosmic self-awareness is being realized in one tiny fragment of the universe—in a few of us human beings. Perhaps it has been realized elsewhere too, through the evolution of conscious living creatures on the planets of other stars. [Huxley 1957, <http://www.transhumanism.org/index.php/WTa/more/huxley>, accessed August 4, 2010]

Now granted, any hypothesis suggesting an emergent cosmic holism among the primates now 50 years into the Space Age is looking well nigh debunked—from this angle, this planet has gone retrograde! Wolfe remains content to treat transhumanism (which would seem to be “pre” posthumanism, with or without the hyphen) through one of its latter-day voices, philosopher Nick Bostrom, concluding that it is an “intensification of humanism,” as if an intensification couldn’t induce

a phase transition, a transformation no less distinct than that from liquid to solid, fish to amphibian. And although each page of the report would support a veritable tag cloud of references from the *H. academicus* totem—a random page will yield five or more references to luminaries “famous” for such formulations as “local transcendence”—the references cluster around repeat visitors to U.S. humanities institutes, and numerous figures whose work is actually instructive to the ongoing deconstruction of species—Brian Rotman’s notion of “distributed being,” Avital Ronell’s technological alterity, Kodwo Eshun’s Afro-futurist sonic fiction, William Burroughs’s “Third Mind,” Alphonso Lingis’s treatment of “beastality,” Phillip K. Dick’s “Man, Android and Machine,” Stefan Helmreich on the “alien ocean,” Evelyn Fox Keller’s “thinking with slime mold,” to name a few from my field notes—remain, as *H. academicus* sometimes puts it, “unmarked.” And speaking of oceans, reporting on posthumanism without recourse to science fiction is rather like studying the Earth and forgetting to mention that it is covered in a saline sea.

The most seductive of the chapters, the last, focuses on the work of Brian Eno and David Byrne in *My Life in the Bush of Ghosts* (1981), but after opening with a paragraph in which Wolfe finally and truly sings, we are again led down a trail of lack, “a lack of an essential identity,” a “not-ours” that remains tied to the notion of territory, that extended phenotype of “species.” Although the early transhumanists looked beyond this “lack” to a profound intertwingularity, a monism that demands the joyful and epic work of collective, planetary scale individuation, this question concerning posthumanism reports essentially on itself, even while it is devoid of the charms of the first person account. Unlike Robin Dunbar’s *Grooming, Gossip and the Evolution of Language* (1998), which begins with the author being groomed by a baboon, Wolfe never explores the posthumanist subject position but only articulates it.

Still, the “prior ecosystemic unity” thesis isn’t dead yet: Stephan Beyer’s comprehensive and encyclopedic treatment of Upper Amazonian shamanism, *Singing to the Plants*, details the rich diversity of Mestizo practice in a gorgeously written and eminently practical field guide to posthumanist healing in the orbit of ayahuasca, the plant admixture that is by now both an anthropological trope and an attractor for tourism. With his awareness tuned to “those modes of intelligence . . . that do not possess a human form,” Beyer diagrams the multiple performances and always mixed potentialities of Upper Amazonian *vegetalismo* through the lens of his own remarkable teachers, Don Roberto and Dona Maria and their multiple-layered historical, political, and social milieux. Through his apprenticeship, readers follow

along the path with the aid of the historical and anthropological due diligence of a seasoned scholar and practiced ayahuascero. Like his teachers, Beyer takes his work (but not himself) very seriously indeed, and the result is that rare admixture of exhaustive scholarship and gripping first person narrative. Beyer's own species in the usual sense remains gloriously uncertain as "in the Amazon, not only do shamans become jaguars, but also humans and animals constantly shift into each other. . . . *All beings are human*" (p. 113). Is this the intensification of humanism Wolfe decries?

Among Beyer's most crucial contributions is an insistence that Upper Amazonian Mestizo shamanism be encountered with an epistemology comfortable with realms beyond either "realism" or "belief." Along with psychologist Roland Fischer before him, Beyer offers a high resolution map for navigating the continuum between "hallucination and perception" presented by shamanic and psychedelic states of consciousness. "To the extent that . . . they are *convincing*, detailed, explorable, then the line between the visionary and everyday worlds is fluid" (p. 263). In navigating this sometimes turbulent fluidity Beyer works insightfully with a "kin-centric ecology" sampled from Tarahumara anthropologist Enrique Salmon, "an awareness that life in any environment is viable only when humans view the life surrounding them as kin" (p. 112). Posthumanism indeed. And some of these kin, are, like Beyer, teachers, whose "knowledge came almost entirely . . . from what the plants themselves taught her" (p. 176). Scripts of "human" or "non-human" give way to "relationships of intimacy with the healing and protective spirits of plants and animals" (p. 180), and it is this intimacy with a "state of non differentiation of humans and animals" (p. 113) as well as plants that makes *Singing to the Plants* such a compelling song. Perhaps the intertwingularity is near! Scholars will appreciate the depth and breadth of the learning here, and would-be ayahuasca pilgrims should consider this a must read. Find room in your backpack for a paperback edition, but be sure to add a waterproof sleeve. You'll want to return to this one again and again as your quest, should you be called on one, unfolds.

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Day of the Dead in the USA: The Migration and Transformation of a Cultural Phenomenon.

Regina M. Marchi. New Brunswick, NJ: Rutgers University Press, 2009, xi + 192 pages.

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The Day of the Dead (*El Día de los Muertos*) is a major cultural phenomenon in the United States and few people have not been touched in some way by this multivalent symbolic and commercial experience. Certainly, the November 1–2 Day of the Dead museum exhibits and processions are common to most urban dwellers, but the holiday enters into popular U.S. culture via computer games (*The Grim Fandango*), movies (esp. Tim Burton movies like *The Corpse Bride*), and a whole host of products ranging from key chains and coffee mugs to toys, candles, and candy in the shapes of skulls and skeletons. In fact, culturally understanding that images of skeletons are acting out parodies of everyday life and critiquing political and economic events is not just a way to index Latina and Chicano ethnic and religious markers but can also serve as a demonstration of one's own cosmopolitan credentials.

The permeation of Day of the Dead iconography into the popular imagination of the United States is one major focus of Regina Marchi's *Day of the Dead in the USA*. Marchi considers why the Day of the Dead, both as a holiday and as a major popular cultural event, has become so widespread and enthusiastically embraced across socioeconomic classes and diverse ethnic groups in the United States. Marchi explores how Chicano artists and activists in California introduced a Latin American tradition in the early 1970s and transformed it from a vernacular, family-focused ritual into a positive public expression of ethnic pride, cultural heritage, and collective remembrance of key Latino cultural and political figures and events. At the same time, she carefully illustrates how the Day of the Dead is a source of debate and contradiction, as more non-Chicanos and non-Latinos participate in festivities, altar exhibitions, and other events associated with the holiday.

Three themes predominate: that the holiday, as practiced in the United States, is a distinctly U.S. hybrid cultural practice; that it serves as a positive marker of ethnic, political, and religious identity for Chicanos, Latinos, and Latin American immigrants; and that the commoditization of a cultural and religious practice such as the Day of the Dead does not necessarily culturally corrupt or make the practice inauthentic. Each of these themes is explored through the analysis of

media sources, archival research, and ethnographic methods, such as participant-observation and interviewing. To fortify her argument that the Day of the Dead in the United States is a hybrid cultural practice and an emergent national holiday, Marchi dedicates the first three chapters of the book to describing the pan-Latin American aspects and variability of the holiday, emphasizing how it is practiced in Guatemala, Bolivia, Peru, and especially, Mexico. In these national contexts, members of indigenous communities tend to be the most dedicated practitioners, venerating their ancestors through elaborate but private household altars that blend Catholicism with indigenous beliefs about dead. Public community practices, like religious processions and public offerings at cemeteries, also, fuse indigenous and Catholic elements but lack overtly political agendas. This is changing in Latin America. For instance, Guatemala and Mexican practices have become even more entwined with popular culture and politics than in the past. Although she does not preclude such changes, mentioning though not describing in depth why this is so, Marchi does imply that Day of the Dead practices throughout the Americas are integrated through the movement of ideas and people through migration, communication, and commerce across borders.

Marchi draws heavily on anthropological literature, but this is not an ethnographic work as is expected of a cultural anthropologist. To most anthropologists, this overview of the Day of the Dead will seem fast paced and topically wide ranging. Descriptions will seem to cover only what is happening on the surface and not get that the thick description that anthropologists pursuing a focused ethnographic methodology. Such a project, however, would yield a different and much more focused analysis than Marchi presents. Certainly, a project that traces the history and identifies changing religious, political, and social practices of a particular Day of the Dead holiday in a specific place is merited. Marchi, by contrast, takes a more panoramic approach in her analysis, visiting several Day of the Dead ceremonies in Latin America and concentrating on a number of festivals in California, the U.S. Southwest, and in New Jersey and elsewhere over the course of more than a decade of observations and interviews. Her approach, at the same time, culturally and geographically decenters Day of the Dead practices from a specific place and interweaves them into a cultural and political web that draws in a broad spectrum of participants, including Chicano activists and artists making cultural and political statements directed at their own community and to dominate U.S. attitudes, Latinos recovering elements of their cultural heritage, Latin American immigrants trying to find their way in the United States and still remain connected to home, and other immigrants and U.S. ethnic groups searching for ways to come to terms

with death in positive ways. Thrown into this mix are others drawn to the festive elements of the Day of the Dead celebrations. Marchi interviews individuals from this spectrum of participants, but concentrates her efforts on Chicano activists and artists to provide a base for her arguments that the holiday grew out of specific social and political concerns of a marginalized immigrant and ethnic population.

What makes this book fascinating and takes it beyond being a broad overview of the Day of the Dead as practiced in the United States is that it is a vehicle to discuss migration politics, ethnic and racial discrimination, and the varying ways in which *mestizaje* has occurred in the United States and Latin America. By locating her observations of the celebrations and interviews with participants within an analysis of popular media descriptions, she argues that the Day of the Dead serves as a collective ritual communication to imagine a new community and elevate and improve popular perceptions of Chicanos, Latinos, and Latin American immigrants. At the same time, she draws on the same configuration of media representations, observations, and people to illustrate how the holiday is a form of political communication that challenges laws and violence against immigrants, laborers, indigenous peoples, and even the soldiers and civilian casualties of war. In other words, Marchi constructs a moral political economy from the perspectives of those who have been disenfranchised from the U.S. political, economic, and cultural mainstream.

Because the Day of the Dead's attraction goes beyond Chicanos, Latinos, and Latin American immigrants, Marchi argues that their political and social messages are having positive impacts, as well as attracting commerce and those looking for diversion. This, she contends does not make the celebrations any less authentic. Authenticity, at least in her example, does not preclude economic commercialization of Day of the Dead festivities and associated items—activities. Nor do these economic elements make the holiday less authentic. She convincingly illustrates that economics are part of Latin American celebrations and that there has almost always been some economic component to the rise of Day of the Dead practices as a form of public political expression. Although this certainly may be the case, several of the Chicano activists wistfully comment that the ritual's enthusiastic embrace by non-Latinos and its overt commercialization detracts from the social and political commentaries, as well as the basic fact that the ritual is about venerating one's personal ancestors and those collective public ancestors.

Certainly, for the Guatemalan Mayas I know, Day of the Dead practices, especially those performed in public, are entwined with commercial endeavors and, often, invaded by throngs of national and foreign tourists. To question whether

this threatens authenticity is to introduce a false conceptualization of the practice itself. The mere assumption that the commercialization of cultural–political–ritual practices makes it less authentic is distinctly non-Maya. Given the culturally and geographically nonspecific orientation of the analysis here, this indigenous Latin American attitude is but one component of a broader and highly diverse practice in the United States. Like the excellent general overview that Marchi provides on the holiday, she lays a strong base from which to further explore the politics of authenticity in relation economics and popular consumption by participants.