VECTORS OF RISK, BODIES THAT BREATHE

by

Kali Stull

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This thesis was presented

by

Kali Stull

It was defended on

December 9, 2016

and approved by

Margaret Potter JD MS, Professor Emerita, Health Policy and Management, Graduate School of Public Health, University of Pittsburgh

Olga Kuchinskaya PhD, Assistant Professor, Department of Communication, Dietrich School of Arts and Sciences, University of Pittsburgh

Thesis Director: Patricia Documet MD, DrPH, Associate Professor, Behavioral and Community Health Sciences, Graduate School of Public Health, University of Pittsburgh

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ABSTRACT

Fogging pyrethroid-based pesticides is a routine component of vector management strategies in Jakarta, Indonesia with the aim to kill the *Aedes aegypti* mosquito and reduce Dengue infections. As more mosquitoes become resistant to pesticide, fogging is an ineffective technology to reduce mosquito populations. This thesis tells a historical epidemiological multi-species narrative about Dengue in a megacity. Power and agency are noticed as dynamic forces that shape the illness experience and the choice to continue fogging. The thesis brings forth questions: "how do mosquitoes, viruses, and humans co-create one another? how do power differentials shape public health intervention decisions?, how do nonhumans and technology act in ways that are disparate from humans intelligence and intention?, and how might affirming the inseparability of nature and culture resign humans to live together with mosquitoes in a way that reduces harmful viral mixing? **Public Health statement:** By discussing mosquitoes', virus', and residents' response to fogging and tracking the ways pyrethroid risks are made invisible, the author suggests that fogging itself is a risk. As 60% of infectious diseases that affect humans spend part of their life course in a nonhuman animal, this considered approach toward the vector's ability to make meaning and exercise agency inspires illuminating questions about zoonotic diseases.

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I notice every day working to make change happen. And to Noel, thank you for being receptive to all the thoughts I share, for your inquisitiveness, and all the love and care.

1.0 INTRODUCTION

The day after I got caught in a ‘fog’ of pesticide in Jakarta, Indonesia I felt unwell. I had the luxury to modify my activities, to remain in bed, and allow a hazy mind and nauseous belly to take precedence and keep me stagnant. I heard the fog before I saw it, a buzzing.

Audio 1: Fogging pesticides in Central Jakarta.

Into the fog, I smelled a strong chemical mixture and pulled the neck of my shirt up to cover my nose and mouth. I saw a pesticide mudslide attack, targeting mosquitoes that transmit Dengue taking non-mosquito casualties in its pummel in a dramatic display of vector management (See **Figure 1**). Residents stood nearby as the fogger introduced a chemical cloud into their neighborhood. Lying in bed, I wondered, is the fog working? How did fogging come to be and how has it remained an integral element in state efforts to promote health and public safety? Did others share the sense that the technology designed to mitigate the risk of Dengue by knocking down mosquitoes might be a risk in and of itself, causing humans more harm than good? And who is the mosquito?

Figure 1: Fogging in south Jakarta

This thesis will explore risk making through a case study of illness-involved interspecies ecology. In Jakarta, Indonesia the vector mosquito *Aedes aegypti* has a central role in transmitting Dengue. I will honor the dynamic, multi-actor, and site-specific health issues through noticing the narrative, evidence and knowledge in between-species relationships, anecdotes, public health communications, movement, matter, and distribution of wealth and power. Conversations and observations in Jakarta, literature from public health, feminist science and technology studies, philosophy, history, and biology are at play here. Drawing from a deep pool of inspiration and brilliant thinkers, I posit that the structures that are believed to be integral to achieve improved health outcomes might themselves be health risks. I will do so by telling a story that at once recognizes the multiplicity of actors, nonhuman and human, by acknowledging that those actors come to be through social arrangements and power structures, and by recognizing that every entity is a *natureculture* phenomenon (Haraway, 2003).

This thesis is a theoretical intervention. My intention is for readers to engage, imagine, and rethink infectious disease. It may leave the reader with more openings than closure, leaving more

space for a new illness understanding to take root. I will look at Dengue, a wicked public health problem with optics traditionally and untraditionally gazed with in public health. I do so because there is worth in listening and applying cross-discipline frameworks and lines of inquiry. Responses are strengthened through a retelling that enhances collective thinking and embraces complexity.

The case study of Dengue in Indonesia is urgent and relevant. As we push along climate change and much of the earth's temperature rises, public health problems that involve species that thrive in a hotter and damper environment are pressing issues. Places home to humidity and heat make mosquitoes more fit and humans more susceptible to vector-borne illnesses. Globalization and urbanization create heightened opportunities for *Aedes ayepti*, the vector of many diseases, to propagate. We can extend the paradigms and questions offered in this thesis about a vector-borne illness to other zoonosis.

2.0 CONCEPTUAL FRAMEWORK

2.1 A NOTE ON POWER

In this thesis, I utilize the term *power* to point to the ways that beings do not have the equal ability to *act over*. Power emerges in relationship, both as relational to an action, agency, and relational to another, domination. One has the ability to perform an action, *power to* (Pitkin, 1972; Weber, 1978), which I will refer to as 'animacy' and 'agency', and the ability to extend action beyond oneself over another being, *power over* (Arendt, 1958; Foucault, 1983). I will use the later, power over, as the working meaning of power in this thesis. Here, I am most concerned with constitutive power structures, which philosopher Michel Foucault (1990) defines as, "the multiplicity of force relations immanent in the sphere in which they operate and which constitute their own organization; as the processes which, through ceaseless struggles and confrontations, transforms, strengthens, or reverses them;…thus forming a chain or system" (p. 9). Foucault's description speaks to the complexity, multi-directionality, and intimately woven dimensions of power - its 'structure'. Power initiates, comes out of, and is present every moment of a relationship. It comes from and determines the distribution of and access to economic, social, and political capital (Bourdieu, 1986). In other words, power structures refer to the inequitable distribution of the ability to *act over* and the presence of institutions that make such differential distribution possible.

I am interested in how power is felt and how it materializes. I will refer to the context through which affect (emotions, feelings, or senses) and matter come to be as emerging out of a particular power structure. Power is not something that exists external to actors; it is not an arena where an individuals find themselves. Rather, power, differential resources, capital, and privilege, are integrally a part of every entity. Power becomes-with every relationship, affect, and material. My reorientation towards power structures in this thesis will serve as a way to notice globalism, capitalism, and colonialism as structuring institutions (Davis, 2003) that are particular and incredibly influential, created historically and upheld today. Distributions of wealth, influence, and prestige that constitute power shape who in society act in what ways and what constitutes truth and knowledge.

Including power in public health discussions adds more fullness to the relationships and larger networks that result in health inequity. Health disparities are metrics that calculate health inequity. Health disparities are systemic health differences (including access to comprehensive care, mental health, reproductive health, and air quality) that adversely affect socially disadvantaged groups, such as people with low socio-economic status reflected by income, wealth, education, or occupation (Braveman et al., 2011). A critique that includes power recognizes the historical and political roots for how wealth and political representation became inequitably distributed. It is especially important to remember that a group is not marginalized without a structure that allows for and a group that does the marginalizing. A person is not oppressed without someone or something enacting the force of oppressing.

The Icarus Project, a support network and education project for and by people with mental illness, further defines the ways that power and oppression relate: “Oppression is the systemic and institutional abuse of power by one group at the expense of others and the use of force to

maintain this dynamic" (The Icarus Project, 2015). Power structures refer to the webs of all stings of privilege and oppression. Power is a crucial and defining force in epidemiological narratives. It directly and indirectly determines who, when, where and how someone gets sick, has access to comprehensive healthcare, experiences mental illness, does not have reproductive health autonomy, or breathes poor air quality and how knowledge about the illness process and risk is created and disseminated.

2.2 RISK MAKING

Social scientist Shiv Visvanathan (1988) says, "science is the grammar of power" (p. 261). He argues that science is used to encode, extend and justify hegemonic rule. The science of calculating risk is political; it comes from and reflects structures of power. Public health risks do not exist objectively in the world, separate from the people and institutions that calculate, communicate, and thus create such risk. A risk is made visible or invisible (Kuchinskaya, 2014) through contemporary scientific understandings, mediated by cultural norms, standards of beauty, moral codes, and political influences. Public health professionals define and communicate health risks in line with what holds value and importance, what money flows into research, what counts as evidence, and what is noticed. For example, throughout the eighties and nineties consuming fat was a health risk, opioid use has only recently become a prioritized health risk since it has affected more middle class white substance users (Gounder, 2016), and incarceration itself has yet to become accepted as a health risk.

Defining something as a risk inherently communicates a level of uncertainty (Boholm, 2003), however state and corporate efforts can maintain an uncertainty so high as to make a risk

invisible (Kuchinskaya, 2014). For example, Flint and Pittsburgh had lead in the water long before city officials communicated the presence of lead or defined it as a risk, even though residents still sensed and knew the health-effecting element was present. While a risk is not always made invisible through intentional data obstruction and malevolent information manipulation, scientific and epidemiological research looks for evidence in some places and misses evidence in others. A risk is made visible or invisible through a vast net of financial, cultural, and political influences. In her work investigating and considering how the risk of radiation in post-Chernobyl Belarus was and was not articulated, Olga Kuchinskaya (2014) writes, “But different hazards do not have equal chances of being made more visible, and precisely that should be the matter of public discussion” (p. 12).

I will discuss the process of fogging pyrethroid-based pesticides in Jakarta and the elements that keep it a risk that has not yet been made visible. As Jakarta and Indonesia continue to have high incidence rates of Dengue, what become calculable points of intervention to address negative health outcomes include behavioral changes, blood tests, neighborhood alerts, and large-scale public health campaigns. Without explicitly advocating for the use fogging, public health interventions operate within that normalized infrastructure. Fog, at once invasive, also disappears. I refer to the infrastructure of fogging as opposed to the technology or act of fogging as a way to recognize the dynamic systems and structures that create and uphold fogging. The technological act of fogging is a large metal gun spraying hot pesticide and gasoline at high temperature and speed. That action would not exist as it does without the systems that underlie the physical act by creating a need for fogging and providing fogging’s funding and labor. The elements that underlie and create fogging practice constitute the infrastructure of fogging. For example, the pesticide ordering protocol, the fogger’s labor practices, the divisions of sub-

districts, research that offers evidence about fogging's effect, the technological maintenance, and the pesticide's marketing co-create the infrastructure of fogging. In the following section I will explore ways to *make visible* by asking: how might atmospheric-chemical sprays become a discernible risk when we look for and notice evidence in new places? How do forms of risk-making, planning, and infrastructural choices get made and momentum sustained through dynamic arrangements of actors in relationship?

2.3 NOTICING

"But it is a particular form of manufacturing, a certain way of organizing the amalgam of human and nonhuman, things and ideas, so that the human, the intellectual, the realm of intentions and ideas seems to come first and organize the nonhuman."
–Timothy Mitchell, Rule of Experts, [2002]

In the behavioral and community health sciences, we value non-experts' experiences, opinions, plans, and desires. We are trained to listen, to allow for and create wider distribution of *agents of change*, *who knows best*, and *who decides* about health-improving interventions. In doing so, the boundaries blur between expert professional and layperson, between sage and novice. The discipline is attuned to challenging vertical power structures by distributing opportunity for decision-making throughout a community. Community health professionals know that community members' expertise is invaluable. Residents know local-specific, nuanced and ungeneralizable information, site-specific history, personal dynamics, strengths and resources.

When we approach power and agency, the ability to act over and the ability to act upon, as an open question (Mitchell, 2002) our narratives of health and illness become more complex and nuanced. In the interspecies ecology of Dengue in Jakarta, I am curious how nonhumans - the

mosquito, the virus, and technology - have power and agency. I will extend Foucault's 'multiplicity of force relations' (1990) to be social, material, and including nonhumans. The open question requires acknowledging an unresolvable tension and an impossible multiplicity (Mitchell, 2002). As such, this thesis is a theoretical intervention that may offer more questions than answers.

Inspired by feminist scholars who have pushed open narrowed forms of knowing, I am interested in how stories of population health can include a widened knowledge-source about illness to also include the extra-anthropo, the felt, the sensed, the heard, and the noticed. As a sommelier knows that the rains from three years ago, the trodden path that weaves through the vines, and the cultural-political reputation of the national borders drawn around the vineyard integrally co-create the grapes' flavor, appearance, and market value, there are always a multitude of agents in the creation of places, people, health and illness. Nonhuman actors' paths inform an invaluably site-specific and nuanced knowledge about our personhood and our health. Mosquitoes are more than a midgut full of Dengue virus; they are opportunistic agents, finding niches in which to grow, and communicating with one another and ourselves. They evolve every few weeks, informing our language and technology choices through an ongoing interspecies relationship.

A conversation about our bodies, health and personhood must include nonhumans. After all, as feminist scholar and interspecies enthusiast Donna Haraway (2003) reminds us, we are more nonhuman than human in terms of material composition of what we consider 'our body.' Human genomes, the blueprint of our living organism, are only found in about ten percent of the cells in the human body (p. 4), and we are composed of more cells of bacteria than human cells (Sender, Fuchs, & Milo, 2016). We are intimately connected to and made by nonhuman beings. Even by

more traditional epidemiological calculations, 60% of infectious diseases that affect people spend part of their life cycle in animals (Robbins, 2016). These facts about the composition of 'our' bodies may come as a surprise because of the myth of 'homo sapien sovereignty', the anthropocentric belief that we are distinct entities from our environment.

The binary of nature (including nonhumans and the material) and culture (including humans and the immaterial) as two separate categories is a construction, an idea mapped upon the world to make sense of it. In other words, a dominant Western perspective particularly in academic and scientific endeavors prioritizes the analytical capabilities of human language and upholds humans as the organism privileged with meaning making. For example, we imagine what we now know as cells, germs, and a DNA strand to have existed materially for millennia, identified as an entity in scientific laboratories relatively recently. However, as Bruno Latour (1993) describes in his account of microbial discovery in France, microbes and the scientific narrative we tell about them comes into being through a dynamic network of groups who had practical and competing interests. The microbe was communicated and created *through* the socio-political landscape and the cultures and networks of scientific communities defined 'nature'. The conceptualization, communication and visualization of biological entities shine a light on a material that is already present in the dark. Life too small for the naked human eye to detect preexist humans. However, through the process, it becomes rematerialized it in a new shade. A Western ontological separation of humans from nature positions scientists and experts to define and communicate the tiny units of life as 'natural', stable, and universal entities in ways that do not discover, but create a microbe.

This separation of culture, mind, and subject from nature, body, and object is an ontology that is not just inaccurate, it is also problematic. Environmental historian William Cronon (1995)

rethinks wilderness as a product of civilization. He asserts the danger in creating a 'pristine' nature as a destination. Through the separation, humans living in a world with 'wilderness' fail to honor the autonomy of that which is not human and fail to respect and offer gratitude with a nonhuman world that is present all the time, not just within designated areas of preservation (Cronon, 1995). When humans understand ourselves as the solitary meaning-makers of the natural world, we quantify disease and observe animals as if they are separate from us. From that space, science, which is always a product of society, can be calculated and communicated at a distance from the world it seeks to know.

Separating nature and culture prioritizes the agency of culture over the passivity of nature, supposing that humans are the only actors and meaning-makers in the world. Haraway (2003) offers the word *natureculture* to reunite the made-disparate nature and culture, entangling them into a single word and inseparable unit. Nature and culture do not act on each other but *become-with* each other. By making natureculture one word, Haraway conceptualizes the webbed ways that previously separated categories intimately co-exist. Natureculture's entanglement embraces the hybrid quality of phenomena, acknowledging the interconnectedness of events and actors that create a particularly health promoting or health-threatening viral mixing. It should be made clear that Haraway's concept of nature and culture as two inseparable categories comes from a long lineage of non-binary thinking that is more prevalent in indigenous and otherwise non-White or non-western spaces.

One way of understanding the emergence of illness and the social, political, and technological response (which is in fact one socio-politico-technico response) is what feminist theorist and physicist Karen Barad (2007) calls "intra-action". Barad describes intra-action as the "mutual constitution of entangled agencies" (p. 33). Entities participating in the mutual

constitution include humans, nonhumans, discourses, matter, and materials. Distinct from *inter*action, where individual entities exist before they encounter each other, in *intra*-action entities materialize *through* encounters, and their ability to act comes from within the relationship, not outside of it. As such, intra-action challenges conventional Western scientific understandings of individualism. A person does not exist separate from their relationship with their neighbor, their school, and the state but rather they become who they are *through* those and every other intra-action. Intra-action is a crucial element of what Barad calls 'agential realism' (2007).

Agential realism reformulates 'agency' and 'realism' in a way that recognizes the importance that both matter and social construction have on reality-making, and it repositions humans and nonhumans as meaning makers in the world. I offer this terminology as a helpful way to re-approach the problem of Dengue, of vector-borne diseases, and of the 60% of infectious diseases that find temporary hosts in nonhumans. This theoretical intervention takes account of power imbalances by recognizing that agency is not localized in the human subject. It is a useful ontology that accounts for bodies as at once cultural and biological beings. Appreciating the multiplicity through which things happen, an agential realist narrative of an illness does not tell a clear cause and effect relationship.

In such recognition, Barad avoids perpetuating the perception that non-humans are passive or socio-culturally 'written-upon', so as to become whatever human minds understand and make them out to be. Instead, she suggests that there is agency inherent in materiality (2007). Neither matter nor culture comes first or has priority in determining the other, rather 'things' (people, mosquitoes, events, epidemics…) are 'material-discursive phenomena' (Barad, 2007). They come to be out of important material and discursive factors. More specifically, matter and

meaning are necessarily entangled, they 'cannot be severed' (Tuin & Dolphijn, 2012). Intra-action shifts the discussion from what matter represents to what matter is capable of doing (Colls, 2006).

Dengue materializes through the vector and virus's intra-action with each other along with human and nonhuman actors (including health communication, political climate, fear, concepts of risks and toxicity). The people who become at-risk, infected, and exposed do so through a web much wider and more entangled than a human-virus relationship that includes biological, political, and discursive processes. The constructed meaning-making of *Aedes aegypti* partially makes it what it is, *and* mosquitoes exist apart from discursive symbol-making. How the fog lands, both materially upon nerve receptors and discursively in the intellectual categories of 'danger' or 'safety', creates the risk.

Barad's concept of intra-action can be applied to public health phenomena to understand the emergence and evolution of illness through the relationships that foster their creation. Categories such as 'at-risk', 'toxic', 'ill' or 'well' come to be as particular and always changing manifestations that surface through a multiplicity of human and nonhuman actors' and relationships. When the liveliness of matter and relationship-contingent agency is accounted for, we can see the fluidity of categories and the movement in every phenomenon. We notice matters of practice, doings and actions more so than linear cause and effect. We orient our tools attuned to the complexities of how illness comes to be. It is a deconstructive rather than additive effort; a dig for truth rather than a solution built on top.

To aid in my description of how working from a natureculture and agential realism model can shift how we create evidence, knowledge, and tactics around disease, I will call on the social ecological model to visually demonstrate the shift of illness understanding. The social ecological

model (See **Figure 2**) is used in the behavioral and community health sciences to contextualize the complex factors that contribute to one's health (Stokols, Allen, & Bellingham, 1996). The model visually categorizes social determinants of health at the individual, interpersonal, organizational, community, and policy level. The model depicts a contained individual unit with their own biological configuration embedded in and influenced by a community, impacted by policy, and in relationships. (Stokols et al., 1996). It mirrors how social scientists and behavioral health sciences understand the world; human action is at the center, surrounded by an external world.

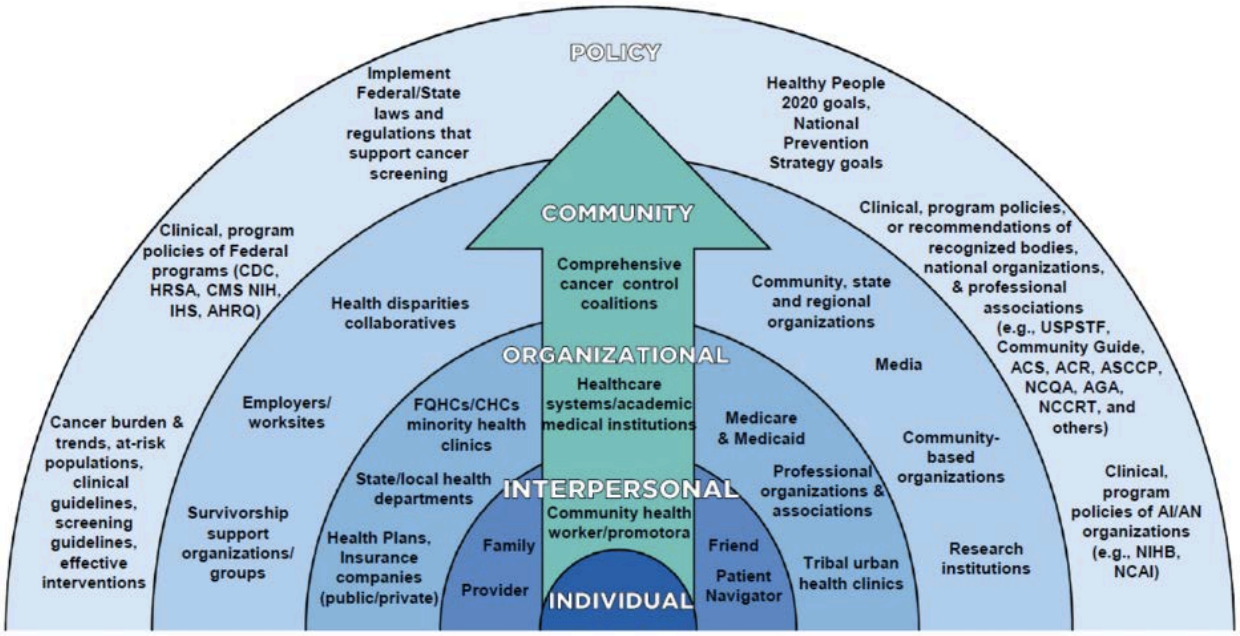


Figure 2: Social ecological model
The social ecological model is a tool used in the behavior and community health sciences to conceptualize factors contributing to an individual's health.

However, the external world is not just an arena where an individual finds themselves, it is full of actors that fluidly cross the containers to affect the centered 'self'. Interventions target policy, community, organization, and interpersonal relationships with the assumption that they

will have an effect on the central individual. What is unique about what I am proposing is that the ecological and the social, like nature and culture, are not separate. Building on the recognition that contained levels are *intra*-dependent and porous, the model becomes at once more complicated and more accurate. A person is not only influenced by the agency in an external world, they do not exist separate from their relationship with the state, their neighbor, or their school. Rather they become who they are *through* those and every other intra-action. Furthermore, models that recognize the hybrid nature of agency (such as discourse, viruses, technology, and capital) present a truer picture to the way that one's health and illness emerge. Using an intra-active account of illness does not necessarily provide a more 'positive' account of nonhuman agents, but it does acknowledge the capacity they have to act in ways that sometimes do and sometimes do not align with human perceptions and discourses of them (Colls, 2006). Offered another way, a significant difference between a socio-ecological and an intra-active paradigm is the unit of analysis. In the socio-ecological perspective, a singular entity (a person, a policy, a neighborhood) is the smallest unit of analysis whereby intra-action proposes that relationships are the smallest unit.

Working from a perspective informed by natureculture and intra-action, I am encouraged to investigate the ways that 'culture' is entangled with the natural environment and the biology of vectors, in the way that we map our culture onto the nonhuman and also in the ways humans and mosquitoes materialize one another. How we co-evolve, change in response, and exist in direct influence of one another. In this thesis, I use natureculture and intra-action as ontological tools to understand the history and process of a vector-borne disease. Moving from the belief that there is no boundary between nature and culture, we imagine a new way of treating and being with our

bodies, the planet, our economic configuration, and upset relationships of domination and subjugation.

2.4 POWER AND SPECIES

The *Aedes aegypti*, a virus-vector penetrating skin, is a critical agent in the manifestation of illness. The mosquito is not an object of health concern, it is a subject dynamically co-creating a landscape and opportunistically finding niches to stay alive and create offspring. We can notice how mosquitoes exploit inequitable capital distributions by finding room to grow in our disparities and injustices. Matter can be repositioned and recognized for its agency and ability to contribute to discussions about the politics of health, life, and death (Chen, 2012). Matter that is considered insensate, immobile, deathly, or otherwise 'wrong' animates cultural life in important ways (Chen, 2012). The Dengue virus and the mosquito are key participants in the ongoing separation of wealth-based classes, of ideas of borders and enemy-crossing, and of the resignation that behavior-based interventions to mitigate Dengue are not enough.

Our technological choices emerge out of political and commercial interests and can be a catalyst for vectors to propagate. Humans, behind the fogging gun, are separate from the mosquito enemy even though fogging was invented out of an intimate *becoming with* the mosquito. The erasure of nonhumans' agency in the technological infrastructure of fogging reasserts an invented supreme position of human intelligence and expertise that does not notice the mosquito's perspective from behind the gun. The fogging technology from the perspective of the nonhuman is not noticed.

Agency does not exist in a reasoning, calculating mind apart from a body or material stuffs. Haraway uses the term 'view from nowhere' (1991) to describe the impossibility of acquiring a perspective able to see objectivity from a totalizing view, systematizing and generalizing knowledge. A view from nowhere also speaks to the impossibility of recognizing truth and agency from a relativist view, which subjugates knowledge and speaks for the unconsidered without recognizing their agency. Agency, rather, is a 'technical' body (Mitchell, 2002), coming to be in process and in relation. Situating knowledge in 'partial perspectives' reveals a 'possibility of sustained, rational, objective enquiry' (Haraway, 1991, p. 191).

Political theorist Timothy Mitchell's (2002) *Rule of Experts* tells the history of Egypt in the twentieth century and the emergence of the economy. In his chapter "Para-sites of Capitalism", he weaves together the plasmodium parasite, capital, personalities, weather events, technology and politics to tell the story of Malaria in 1940s to turn of the century Egypt. He notices and considers the mosquito and its parasite as having agency. They give shape to "transnational corporate philanthropy" (p. 26), take advantage of the change in the "flow and chemistry of the Nile" (p. 24), enter Egypt through dams, irrigation for sugar cultivation (p. 33), and signal the need for hydraulic engineering (p. 39). Agency in Mitchell's 'technical' understanding is embodied and co-constitutive.

Noticing embodied agency challenges hierarchical configurations of power by recognizing the horizontal and networked diversity of actors. There is a 'view from somewhere' that notices agency *and* the socio-cultural context of that agency. Beings have power in the sense that they are able *to act upon* something, and they come into being through a particular web of power, where privileged agents have more ability *to act upon* someone. Animacy can be noticed within all layers of the inequitable distribution of wealth, prestige, and preference that constitute power.

And inequitable power can bring about agents' growth. From this vantage point where matter is never passive, and the webs of connection between actors is visible, we can notice intra-actions that create matter and the visualization of risk.

In Michelle Murphy's (2006) investigation of sick building syndrome in office buildings, she explains that risks are both discursive and material; they are 'articulated' (p. 183). Mosquitos are visible to the naked eye. They can be felt by sensing bodies, a prick, a fever, and fatigue. After the technological choices to fog, mosquito populations flourish, as do the pricks, the fevers, and the fatigue. Despite the mosquitoes' response to continued fogging, the fog remains largely an unnoticed risk. The risk of fogging is at once articulated, through mosquito population resistance; and unarticulated, not clearly communicated as a risk to the public or abandoned as a Dengue mitigation technique.

By noticing where mosquitoes are, how they opportunistically find a place to grow and reproduce, and how they intra-act in those places, we will see that *where* they are, not just *that* they are, matters. How mosquitoes emerge and how they "come into perceptible existence" is part of the webbed structures of power. Materialization comes out of power as it is exercised through the concrete arrangements of objects, actions, and subjects (M. Murphy, 2006). The adaptive species fold into existing differentials of political, financial, and social capital.

I am drawn to these concepts as a way to tell epidemiological stories, the narratives of public health and illness, differently because telling different stories elicits different results. I am curious what imagining a vector borne disease with more entangled relationship with the vector and technology can offer. I am hopeful that this novel theoretical intervention will reveal novel approaches to make wellness more equitably felt. Haraway (2003) writes, "Feminist inquiry is about understanding how things work, who is in the action, what might be possible, and how

worldly actors might somehow be accountable to and love each other less violently" (p.7). Could sitting with the complexity of relationships and cross-Kingdom creating one another overtime open the possibility of 'loving each other less violently'? Power, agency, and the relationship between them remain a question to explore throughout this case study to better understand the world, which holds potential for pain and pleasure, illness and health. I approach these case studies from a natureculture perspective not only because it is more accurate to the complex way things materialize, but also because a binary separation of human and nonhuman, ideas and matter, mind and body re-creates and re-emphasizes current imbalances in power distribution that perpetuate health disparities.

3.0 OUR VECTORS, OURSELVES

Nothing can hold out against civilization and the power of industry.
The only animal species to survive will be those that industry multiplies.
Jean-Baptiste Say, A Treatise on Political Economy [1836]

Government is concerned not only with the subjects that altogether compound the supposedly coherent body politic of a nation-state, but also, and perhaps mainly, with objects and materials that surround those subjects and that make collective life possible.
Paulo Tavares, General Essay on Air [2015]

3.1 ANIMATE VIRUS

Dengue is a mosquito-transmitted viral disease found in tropical and subtropical regions of the world, mostly in urban and semi-urban settings. It is the world's fastest spreading vector-borne viral disease, with 40% of the world's population living in an area at risk for Dengue (World Health Organization, 2016a). Cases of Dengue fever worldwide may be as high as 400 million per year (Murray, Quam, & Wilder-Smith, 2013). Urbanization, globalization, climate change, and travel are the most common explanations provided for the rapid increase in worldwide incidence rates over the last half-century. Dengue is now 30 times more common than the flu and half a million people annually are hospitalized from Dengue. Indonesia has the highest number of cases in Southeast Asia, and is home to 70% of the Dengue fatalities in the region (Kusriastuti & Sutomo, 2005) (See **Figure 3: Incidence rate of Dengue in Indonesia**). In Jakarta, the

capital city of Indonesia and home to around thirty million residents, the case fatality rate of Dengue Hemorrhagic Fever is 4% and 40% for Dengue Shock Syndrome (Kusriastuti & Sutomo, 2005).

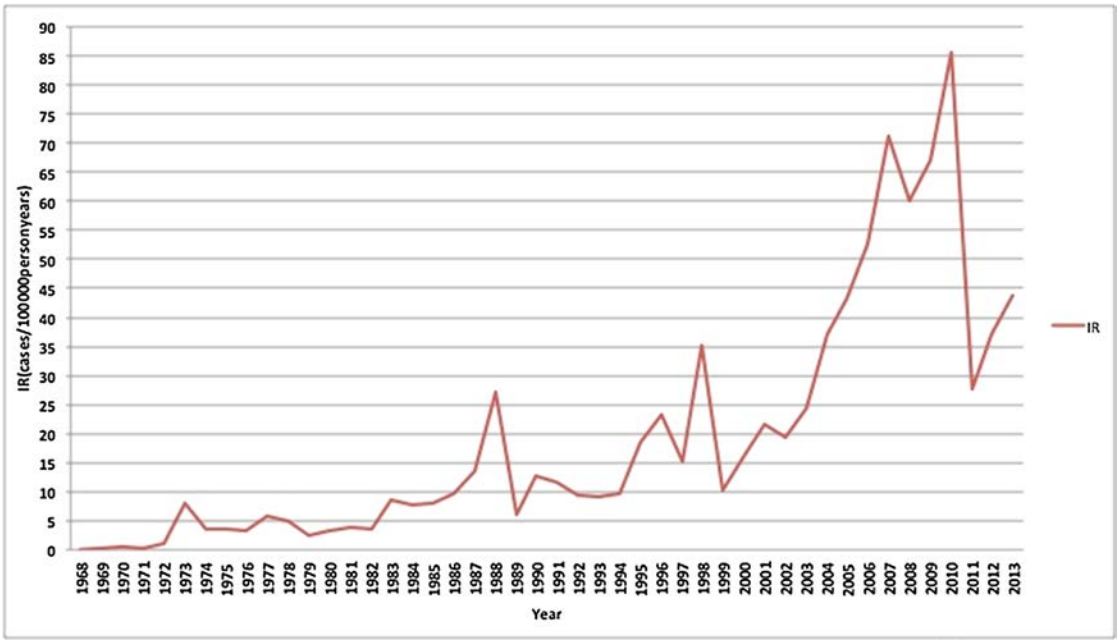


Figure 3: Incidence rate of Dengue in Indonesia
Incidence rate of Dengue in Indonesia from 1968 to 2013, cases per 100,000 person years. Permission given by Mulya Rahma Karyanti.

Like Zika and West Nile, Dengue is a flavivirus. All members of the flavivirus genus are transmitted by anthropods, such as mosquitoes or ticks (Siegel, 1999). Day-biting *Aedes* mosquitoes spread Dengue, primarily the species *Aedes Aegypti* and *Aedes Albopictus* (World Health Organization, 2016a). In Jakarta, Indonesia *Aedes aegypti* is the primary vector transmitting Dengue (Simanjuntak & Selian, 2014). Unlike the majority of flaviviruses, the Dengue virus is well enough adapted to humans that it does not depend on animal hosts (Murray et al., 2013). The virus replicates in humans to high enough titers that they can in turn infect mosquitoes with the virus. The virus is primarily maintained in a human-to-mosquito-to-human

cycle (World Health Organization, 2016a). When *Aedes aegypti* takes a blood meal from a viremic host in the early stages of Dengue, the blood moves into the mosquito's midgut. There, the virus binds to receptors, moves into the circulatory system then to the salivary glands. Once enough viral replication has occurred in the salivary glands - a process lasting four to ten days - the virus can spread to another person. The mosquito will remain infected for the rest of its life.

Dengue is a 'dynamic' disease with a wide clinical spectrum. The mildest and most common expression is asymptomatic, while a typical symptomatic case expresses itself as a high fever, headache, stomachache, rash, muscle pain, and joint pain (World Health Organization, 2016a). As Dengue progresses into its later stages, Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS), the disease becomes more painful and life-threatening. DHF and DSS emerged only in 1953, first seen in a child in Manila who became the first known patient to die from Dengue (Murray et al., 2013). DHF gets its nickname 'break bone fever' because the joint pain becomes so severe it feels as though your bones are breaking. Accompanying symptoms of DHF and DSS include bleeding from the nose or ears, bleeding underneath the skin, and vomiting (World Health Organization, 2009a). DSS is also accompanied by circulatory shock (rapid or weak pulse with cold and clammy skin) caused by plasma leakage into interstitial spaces (World Health Organization, 2009a, 2009b). There is no specific treatment for Dengue fever apart from standard care, including paracetamol use, such as Tylenol, and liquids to keep patients hydrated (World Health Organization, 2016a). Dengue patients who detect the disease early and access medical care have a mortality rate of less than 1%. Patients who progress to severe forms of Dengue and who do not access medical care have a mortality rate of 5% (World Health Organization, 2016a).

While vaccines have been in development since as early as 1929, there is currently only one licensed Dengue vaccine on the market, CYD-TDV, or Dengvaxia® (World Health Organization, 2016b). Dengvaxia has been licensed for distribution in about twenty countries (Ferguson et al., 2016). In 2013, 25 vaccines were being tested in clinical trials and as of fall 2016, two vaccines are in the final phase of clinical trials (World Health Organization, 2016b). The Dengue virus's dynamic viral evolution creates a challenge for pharmaceutical developers to create a comprehensive vaccine. The Dengue virus (**Figure 4**) has remained relevant, adapting for thousands of years to fit with *Aedes'* changing behavior. When *Aedes aegypti* shifted from zoophagous to anthropophagus, Dengue also advantageously adapted to live better with humans, ensuring its largest spatial range. Humans and Dengue can both claim the superlative of widest geographic reach, for species and anthropod disease respectively (Tabachnick, 2012).

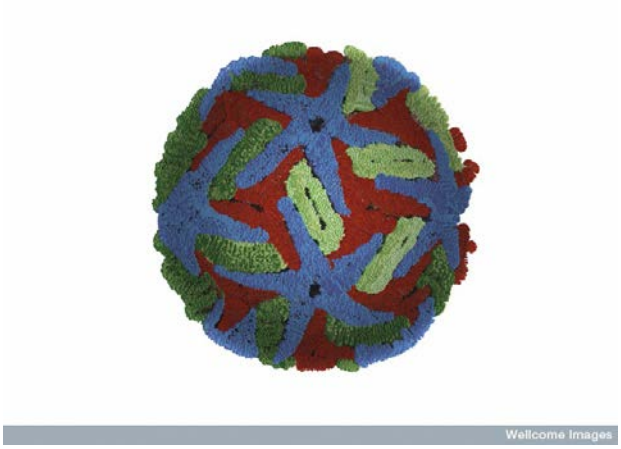


Figure 4: Dengue virus (DENV) particle
Illustration by Pete Jeffs, Courtesy of Wellcome Images.

Dengue's RNA structure produces one mutation every genome replication largely because it does not go through a 'proof-reading' stage. As a result, the pathogen's path is one of expansion and diversity at about one hundred times the rate of DNA (Mustafa, Rasotgi, & Gupta, 2015).

Dengue's genetic typos are more likely to 'make sense' and stick in future generations in a cityscape with diverse genetic pools offering niches for experimental viruses to survive (Kuriastuti & Sutomo, 2005). World urbanization rate and Dengue virus diversity have been continuously increasing for at least 300 years (Twiddy, Holmes, & Rambaut, 2002; United Nations, 2014; Waman, Kolekar, Ramtirthkar, Kale, & Kulkarni-Kale, 2016).

In the last three centuries, the Dengue virus (DENV) split and adapted into five distinct serotypes. DENV-1, DENV-2, DENV-3 and DENV-4 circulate in humans and DENV-5, discovered in 2013, circulates only among primates in Malaysian forests (Mustafa et al., 2015).[1] The serotypes are approximately 65% genetically identical (Mustafa et al., 2015), and nearly fifty subtypes within those serotypes have developed in 300 years to meet geographic and population niches to be dispersed globally (**Figure 5**) (Twiddy et al., 2002). Dengue can infect the same person twice (a third and forth infection is incredibly rare). Dengue is more painful and life threatening the second time a person becomes ill because human antibodies boost rather than prevent novel Dengue strands' sickening effect as the serotypes are similar-but-distinct (B. R. Murphy & Whitehead, 2011). The categories separating DENV-1 from DENV-2, 3 and 4 are leaky. They emerge out of relating with evolving hosts in new environments. The definition and categorization scientists map onto the virus are attempts to chart the virus acting in new ways to prepare a vaccination antidote to prevent infection. However, the vaccine itself may be a risk because it cannot keep up with the virus's dynamic and opportunistic alterations. Coming in contact with Dengue for the second time, bodies and immune systems do not distinguish identity and risk in line with a medical classification.

[1] Most primate to human disease transmission follow patterns of deforestation. With the high rate of forest clearing in Borneo (There was a 12% change in forest cover between 2000 and 2010, increasing throughout the decade (Miettinen et al., 2012)) humans will likely soon serve as hosts for DENV-5.

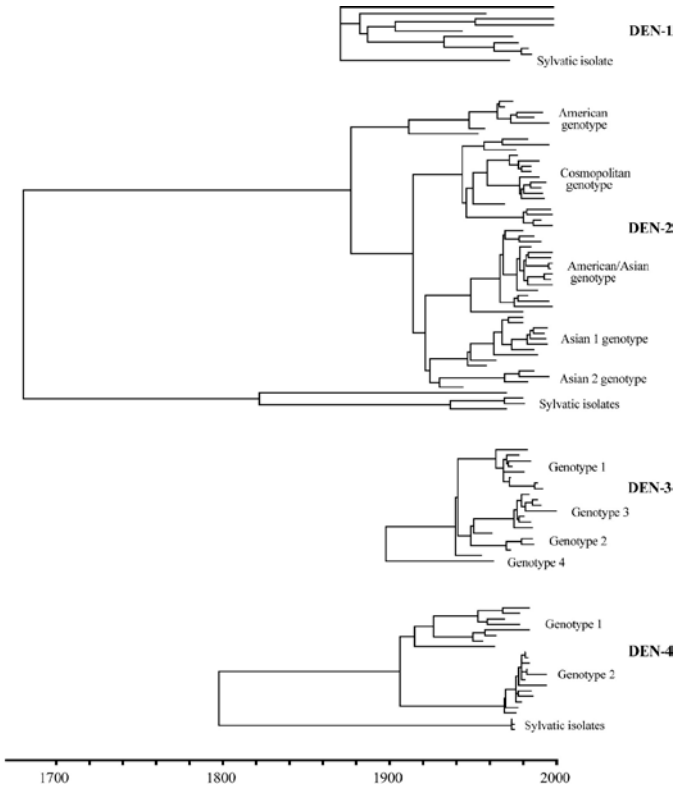


Figure 5: Dengue virus serotypes and genotypes
The Dengue virus serotype and genotype development from 1700-2000. Permission from Oxford University Press. (Twiddy et al., 2002)

Molly OhAinle, a post-doctoral fellow of infectious disease at the UC Berkeley's School of Public Health describes, "With the second infection, the antibodies sort of recognize the new type of viruses, but not well enough to clear them from the system. Instead of neutralizing the viruses, the antibodies bind to them in a way that actually helps them invade the immune system's other cells and spread" (Yang, 2011). OhAinle goes on to animate the virus as invasive, calling the Dengue virus a "Trojan horse" (Yang, 2011). The fellow articulates the risk of Dengue by likening it to an infamous ancient battle scene communicates the risk through her studies' language: Dengue is sneaking into our bodies to take over and start a battle. The binary separation of human and nonhuman is retold here through the dominant biomedical discourse of

the immune system's role of distinguishing 'self' versus 'non-self' and destroying invaders (Martin, 1994), present in the language of the Dengue virus invading and 'tricking' a human immune system.

The risk is again articulated, materially and discursively produced, through vaccine production. Working from the distinction between nature and culture, the World Health Organization (2016b) writes, "The vaccine…closely mimics a natural infection" (p. 137). The pharmaceutical company marketing the vaccine highlights human ingenuity: the 'innovative' Dengvaxia® ("Dengvaxia, world's first dengue vaccine, approved in Mexico," 2015). The narrative of *naturally* occurring Dengue as risky and a man-made vaccine that will mitigate that risk is dominant. An intra-active lens notices that the virus in a live attenuated vaccine and the virus present in an *Aedes aegypti* in Southern Jakarta are both natureculture phenomena.

Outside of the lab, the vaccine has low effectiveness in low-transmission areas where it has a priming or boosting effect on the virus (Ferguson et al., 2016). In much the same way someone who becomes ill with Dengue a second time will likely experience a more severe manifestation of the illness, a person vaccinated with Dengvaxia® may be more at risk for severe illness if they are exposed to a new Dengue serotype. The socio-technological solution, a defense against an 'enemy' border-crosser reconfigures Dengue illnesses and may itself be a risk.

The Dengue virus has nestled itself into a propagating relationship with *Aedes*, originally its sole host and, as the virus evolved to live in primates, its sole vector. In every infection, Dengue designs its ideal partner by altering 147 proteins in its primary vector species, *Aedes aegypti's* RNA, which reorients the mosquito's behavior. The virus makes mosquitoes hungrier for human blood, smell more acutely, and more likely to re-feed after interruption (Platt et al., 1997). The protein alteration also makes mosquito's saliva more hospitable to the virus (Sim, Ramirez, &

Dimopoulos, 2012). Urban landscapes serve Dengue by providing environments that fit with its continuous re-design while also strengthening the fitness of its ally, *Aedes aegypti*. The environment is not a backdrop to action, it is a participating co-determinant of the Dengue virus and its host, *Aedes aegypti*. The behavior-shaping traits of the virus RNA affirms that there is agency inherent in materiality.

When an infected mosquito follows her now heightened senses and finds human blood, viral-rich saliva is deposited below human skin line. The virus is likely to be subdermally passed several times for every successful blood feed as the *Aedes aegypti* is a skittish sip feeder (Platt et al., 1997). Once inside the human body, Dengue burrows in first in the epidermis cells, then moves to the lymph nodes and spreads throughout the lymphatic system (Martina, Koraka, & Osterhaus, 2009). Three to eighteen days of incubation later, symptoms emerge. A day or two before sudden fever onset, the virus is ripe to be passed from human blood onto another mosquito – the cycle continues (Martina et al., 2009) (See Appendix A for the lifecycle of *Aedes Aegypti*).

Female mosquitoes feed on vertebrate blood to complete the processes of pregnancy and birth. With hundreds of eggs in her ovaries, she begins a search for carbon dioxide and heat. Once she detects a suitable host, she lands and penetrates the epidermis with her proboscis in order to deposit her saliva, which, as an anti-coagulant, ensures her meal of blood will flow smoothly to the next generation. Within sixty hours of this fluid exchange—spit for blood—oviposition is triggered in the expectant *Aedes aegypti* and her eggs are released along the surface line of still water, where they complete their embryogenesis and wait.

And of all the host species available to *Aedes aegypti* - cat, rodent, bovine, pig, primate, and bird - *Aedes aegypti* came to prefer human blood (Ponlawat, Scott, & Harrington, 2005). Our

blood, which, due to low levels of isoleucine, facilitates an extended *Aedes aegypti* life and an offspring count of nearly one thousand; and with high level of lipids, creates thirstier mosquitoes who fly shorter distances (Harrington, Edman, & Scott, 2001). Mosquitoes develop their sanguine preference based on their first successful blood feed (Harrington et al., 2001). More humans, densely arranged, increase the likelihood that *Aedes aegypti*'s first feed will be human, establishing her lifelong preference for human blood. We have co-evolved, becoming affine without affinity in urban environments.

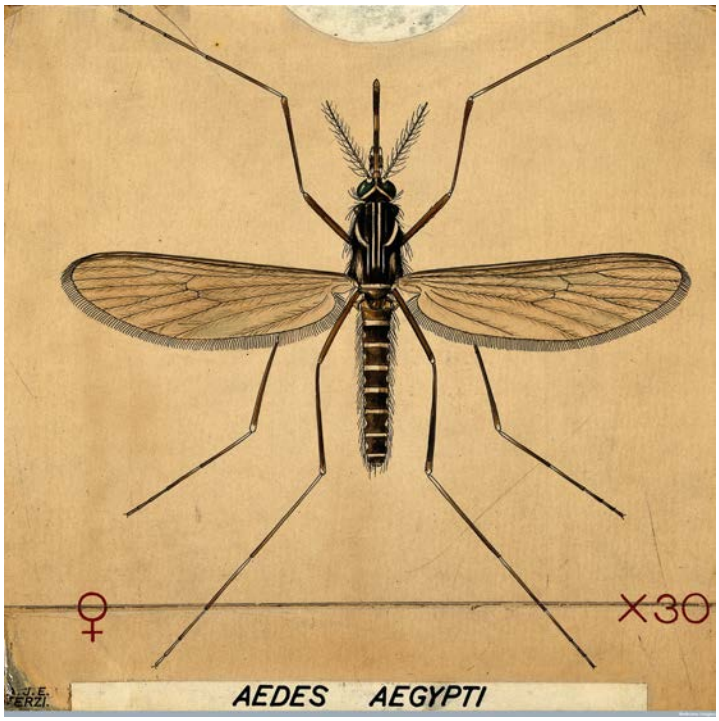


Figure 6: *Aedes aegypti*
Female *Aedes aegypti*. Drawing by A.J.E. Terzi. Courtesy of Wellcome Library, England.

Mosquitoes sucked the blood of vertebrates for thousands of years before humans emerged from the evolutionary phylum; Dengue evolutionary roots are in the forests of Africa, where its host species was primarily primates. Around 10,000 years ago when humans tilled, irrigated, and

settled and the Sahara dried, human settlements became the primary source for the blood and water that *Aedes aegypti* needed to survive. A sylvan arthropod was domesticated without plan or intention. Its performance of adaptation has mattered for our species' somatic experiences and definition of self. The domestication as a process acted-out created a sense of threat and added an expression of ill among global forces. We can see that what is on the other side of the agential act is never separate from us (Tuin & Dolphijn, 2012).

3.2 BECOMING-WITH

On May 25, 1779 David Bylon, a Dutch surgeon living in present day Jakarta became suddenly ill with a severe fever, causing him to leave the company of two good friends and go to bed early. In what is cited as the first clinical description of Dengue, Bylon describes intense muscle and joint pains into the third week of his illness (Pepper & Bylon, 1941). Ultimately he recovers fully. Bylon's illness represents one case among a cycle of epidemics reported in Asia, Africa, and North America throughout the 1780s which followed a 150 year trend of outbreaks following cycles established by shipping and trade routes (Murray et al., 2013). Initially moving from Africa to the Americas aboard slave ships (Powell & Tabachnick, 2013), the Dengue virus's trajectory amplified in speed and range. *Aedes aegypti* bred among violence, cruelty and stagnant water caskets, growing in spaces of inequity. They have a long history of sailing with the money flows, their emergence is financially mediated.

The virus once again widened its geographic scope aboard military planes and boats in during World War II, initiating the first eruption of distinct Dengue genotypes (See 1939-1945 in **Figure 5**). The post-war economic boom results in heightened international trade, and *Aedes*

aegypti rides along with moving goods and people, penetrating borders and bodies, increasingly carrying the Dengue virus. From 1960 to 2010, Dengue increased thirty fold. Whereby agriculture set our pesky partnership with *Aedes aegypti* in motion, the relationship has spiraled into amplified speeds, expanded locations, and more painful, lethal illnesses since WWII. Since the second half of the twentieth century, the proliferation of human urban settlements has rewritten the evolutionary trajectory of *Aedes aegypti* while accompanying mosquitoes have counter programmed human approaches toward pestilential urbanism. Human, virus, and mosquito affect one another and materially become-with one another in a complex move to the city over time.

Urbanization is tied closely with deforestation and rural destruction. In Indonesia, humans are decimating forests for palm oil plantations alongside the global rise in palm oil use and demand (Miettinen et al., 2012). People from rural areas are moving to the hypercomplex megacity of Jakarta (Turpin, Bobbette, & Miller, 2013) with hopes to find employment unavailable to them in their homeland. The urban population has been on the rise for the last century, increasing from about 150,000 in 1900 to almost 30 million in 2010 (Firman, 2011). Indonesian urban migration linked with destruction and loss of economic vibrancy and opportunity in non-urban areas (Frederick & Worden, 1993) is a process that parallels what Anna Tsing calls 'loss of refugia' (2015), a loss of ecologies with diverse species through repeated habitat destruction. A rapid reduction in diversity results in the accelerated loss of many species and accelerated growth of others. In Malaysian Borneo, bordering Indonesia, there was a steep rise in malaria cases in a region undergoing rapid deforestation (Robbins, 2016). Similarly, in Indonesia, destruction of diversity of plants, animals, and economic opportunities has coupled with an increase in Dengue cases.

The same global forces that make the monopolies of palm oil plantation possible support the expanded use of carbon emissions to ship the thousands of products manufactured with palm oil. Fossil fuel consumption for product distribution plays a part in the rising global temperatures, increased humidity, and erratic weather. As climate change transforms the torrid zone and expands the geographical distribution of vectors, incidences of Dengue have increased (Morin, Comri, & Ernst, 2013). In Jakarta, the primary seasons of dry and rainy are less distinguished. Rain throughout the year creates stagnant water nests for *Aedes aegypti* to lay her eggs. Rising temperatures also speed up every process of mosquitoes development, resulting in more generations at an increasing rate (Morin et al., 2013). Dengue is now in over 125 countries as compared to six before 1960 (Gubler, 1997; World Health Organization, 2016a), as *Aedes aegypti* can survive in an increasing latitudinal reach.

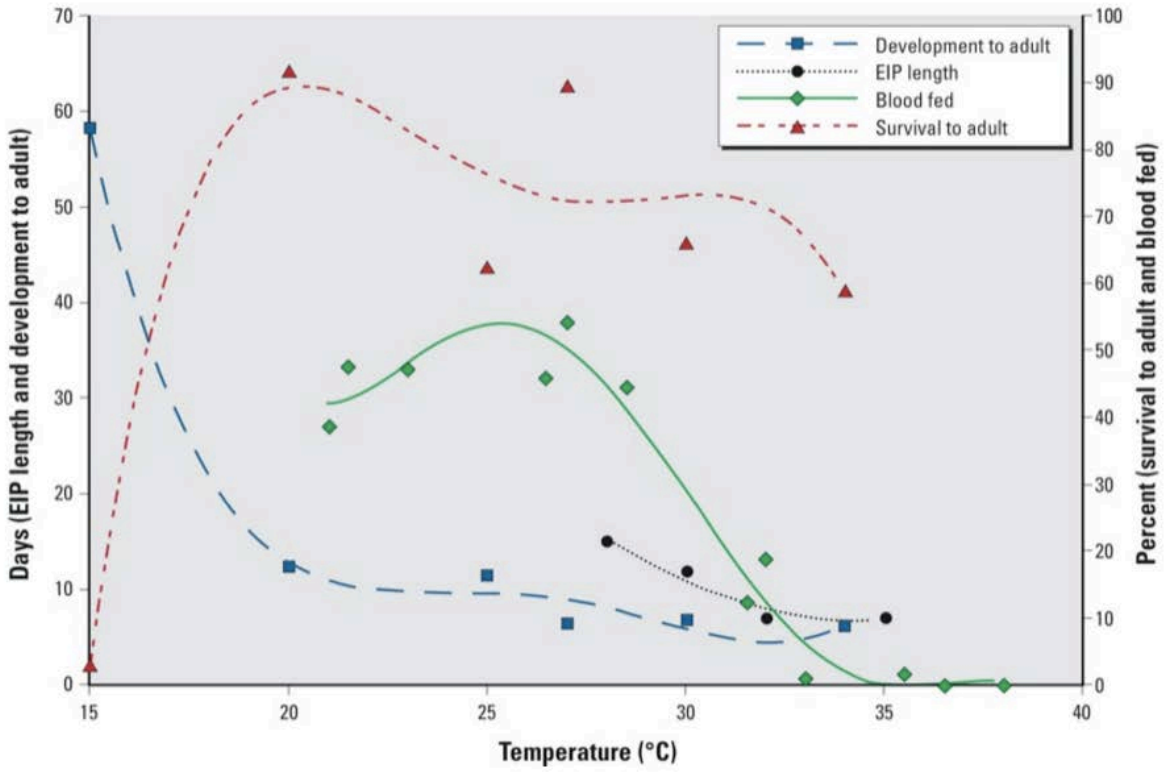


Figure 7: Effects of climate change on *Aedes aegypti*

Effect of temperature on variables associated with Dengue transmission: Days required for immature Aedes aegypti to develop to adult (Development to adult), length for DENV-2 to incubate between when mosquito takes a viremic bloodmeal and the time when a mosquito becomes infectious, the extrinsic incubation period (EIP), the percent of Aedes aegypti that completed a blood meal within 30 minutes after a blood source was made available (blood fed), and percent of larvae surviving to adulthood (survival to adult). Reprinted with permission from (Morin et al., 2013).

The quests for money and power that materialize in sylvan destruction and construction of roads connecting fields of unsustainable monocrop changes the ecology in Indonesia. Alongside urban migration, loss of refugia, and rising temperatures and humidity, an opportunity arises for mosquitoes. They are synanthropes who thrive in cities for the proximity of human blood, dark corners, and trash. Leading entomologist in Jakarta, Dr. Saleha Sungkar identifies "consumerism" as the leading source of vector breeding (Sungkar, 2015). Human activity, the ways we pursue freedom and growth materialize in cross-species populations. The female mosquito lays her eggs just above a still water line. Residents who store water in containers close to their home, often due to unreliable water supply and discard plastic containers provide larval habitats. *Aedes aegypti* prefer to reproduce in the symbolic and material sites of production and mobility; construction sites and spare tires are notorious mosquito breeding grounds. In Puerto Rico, mosquitoes breed primarily in septic tanks, technology that symbolizes and enacts public health progress through waste management. In an unplanned exchange for illness-causing nonhuman companionship, humans come into less contact with bacteria and more contact with mosquitoes. In literature about vector control, *Aedes aegypti* larval breeding sites are consistently distinguished between *natural* and *man-made*, just as factors in illness are consistently distinguished between nature and nurture. However, they are always both.

In turn, the ecology, and more specifically the viral and vector presence, shapes the urban experience and the risk of illness for human co-habitants. This multi-organism arrival in cities, or the cities arriving to the disease, remakes our intra-actions in the urban environment. The virus

and mosquito, co-evolving and relating in always changing environments, expanding their reach, have designed one another without intention or plan, but with meaning. Their intimate partnership responds to shifting populations and landscapes, opportunistically moving in adaptation and union. The virus and mosquito's story is incomplete without the web of connection, the localized intra-action.

However, the risk that is communicated relies on untangling or not noticing the connections and simplifying and objectifying *Aedes aegypti*. What is made visible is a six-legged enemy carrying and transmitting a potentially lethal and probably painful virus. Unconsidered in this complex web of becoming-with and becoming-ill are the forces that co-shape an opportunistically more viable environment for mosquitoes. Also unconsidered is the mosquito's ability to act; to respond to technological weaponry in ways that promote *Aedes aegypti's* vitality. Along with emerging mosquito populations arise a narrative of enemy, and use of atmo-warfare technology to eradicate the visible six-legged risk.

3.3 MAKING OF A SIX-LEGGED RISK

With tears and toiling breath,
I find thy cunning seeds,
O million-murdering Death.
I know this little thing
A myriad men will save.
O Death, where is thy sting?
Thy victory, O Grave?

-Ronald Ross, written the night he discovered that mosquitoes transmit malaria [1897]
(Baton & Ranford-Cartwright, 2005)

Timothy Mitchell (2002) explains that a postcolonial perspective locates "problems of colonialism, global expansion, and transportation within the history and practice of the science"

(8). In this section I will present a chronology of Dengue scientific discoveries as events that come from and participate in the creation of Dengue and *Aedes aegytpi*. I will explore the ways that the science of Dengue and the technological choices to mitigate the risk of Dengue are part of colonialism, global expansion, commercial interests and warfare.

Throughout the 1800s, dirt, waste, and flawed morality were the identified culprit of malaria, they were risks to falling ill. In 1897, a young British scientist, Ronald Ross demonstrated that mosquitoes transmit disease (Sinden, 2007) by culturing twenty mosquitoes from collected larvae in Secunderabad, India and paid malaria patient Husein Khan eight annas (equivalent to less than one U.S. cent) to let mosquitoes feed on his blood.[2] One month later, Ross dissected the mosquito's midgut and confirmed that the malaria parasite was present in the mosquito's blood (Sinden, 2007). Through relationships between a British doctor's presence in colonized India, mosquitos inoculated in a University-funded laboratory, and an Indian man willing to participate in an experiment for meager compensation, the risk shifted. It went from living conditions and 'moral behavior' to having skin penetrated by a malaria-carrying mosquito. Dengue became medicalized and lost its social meaning. Risk could now be localized in a 'natural', nonhuman entity.

The discovery immediately and radically reoriented public health efforts to focus on the eradication of *the vector*. It clearly defined an enemy, embodied as a distinct family. The risk was made visible in the six-legged "little thing" delivering "million-murdering Death"(Baton & Ranford-Cartwright, 2005). Hegemony "shapes and limits" the process of creating health

[2] After more than 50 years of research, gaps in the knowledge of the specifics of the Dengue virus pathogenesis remain, partially for the complexity of viral mutations, and partially because of an absence of appropriate animal disease models. Public health ethical standards have changed and now artificial infectious blood meals, mice, and guinea pigs mimic live humans in the majority of Dengue research (Tan et al., 2016).

discourse and communicating health risks (Briggs, 2003, p. 293). Socio-political dominance shapes the definition and communication of what is risky, even when the risk is a six-legged being.

In 1902, a Syrian scientist, H. Graham demonstrated that mosquitoes also transmitted the Dengue virus. He wrote, “Besides its maleficent function as the transmitter of malaria and yellow fever and its general character as pestilent nuisance, there is yet another disease of tropical and warmer temperate regions that is being credited to its mischief...dengue” (Shrady, 1903, p. 264). The *Aedes* identity as carrier of Dengue repositions the genus from “pestilent nuisance” to dangerous enemy. A biological dissection of a midgut reshapes discourse of, orientation toward, and technological approach to mosquitoes.

Today, the language of a mosquito enemy-object remains the predominant discourse. Drawing from a paralleled insect antagonism, several news stories in 2016 call *Aedes aegypti* the ‘cockroach of mosquitoes’ ("CDC struggling to wipe out mosquitoes carrying Zika virus," 2016; Dennis, 2016; McKay, 2016). Another called *Aedes aegypti* the “Darth Vader of mosquitoes” (Garvin, 2016). Even the World Health Organization awards *Aedes aegypti* the superlative of “the greatest menace” of all disease-transmitting insects (1996). This contemporary language contributes to the materialization of *Aedes aegypti* as a dangerous troublemaker through reference to our cultural imagination of immortal, icky, and evil characters. *Aedes aegypti* is a risky material-discursive phenomena. The species is what it is today partially because of our cultural references that imply that *Aedes aegypti* matter because of their cruel intentionality and partially because of its own agency that exists through neutral adaptation.

Before 1945, technological approaches targeted mosquitoes in the larval stage through largely environmental measures (I. R. F. Elyazar, S. I. Hay, & K. J. Baird, 2011). As colonizing

forces shared techniques to control native populations, the British in Malaysia influenced the Dutch in Indonesia to use standard civil engineering techniques such as lining drainage ditches with cement to deny mosquitoes their preferred breeding site. The interventions were successful, as assessed by a ‘spleen index’, measured by touching one’s spleen to measure its size. If the spleen is enlarged, the person likely has malaria (Iqbal R. F. Elyazar et al., 2011). The effort, which included widespread citizen participation, was stopped when Dutch officials in the Netherlands deemed the efforts coercive and unfair administration of unwaged labor (Iqbal R. F. Elyazar et al., 2011). In an unusual display of concern for the ethical treatment of those native to what is today Indonesia, colonial Dutch leadership set a precedent for who is responsible for ‘vector management’. By ending widespread resident participation in mosquito reduction efforts, they acted out a message that the government is responsible for reducing *Aedes Aegypti* populations.

Industrial chemistry first shaped in the early 1900s by military needs and a shift in warfare strategy to attack the enemy’s environment found a continued application and revenue stream by marketing atmospheric chemicals as effective pest control (Sloterdijk, 2009). Thermal fogging was invented in 1949 by German airline captain, Dr. Stahl, based on technology used in cars, rockets, and military vehicles ("The pulsfog history," 2016). Fogging machines were displayed at health fairs around the world throughout the fifties, presented as an effective pest management technology to control malaria (Iqbal R. F. Elyazar et al., 2011). Experts of vector management attached themselves to the logic of development, progress and modernity (Mitchell, 2002, p. 15) 15 as they marketed European technology in a Dutch-ruled, colonized nation in the global south. In stride with worldwide public health trends which are also trends of progress, development,

and modernity, Indonesia began a fogging campaign that ran throughout the fifties. The fogging machine's proboscis points towards the enemy vector's vicinity.

Figure 8: First fogging model used in Indonesia
The first fogging performed in Indonesia was in response to Malaria. Photo taken by Kali Stull. Courtesy of Surabaya Health Museum.

In a 1918 conference at the 'German Society for General and Applied Entomology in Munich', Fritz Haber, co-inventor of the Haber-Bosch process[3] commented on his "Technical Committee for Pest Control", a group working to apply hydrogen cyanide gas to agricultural use as an insecticide (Sloterdijk, 2009). Haber states, "The basic idea is to also make other substances used in the war, not only hydrogen cyanide, useful for pest control in the interest of promoting agriculture once peace is restored" (Sloterdijk, 2009, p. 31) 31. In an effort to adapt the gaseous technology to stay relevant and economically fit, Haber saw an opportunity in atmospheric-chemical approaches to pest control. A postcolonial perspective "locates the

[3] The 'Haber-Bosch process' is an artificial nitrogen fixation process. The invention played a key role in World War I, providing Germany with a source of ammonia to produce explosives. Today, the same process is used to take hydrogen from the atmosphere and turn it into fertilizer. Fritz Haber's wife, Clara Immerwahr, a women's rights advocate and feminist unable to live with her husband's violently-applied invention killed herself.

problems of colonialism, global expansion, and translation within the history and practice of the science" (Mitchell, 2002, p. 7). From that view, fogging is a scientific process of developing and marketing a micro-droplet chemical emission machine significantly located alongside World Wars. The early twentieth century brought forth a new warfare strategy of targeting the enemy's environment, a shift that came about through breaking an international treaty that restricted against such a strategy.

In 1968, for the first time an Indonesian resident became reportedly ill with Dengue. By the end of the year, 57 clinical cases and 24 deaths were reported and a national public health campaign to identify and treat Dengue cases was underway. The year following the city's first Dengue cases, Indonesia fogging technology sprayed organophosphate pesticides into the air to reduce *Aedes aegypti* populations for the first time (**Figure 9**). The same year, the WHO shifted their approach from eradication to 'vector management' (Mitchell, 2002). The language used to describe *Aedes aegypti*, applying warfare metaphors of 'enemy' and strategies of atmospheric 'hits' reshapes vector management. It becomes more forceful, urgent, and chemical; national budgets add a line: *fogging*.

Figure 9: Fogging in central Jakarta

3.4 THE FOG

"Some pressures may add some directionality to evolution, as in the case of natural arms races: a thickening of the armor in a prey species directly provokes a sharpening of the claws and teeth in its predatory counterpart, which in turn puts pressure on armour designs to get even thicker..."
-Manuel DeLanda, Nonorganic Life, [1992]

Boxy silver fogging machines swing across orchestrated city-hired foggers' shoulders as they navigate the streets. The gun's body mixes gasoline and pesticide with a heat that pushes micro sized droplets of insecticide to the machine's proboscis where they're projected as a thick white

cloud, dramatic and eruptive. The ‘fog’, more mudslide than dust, penetrates the atmosphere, targeting the adult *Aedes aegypti*’s environment - dark nooks and hidden corners. The expansive fog makes the fogger himself invisible, buzzing behind a wall quickly emerging and evaporating, remembered only by a lingering chemical smell and drunken cockroaches staggering onto the street under the morning sun.

After nearly twenty years of fogging, a national spike in Dengue incidence in Indonesia in the late eighties helped to relocate the technology’s use, both in policy and practice, from being responsive to Dengue cases to one being preventatively performed. The seasonality and regularity with which fogging was conducted shifted the technology from responsive to routine and expected. Fog became everyday, unseen. An infrastructure that had always evaporated became further invisible. Fogging technology developed out of and came to be used through intra-actions between industrial dyeing chemicals, plastic packaging taking the place of banana leaves, global trade, Dengue virus reproduction ‘errors’, increased temperatures, microbial content in still water, and exposed ankles. However, the simplified narrative of fogging puts forth a binary: technology versus mosquito, man versus nature. Through over fifty years of fogging pesticides, the fogging gun, the virus, the mosquito, national finances, and a change in country leadership act in ways that came to be in relation to one another.

Between 1986 and 1998, due to lack of financial resources, Jakarta health officials restricted fogging, allocating its use only in areas where DHF cases were reported in the last three consecutive years. In 1998, Indonesia was coming out of a financial crisis that affected most of Southeast Asia and shrank the Indonesian economy by 13.7% (The World Bank, 2016). That year, the second president of Indonesia, Muhammad Suharto marked his 31st and final year ruling the country. His transition to power in 1967 followed a United-States supported genocide

of suspected communists and anyone who opposed Suharto's nationalist military regime. In 1998, demonstrations calling for Suharto's resignation increased initially at University campuses across Indonesia. Following the military's killing of four demonstrators, demonstrations spread throughout Jakarta and other Indonesian cities. In May 1998, Suharto resigned (Katsiaficas, 2013).

That same year, health officials decided that fogging was not only too costly, it was also ineffective when used preventatively. From then on, fogging could only be used as a responsive measure. Today, Jakarta provincial health policy requires that fogging is limited to neighborhoods with one serologically confirmed low platelet count patient plus either three more confirmed Dengue cases or larvae in 5% of the houses in a 100 meter radius of the neighborhood's 'patient-zero' ("Pengendalian Penyakit Denam Berdarah Dengue," 2007).

However, fogging practices vary from the policy. The decision to fog is relationally-mediated and swayed by capital. When the epidemiological investigation requirements to ensure that fogging remains responsive cannot be confirmed, health officials may wave the responsive policy and proactively fog. They are particularly inclined to do so when their friend, relative, or a powerful community member requests the fog. As anthropologist Kathleen Stewart (2010) writes, "Everything depends on the dense entanglement of affect, attention, the senses, and matter" (p. 6). Fogging depends on the existence of money, political leadership, and a hunch of effective-enough.

Pesticides enter mosquitoes through their outermost organ, the cuticle, and cholinesterase in the pesticide binds to receptors that receive signals to move, paralyzing them (Rauner, 2007). The men who fog are advised to check the level of cholinesterase in their blood to ensure the paralyzing effect targeted toward mosquitoes is not mirrored in their veins. In the early aughts,

lab results revealed high levels of cholinesterase in fogger's blood when fogging with an organophosphate-based pesticide. Organophosphates were shown to have negative human and environmental health impacts after thirty years of use (Hardjanti, Indrawati, Donanti, Wibowo, & Zulhasril, 2015). In response, the health department chose to switch to pyrethroid-based pesticides. Pyrethroids have been the pesticide of choice for nearly twenty years in Indonesia. The discovery of DDT's endocrine disrupting effects, its move from 'non-toxic' to 'toxic' classification and subsequent ban initiated the development of pyrethroids in 1973. Pyrethoids are heralded by pesticide companies and the government alike as the safer options for non-mosquito beings, despite their acute toxicity to fish, bees, dragonflies, dogs, and cats, while still offering a mortal mosquito knock-down.

Pyrethroids are the synthetic and concentrated form of a pyrethrum, a chemical found in chrysanthemum flowers. Pyrethrum has been used to kill ticks and mosquitoes in Asia for at least two hundred years (U.S. Department of Health and Human Services Agency for Toxic Substances and Disease Registry, 2003). Pyrethroids mimic pyrethrum, but are more toxic to insects and are detectable material for longer. Main routes of pyrethroid exposure are through respiratory and dermal contact and through residues on food (World Health Organization, 2005). In the 1980s, many Chinese cotton growers who handled pyrethroids in direct contact with their skin became ill with deltamethin and fenvalerate poisoning (Aggarwal, Jamshed, Ekka, & Imran, 2015). Since 1988, no clinical case of pyrethroid poisoning has been reported. When fogging occurs, sub-district health officials advise but do not require residents to open their doors to let the pesticides inside, cover anything that will come into immediate contact with human skin or be consumed, and vacate their houses for three hours. Whether residents do or do not depends on a dense entanglement of how they relate and communicate with their sub-district health official,

how concerned or safe they feel, the presence of consumable goods, and their orientation toward pesticides.

In August 2016, the majority of Jakarta fogging machines were loaded with BASF Fendona®, which is composed of the WHO classified “moderately hazardous” active ingredient alpha-cypermethrin. BASF is the largest chemical producer in the world, focusing on pharmaceuticals and agriculture since the 1990s. BASF markets its pest-control line with the narrative that dead vectors will revive equitable economic distribution, leading regions “to better health and to beat poverty” ("Good health is a basic human right," 2016). Here, technical expertise claims to overcome the obstacles to social improvement. BASF also acknowledges that mosquitoes are becoming immune to existing insecticide and are making a new generation of products marketed to effectively kill mosquitoes that are resistant to the most widely-used pyrethroid pesticides, such as Fendona®.

3.5 PERFORMING PUBLIC HEALTH

The hot combustion mirrors urgency in the face of Dengue risks; heat moves fast and accelerates. Atmospheric rising temperatures speed up *Aedes aegypti* development and behavior. Every stage in their life cycle is condensed when incubated in heat, and warmer temperatures make *Aedes aegypti* hungrier for blood (Hardjanti et al., 2015). Our response to their bite is to bite back with technology that feels at once assuring in its bitter intensity and display, and harmful in its chemical taste and long-term waning effects. *Aedes aegypti* is threatened by our scorching weaponry, and maybe assured that they are faster, hungrier and stronger for it. And yet, in terms of public health’s orientation, fogging hovers in a hazily defined ‘use-as-needed’ space, not

crossing into the category of a risk made visible (Kuchinskaya, 2014). Very few people would argue that fogging has produced successful enough results to change the arc of increasing Dengue incidence rates worldwide. And still, perhaps fewer still would argue that fogging is a danger in and of itself, that it is risky infrastructure that both negatively affects non-mosquito beings and increases the population of mosquitoes. How does fogging feel assuring and not risky? What specific senses affirm its use? How does our understanding of the government's role as public health performers make risks more or less visible? If we notice the agency of nonhumans, our calculation of risk will shift.

After nearly fifty years and a thousand generations of mosquitoes, fogging has become the public health infrastructure synonymous with Dengue control and *Aedes aegypti* eradication. The elusive haze has a stronghold on many a human psyche as a strategy worth performing to remain safe from diseased vectors. National level laboratory tests confirm high levels of insecticide resistance among *Aedes aegypti* in Indonesia (Boewono & Widiarti, 2007) (Mulyatno, Yamanaka, Ngadino, & Konishi, 2012; Sayono et al., 2016), prompting the ministry of health to continue to advocate for less fogging and more widespread citizen behavioral changes that target larval breeding sites to reduce mosquito populations. However, fogging has become synonymous with being taken care of and public safety in a way that the infrastructure itself is obstructed from being made visible as a risk. The results from laboratory studies conducted in Jakarta on the effects of pyrethroids on *Aedes aegypti* have not been published or shared with public health officials at the district and sub-district level. The political power of national and city level positions decides what information is shared and how knowledge is produced.

Even with lab results showing that fogging is not effective enough to substantially reduce the *Aedes aegypti* population, new apps that make resident communication with government officials

more streamlined include a fogging request platform. If a Jakarta resident sees larvae or falls ill with Dengue, they can request to their sub-district health minister that the neighborhood is fogged using either the Whatsapp messenger or the Qlue app. Residents receive an ambiguous public health messaging that at once says ‘fogging will never be enough without adequate behavioral efforts’ and ‘we will fog if you ask us to’. Residents are at once asked to notice fogging’s shortcomings, its risk, and to make the risk invisible through increased avenues to procure its use. The consistent use of fogging technology highlights the uncertainty of when in public health is enough enough? And what counts as evidence?

Science, the grammar of power (Visvanathan, 1988) cannot reorient fluidly without a corresponding shift in power. The laboratory-created and citizen sense-based evidence that fogging does not work and may be a risk in and of itself cannot be made visible because the technology is knotted with claims to bring the expertise of modern engineering, improve the defects of nature, repair the ills of society, and fix the economy (Mitchell, 2002, p. 15). As anthropologist Nicolas Shapiro (2015) writes, “When all things are linked, the failure of one subverts the confidence in others” (p. 370). Deteriorating socio-technical systems like fogging communicate economic, political, and infrastructure instability. In an effort to not admit or communicate ideological failures, the ineffectiveness of fogging is presented mildly.

That orientation of fogging-as-development is seen in how Prosper, a social work group in Jakarta, promotes fogging. They argue that one’s access to the technology is a human right. Prosper provides fogging free of charge to citizens who cannot afford to hire private companies. Simultaneously, private companies are tuning into the profitability of public health infrastructure. Termax Corporation has fogged “everywhere in Jakarta,” a salesperson boasts geographic range and citywide familiarity to ensure their expertise to a prospective client. My

internet search in July 2016 elicits twelve companies in Jakarta that will fog your home, office, mall, or nine-story parking garage without a pesky epidemiological confirmation. And more individualized than governmental response, you choose when foggers show up and what dosage of the pesticide they spray. The government does not have a system in place to track private fogging. The scope can be inferred and estimated by anecdotes that suggest its widespread commonality. For instance, it is common practice for apartment complexes to fog parking garages and common areas weekly.

Pyrethroid's lose their potency in one or two days depending on exposure to the sun (World Health Organization, 2005). Despite fogging's short-lived effects, the comfort it provides is more residual. Fogging has come to matter. It is a performance of the biopolitcal, an expression of 'make live and let die' (Foucault, 2004). It holds a mirror to the ruling Dutch's 1940s decision to define vector control as more of a governmental, and less of a citizen operation. The Indonesian government strategically supports some forms of life and the methodology and technology to eradicate others. Public officials continue to fog as a performative assurance to its people that something is being done and to show in a dramatic display that citizens' lives and health are being attended. Director of animal-derived disease control at the Indonesian Health Ministry, Rita Kusriastuti, said, "We're aware that the chemicals also kill the mosquitoes' natural predators, but sometimes we still have to do these fumigation drives [fog] because the people ask us to" (Sagita, 2011).

Public health officials publicly warn residents that fogging can only be effective when non-fogging infrastructure, monitoring *Aedes aegypti* breeding grounds by eliminating stagnant water, is solidly in place. However, citywide participation in routine, low-tech strategies like dumping and covering water is irregularly performed. Fogging remains present, despite the

supplemental behavioral requirements for fogging to be effective, and perhaps also weakening the likelihood that Dengue control efforts will ever be behavioral. The performance of visually and multi-dimensionally penetrative fog symbolizes and communicates to citizens that the government is meeting their expectations to take care of their health. Fogging is not *working* on mosquitoes, at least not as before, but it is, as always, working on people.

In the current orientation of biopolitical rule (Foucault, 2004), governments are invested in supporting the growth of a healthy populous. This arrangement between subjects of a nation and the leaders, benevolent providers of technology and actions to improve population health is routinized, practiced, normalized and expected. Fogging became the performance that communicated state-sponsored and sanctioned improved health. In Barad's (2007) theory of intra-action, the focus shifts from descriptors and reality to matters of practice, doings, and actions. The evidence that fogging works, that it is worthwhile, and that it is not a risk is an action performed first by government officials, later taken on by nonprofits and for-profit companies. The technology acted to assure the populous *something was being done* and became infrastructure that commercial efforts recognized and capitalized off of the sense of care built up during its half century of use. Fogging has an agency distinct from human ingenuity came to be through the relationships between the ministry of health and fogging, the fogging companies and fogging, the population and fogging, and the mosquito and fogging. Its agency comes out of a multiplicity of relationships and performances.

3.6 RESISTANCE

As we employ atmospherically-oriented chemical methods to cut the ties on this mosquito-human unwanted bloodline perhaps the question isn't *how do they* resist our best efforts to keep human blood sacred to our chosen kin, but *how could they not* resist? To *Aedes aegypti*, our atmospheric-warfare strategies to end the intimate interspecies kinship might be the ultimate invitation to continue the relationship. Witnessing and re-telling a process of increasing disease and becoming sick where nonhumans and humans "emerge together, in a variety of combinations" (Mitchell, 2002, p. 29). Mosquitoes are meaning making in their act of resistance to the pesticide. Their genetic responses and survival are a more-than-human semiotics (Kohn, 2013). In communication, intra-action and meaning-making, humans and technology changed mosquitoes and mosquitoes and technology changed humans; we co-emerged.

Mosquito's history of resistance extends far beyond our antagonistic relationship; they evolved detoxification mechanisms thousands of years ago to cope with organic chemicals leached from plant materials in the stagnant water of their larval habitats. What is novel about human's role in their last eighty years is a hyper speed track of mutation and evolution. In 1946, there were only twelve cases of insecticide resistance reported worldwide. In 1954, four years after USAID donated US$1.5 million dollars for DDT fogging programs, Dr. Crandell, an entomologist working in the Government Malaria Institute, reported that DDT resistant mosquitoes were in Jakarta's seaport (I. R. F. Elyazar, S. I. Hay, & J. K. Baird, 2011). By 1990, five hundred species of mosquitoes, including *Aedes aegypti*, were resistant to one or more pesticides (Karunamoorthi & Sabesan, 2013). The WHO (1996) defines species resistance to a pesticide as the mortality of less than 90% of mosquitoes within 24 hours upon contact with a

pesticide. Despite our intentions for the fog to be an impenetrable wall, the mosquito hurdles over each obstacle, more fit.

We *other* the vector, pursuing methods using toxic chemicals, with the hope of securing more distance without consideration of the ways we have been co-creating one another - virus, mosquito, human. Large processes of urbanization, climate change, war, and commercialization expand *Aedes aegypti's* range and increase the *Aedes aegypti* population. Similarly, fogging is unintentionally creating a fitter *Aedes aegypti*, now more resistant to our weaponry and with less predators who die as fogging casualties (See Appendix B). The risk calculations of fogging amend when we notice *Aedes aegypti's* agency and when we consider the material way it becomes-with our socio-technical fogging strategy. The mosquitoes that survive (at least 10% as communicated by research and conversations with Jakarta Health Agency officials), are mortally unaffected by pesticides and the near-thousand mosquito offspring every female *Aedes aegypti* has are more likely to also live through the fog.

In the last decade there has been growing evidence of *Aedes aegypti*'s resistance to pesticides in Indonesia (Boewono, 2007; Mulyatno, 2012; Sayono, 2016). Research demonstrates that the form of *Aedes aegypti's* pyrethroid-resistance is located in a gene-mutation the voltage-gated sodium channel (Stenhouse et al., 2013). Studies demonstrating fogging's ineffectiveness push the government to advocate for resident's participation in vector control through behavior change. This change in strategy was reflected in the Jakarta government's communication to the public as well as legislation. In 2008, the Jakarta Health Agency changed their strategy to reduce Dengue, prioritizing the behavioral shifts to reduce the *Aedes aegypti* population, such as keeping a clean city and promoting the '3M Campaign'.

The 3M campaign advocates for three human behavior-based vector reduction strategies that all begin with an ‘m’ in Indonesian: cover water containers (menutup), clean or empty water containers (menguras), and bury discarded containers (mengubar). It was initially created by the DHF Working Group, which included members of the Women’s Empowerment Welfare Group (PKK) in 1992. The DHF working group formalized and orchestrated efforts that leaders at the village and neighborhood level had been promoting since 1975 (Kuriastuti & Sutomo, 2005). Three components of the 3M movement include health education using mass media, women’s groups and schools; door-to-door visits by the PKK; and ‘source reduction’, killing larvae and eliminating still water to prevent larvae using community participation. The 3M campaign works from a diffused, semi-horizontal strategy. It was established at many administrative levels including villages, districts, sub-districts, provinces, and the national level (Kuriastuti, Suroso, Sustriayu, & Kusumadi, 2004).

Behavior and community-included efforts were operational since 1975, and orchestrated with political backing since 1992, however the Jakarta Health Agency began communicating the importance of behavioral strategies to reduce *Aedes aegypti* and Dengue cases in a concerted effort since 2008. Health communications present 3M as a necessary compliment to fogging rather than an alternative. The founder of the Pikoli Foundation, which focuses on Dengue eradication in Indonesia, says that while most people know about the 3M campaign, it has largely been ignored. He speculates that residents fail to enact source reduction actions because, “there’s no sense of togetherness and involvement in doing these things” (Sagita, 2011). Public health efforts come out of and materialize in implementation through feelings and senses as much as scientific efforts toward objectivity and fiscal allotment.

When risks are understood as material-discursive phenomena, the language and behavior of larvae ladies entering homes in poor areas more than homes in wealthy areas was part of public health campaign for many years and reified the notion that poor residents are more ‘at risk’ and their behaviors are more ‘risky’. Entering spaces with less wealth more readily than wealthy spaces asserts that the government can and should be more involved in controlling the health habits of poor residents.

Policy makers and ministry of health are important participants in the Dengue illness narrative, but they are not the only or the most important. All agents; mosquito, virus, residents of all neighborhoods, fogging technology, foggers, journalists, play critical roles that cannot be considered isolation from one another. They came to be together and came to make sick in performative unison. The Dengue narrative is one of a multiplicity of forces and resistance, dynamics present cross-species. The mosquito resists pesticides and humans resist behavioral and infrastructural change.

3.7 BREEDING AT A DISTANCE

A central challenge of getting residents to enact the 3Ms is an assumption that mosquitoes exist in other neighborhoods with other classes; that they breed elsewhere. Mosquitoes move and matter in a co-habitive dance with existing power relations. The mosquito is shaped by and shapes our technical and infrastructural choice. Its presence also folds into and further creases existing socio-economic inequities. While Indonesia has had fifteen years of ‘sustained economic growth’, the growth has primarily benefited the richest 20% while the remaining 80% have not experienced a significantly improved economic standing (The World Bank, 2016). Jakarta

parallels national trends, the city is divided geographically into residential spaces of widely unequal wealth. Adaptive creatures, the *Aedes aegypti* and the Dengue virus advantageously find niches in the economically divided landscape.

Mosquitoes are a hybrid phenomena, an example of natureculture. They come to be and bite through intra-actions between fogging technology, global trade, rainfall, temperature, plastics, and income inequality that separate the rich and poor. Residents, regardless of wealth status, can place themselves outside the entanglement of mosquito population growth by finding fault in another class's inadequate vector management practices. Wealthy residents say kampongs (poor, dense housing) are dirty and their filth and trash allow mosquitoes to breed. Poor residents say wealthy residents have too much space and too many things to keep track of and keep free from larvae.

Regardless of where residents live, they orient themselves away from where Dengue breeds. Across class, residents see fogging as an action that has been done to fight Dengue, but residents with gates shut them to foggers, restricting the fog to shared streets and gutters. Kebayoran Baru, one of the wealthiest sub-districts in Jakarta, had the highest number of Dengue patients in 2015 (Izzudin, 2015) (**Figure 10**). Dengue's long history reveals that it has emerged alongside increased urbanization, prosperity, wealth, and inequity. Like policy-makers, residents have an ambiguous relationship with fogging. They both deny fogging move inward on them and insist that fogging come to them. When government health workers deny fogging based on unmet epidemiological requirements necessary to fog, residents pay for private fogging companies to perform the task. Ungated kampong residents living in dense settlements request fogging and remain receptive to public health campaigns and larvae checks.

Figure 10: Fogging in wealthy Kebayoran Baru sub-district in Jakarta

The diameter of pesticide droplets, 1/20 of a strand of human hair (Hoffman et al., 2008), is not fine enough to penetrate sealed nooks, nor convincing enough to move through barricaded entrances. Despite health officer's advice to open homes to foggers as a strategy to achieve maximum fogging success, residents with gates often keep them shut to keep foggers out. Gated homes of the wealthy are also more likely to deny entry for community health workers called 'larvae ladies' (**Figure 11**).

'Larvae ladies' began as volunteers and are now paid women who check residential 3M maintenance and kill larvae. Part of the 3M campaign sends larvae ladies to houses in the sub-district where she is a resident to perform the breeding ground erasure. Whereas homes in poor communities, called kampongs, are open and much of daily life occurs in the streets and ally

ways, rich communities live more privately, passing through several guarded gates to enter their homes. The gates often serve as barricades to larvae lady volunteers who may be seen as a nuisance or a security threat. Residents in the kampongs have less physical blockades and less apprehension that keep community health workers out.

Figure 11: Larvae lady
Larvae lady checks for larvae in an elementary school washroom in Senen, Jakarta. *Aedes aegypti* larvae uniquely retreat from the beam of a flashlight.

In his article, "Why nation-states and journalists can't teach people to be healthy: Power and pragmatic miscalculation in public discourses on health", anthropologist Charles Briggs (2003) explores how Venezuelan public health officials collaborated with journalists to produce information about Cholera in 1991. Briggs uses Jaber F. Gubrium and James A. Holstein (1997) term *deprivatization*, to describe the process of the state inspecting homes and attempting to transform behaviors and practices (Briggs, 2003). He specifies that "the state makes more efforts

to deprivatize the lives of poor ‘at risk’ than middle class” (Briggs, 2003). Similarly, in Jakarta health surveillance was performed predominantly on residents in the lower-middle and low socio-economic class where larvae ladies and health messaging were allowed inside.

The only time a public health campaign to eradicate *Aedes aegypti* has been successful was throughout Central and South America in the early and mid twentieth century. After hundreds of years in the Americas, the mosquito population continued to grow and yellow fever incidence and mortality continued to rise. Two aggressive men from the United States led public health campaigns that hinged on the deprivatization of all citizen spaces, regardless of socioeconomic status (Laskow, 2016). William Gorgas employed the systematic, disciplined, and forceful disposition he acquired through a military background and sent out soldiers to find larvae breeding sites throughout Cuba. They rid trash, emptied standing water, poured oil on stagnant water, and punished people for non-compliance. In just one year, 1900-1901, yellow fever mortalities in Cuba dropped to zero (Laskow, 2016).

Fred Soper, another militant man from the United States, led a relentless crusade to kill *Aedes Aegypti* in Brazil. He tasked brigades to search every building and gutter to eliminate larvae breeding opportunities and liberally applied larvicide. In four years he eradicated *Aedes aegypti* from eight Brazilian cities. In 1958, Brazil was declared free of *Aedes aegypti*. By 1962, only a few countries in the Americas had *Aedes aegypti*, the United States was one. He could never convince U.S. public health or U.S. residents to grant inspectors universal domestic entry.

Power structures exist in overlapping and corresponding levels, all knotted together. The global north systematically deprivitized the lives and homes of residents in the global south just as poor neighborhoods in Jakarta and Venezuela are more porous to larvae ladies and less likely to purchase a private fogging session. All infrastructures and public health campaigns exist in a

particular power structure, behavioral as well as technological. A high socio-political status provides opportunities to accept or deny infrastructure and practices in ways unique to co-residents of a low socio-economic status. This brief case study highlights once again the complexity of any public health strategy, the multiplicity of forces and resistances present to consider.

Contrasting home inspections in Cuba and Brazil with Indonesia also highlights the ways public health practices follow differently gendered lines specific to the intervention and how the mosquitoes tie people into knots of class, gender, nation, and community. I will tend to the gendered dynamic while remembering that gender is only one identity materializing in this and any intra-action. Gender, class, and community are "folded into, and produced through, one another" (Barad, 2007, p. 243) An ideal national-level *Aedes aegypti* eradication leader throughout the Americas exhibited masculine qualities of aggressive, militant, uncompromising, and strict. They were well-funded, well-regarded, and governmentally backed. Incongruously, an ideal larvae lady demonstrates feminine qualities of friendliness, sociality, and care. The larvae ladies practiced unwaged labor of care when the program began as volunteer. Their work, like so much of feminized labor of care, was uneconomically valued. Women, as the family member and thus community members are the primary responsibility to order the urban household. Mosquitoes, like garbage and dirt, did not belong (Nading, 2014). Larvae ladies formed new relationships through mosquito-control work with fellow larvae ladies. Relationships between larvae ladies and apprehensive or suspicious neighborhood home caretakers at times kept larvae ladies away from thorough home inspections. At other times, sub-district political figures and leaders accompanied larvae ladies to enact their political capital by encouraging skeptical home caretakers to receive the less socio-politically valued larvae ladies.

Recognizing the higher-measured incidence rates for wealthy residents and the coupled resistance to existing public health campaigns, the Ministry of Health started a campaign in 2015 directed specifically toward middle and upper class residents in Jakarta. Jakarta Health Ministry's Director General for Disease Control and Environmental Health, H.M. Sabah, said that the upper and middle class residents, "tend not to welcome our campaigns" (Wardhani, 2015). Jakarta's Governor, Ahok, who fell ill with Dengue himself and found larvae in his sink shortly after, said, "Many upper and middle income neighborhoods are reluctant and hostile toward the 3M campaign. They opt to carry out fogging" (Wardhani, 2015). In the new intervention intended for wealthy residents, large buses with bright health messaging painted on the side park in affluent neighborhoods to distribute vector management literature. Public health officials have initiated campaigns that focus on a wealthy subset of residents to change their behavior, but they still have not drawn attention to fogging, an institutionalized approach that may be dangerous in and of itself. By continuing to fog, the infrastructure along with its risks are continually made invisible.

Figure 12: Fogging machines after a morning fog

4.0 DISCUSSION

4.1 UNITS OF RELATION

By imagining the historical and contemporary intra-action of the Dengue virus, *Aedes Aegypti*, humans, globalization, conceptions of risk, feelings of protection and danger, orientation toward warfare technologies, biological processes, and class divisions, I have noticed and connected power, agency, emergences, entanglements, and feelings that tell an expanded epidemiological narrative. Approaching Dengue with an widened optic, I posit that fogging makes *Aedes aegypti* more resistant and introduces uncertain assurance to residents in Jakarta, thus it is a risky infrastructure that supports Dengue's growth.

In addition to considering the moment a person comes into relationship with the Dengue virus, I have considered biological, political, and discursive factors working, doing, and relating in the becoming (ill) with Dengue. The story of Dengue in Jakarta is rich with capital agents that intra-act, re-route warfare technology from international to interspecies foes, geographically and chronologically map virus serotypes, write expert scientific papers defining *Aedes aegypti's* resistance to a genetic mutation, and invest in the production and patent of a vaccine. Humans, behind the fogging gun, are separate from the mosquito enemy even though fogging was invented out of an intimate *becoming with* the mosquito. It is only in noticing the othering language used to describe mosquitoes and to promote fogging weaponry that we can ask if the

ways humans separate ourselves from mosquitoes discursively pigeon-holes us into a response that has shown to be ineffective so far.

Intra-action is a material-discursive phenomena. Language of separation and material becoming-withs illuminate our kinship. Because Dengue does not exist without the mosquito, I spend time with mosquitoes as material-discursive phenomena. For hundreds of years we have unintentionally become urban-domestic kin with *Aedes aegypti*. By retelling a narrative of co-domestication, I can notice that patterned historical relationship and argue that fogging continues our path of becoming closer co-habitants with unwanted mosquitoes. I am seeking to know the mosquito as an animate unit, maintaining the context and the relationships that act in relationship with the organism to facilitate its creation. The mosquito changes over time through relationships with a changing landscape that includes humans, atmosphere, other invertebrate, water buckets, bathrooms, sense of community, urban density, and pesticide. In this recognition of changing with, moving with, and becoming with, *Aedes aegypti* is an animate agent, not an object. As such, intervention strategies in an intra-active lens are coupled with questions about the possibility of its agency: how will mosquitoes respond, relate, or resist in some way?

I used natureculture and intra-action as ontological tools to understand the history and processes of a vector-borne disease that call for an attention to the complexity and relationship-dependent process of entities, phenomena and selves coming into being. In a natureculture case study of Dengue in Jakarta, the causes for nearly 40,000 of every 100,000 residents in Indonesia falling ill with Dengue in 2014[4] (Simanjuntak & Selian, 2014) cannot be bifurcated into natural and socio-cultural causes. Doing so ignores the responsibility of all beings contributing to the high Dengue incidence. In an intra-active perspective an entity cannot exist apart from its

[4] The passive surveillance system means that this incidence rate is most likely an underestimate (Karyanti et al., 2014).

relationships, union is the smallest unit. Agency is an enactment. Entities come to be through relating and doing. This lens encourages focusing on and prioritizing process, the stages where things are happening. The approach of inquiry mirrors the reality of world happenings by valuably eliminates the reduction of considering an individual unit in isolation.

When nature and culture are separate we might observe Dengue happening, changing, infecting at a distance, without noticing human involvement. Natureculture is useful because we cannot and should not take the relationships and mixing that are present for granted. We are a part of its becoming, neither determining nor solely observing. Nature-culture-technologies are always already mixed up and mixing. Natureculture is an especially important concept with the high rates of urbanization. We must see cities, even hypercomplex cities home to over 30 million people, as locations with as much nature as a designated wilderness area so we connect to and respect the autonomy of the land, all beings, and our relationship to it. If nature is no longer ‘over there’, if there is in fact no nature/culture divide, all beings are hybrid beings coming into existence from cultural, biological, technological, and discursive processes. We will likely continue new forms of zoonotic combining at higher speeds, higher rates of urbanization, and increased climate change. The changes in who comes into contact with whom and the kinds of emergent life unruly bodies can throw up have been considered through the rapid evolution of Dengue genotypes and pesticide production. New material circulations - bodies, war, urbanization - create increased possibilities and risks.

The isoleucine concentration in human blood, dark spaces between jackets, a candy wrapper collecting rain, negligence of a half empty flower pot, changing climate, chemicals created and disseminated are all part of the process of creating a mosquito ‘enemy’ with more vitality. Humans’ best effort to eradicate mosquitoes is to create devices that look like them and sound

like them, with an active ingredient that cannot keep up with the monthly-produced generations of *Aedes aegypti*. Fiscal years and product ordering cycles move slower than the pests and the coordination of our governmental health agency 'bodies' cannot evolve at their rate. Not only do mosquitoes remain, they gain in strength and numbers. *Aedes aegypti* act opportunistically in coordination with our inability to act in coordination.

4.2 ANIMATING AEDES

Aedes aegypti is not either biological or cultural, it is both at once. Working with agential realism, we see how the mosquito is a meaning-maker and can intelligently participate in finding opportunity for survival. Applying an intra-active lens to explore Dengue in Jakarta searches for agency that is not necessarily aligned with human intention or subjectivity (Barad, 2007, p. 235). *Aedes aegypti*, a material-discursive phenomena is created through every intra-action with a scientific study that communicates its microscopic structure and every round of fogging selectively breeding the pyrethroid resistant. *Aedes aegypti* animates cultural-political life by making-sick, affirming the need for a bitter atmospheric-chemical response, and requiring the Indonesian government to financially attend to the persistent enemy. Mosquitoes and the virus are both indicators and agents of precarity (Shapiro, 2015). *Aedes aegytpi* finds opportunity to grow in the inequities that allow for communities of disparate wealth to remain separate and blame one another, indicating the disequilibrium of social classes and the uncertainty of when illness will occur. They also cause anxiety and instability through their distribution of the painful and dangerous Dengue virus.

Our language and perception, scientific experiments and imagination shape *Aedes aegypti* and *Aedes Aegypti* also has an agency inherent in its presence. From an intra-active lens, the organism's resistance is intelligent and meaningful. It is not only a sign that our technology has failed, it is an indication that humans contribute to but never determine effects. The virus and mosquito, co-evolving and relating in always changing environments, expanding their reach, have designed one another without intention or plan, but with meaning. *Aedes aegypti* has found opportunity in existing class divisions, changed the pyrethroid content in Jakarta, and structured the countries uptake in global health technologies. *Aedes* and humans come to be together. The economic structure and the air we breathe is mediated with pesticides.

4.3 RETURN TO THE SOCIO-ECOLOGICAL MODEL

The socio-ecological model is a useful framework to begin to understand a public health problem. My inclination is to expand from that model to include more space for senses and multiple forces and agencies. I have shown in my exploration of Dengue in Jakarta that those components are crucial elements to more deeply understand the risk visibility, fogging infrastructure, and Dengue illnesses. Senses - of being taken care of, feelings of citizenship, orientation toward the problem - play a crucial role in fogging's continuation. The mosquito, fogging, weather, bacteria, all have agency that compile a particular Dengue experience.

Another shift I am inclined to make through the exploration of Dengue in Jakarta is to blur boundaries drawn in the socio-ecological model which separates humans from their environment and makes a distinction between natural and socio-cultural factors. My description of how co-constitutive nonhumans, land, climate, and technology are indicates that categories are more

blurred. Humans are not at the center, surrounded by an external world, they are acting out their agency to create the world with other material-discursive phenomena.

A socio-ecological approach to epidemiological narratives is useful and informative. It parses out contributing factors of an illness and puts problems in categories with the solution one step away by addressing an individual behavior change, a community change, or a policy change. The intervention, like the model, is conceptualized through the rippling causal affect of changing one unit. The orientation of the socio-ecological model suggests that a structural change at the top will trickle down and affect the individual. This often does occur, especially in a thoughtful implementation where many entities align in a supportive way. In this case study, the structural change of the Jakarta Health Agency made the decision to change the pesticide used in a fogging gun in an effort to kill more mosquitoes and prevent Dengue incidences. Their decision was met by opposing and alternative forces. Mosquitoes, sub-district Health Agencies, and the wealthy population resisting and seeking out other means to secure fog.

The socio-ecological model bifurcates natural and cultural causes. Evolution of the Dengue virus and *Aedes aegypti* occur naturally. Home caretakers unwillingness to let larvae ladies inside is cultural. Both contributors to Dengue should be responded to with human ingenuity and technology. The human is the only meaning maker in the health scenario and the only actor to mitigate the health risks through interventions. Through re-severing the distinction between mosquitoes and humans and universalizing their existence with laboratory-based experiments, we have stunted our ability to know the complexity of intra-actions through which humans and "the cockroach of mosquitoes" become-with one another. And by separating humans from nonhumans and failing to respect and offer gratitude with a nonhuman world that is present all the time we miss an opportunity to weigh the risks of extra-mosquito casualties as important or

contextualize mosquitos in a large network of fish, bees, cockroaches and birds. In a becoming-with natureculture paradigm we notice and consider that fish are dying from and negatively affected by pyrethroid use.

4.4 MOMENTUM

An infrastructure, like fogging, is below the surface, it is sub-structure. I am digging and asking: what roots are deep and cannot be yanked even when we sense they may contribute to making us more sick and the mosquito more domesticated, closer kin? What allows for a technology and infrastructure to mitigate a health risk continue with such a forceful momentum? The fog pummels and fogging pummels. The performance on singular and collective scales has a momentum and creates a momentum. If public health officials and the public know fogging is not securely tucked into the effective category, why is fogging regularly performed? When we include the extra-anthropo, the sensed, the felt, and the heard we notice the sense of fogging powerfully contributes to that momentum. The expectations and feelings of something-being-done allow for fogging technology, an infrastructure put in place to mitigate a health risk, to continue with forceful momentum. By pausing to ask why and how fogging continues as a primary mechanism for vector management in Indonesia and throughout the world, we notice that unintended momentum is present and materializes continued fogging.

What creates a sustained momentum for habitual acts to address illness? It is an open question incompletely answered by my suggestions. To begin, Dengue and fogging in Jakarta have always been coupled, since patient zero. When is enough (health risking evidence, mosquito resistance, investment in pesticides…) enough? Fogging's pummel might push

'enough' further away. The fact that fogging has been and continues to be performed routinely contributes to its momentum, its expected nature. Pyrethroid piling up from past year's orders in health agency closets suggests that aging supplies be used. Secondly, the separation of humans from nonhumans and nature establishes acceptance of aggressive environmentally-oriented guns. Thirdly, fogging indicates to residents that something is being done, that life is controlled from above, which is the modern nation-state's orientation of biopolitics in which residents participate. The performance of the infrastructure matters and materializes, communicating a biopolitical sense of 'taken care of'.

4.5 A SUBSEQUENT NOTE ON POWER

Matter is iteratively shaped by and shaping power dynamics. Webbed power structures move and relate with *Aedes aegypti*. The determinants of health inequity are opportunities for nonhuman actors to fold into that inequitable landscape and ride on the momentum of mal: –adies, -distribution, -treatment. *Aedes aegypti* fold into the power relations opportunistically. They fit into the economic and social trends of the times (Nading, 2014). Our inter-species relationship deepens the divisions between class-based behavior assumptions, blame, and technological choices. I am interested in extending that work through to find a different way to know our current late industrial postcolonial present in ways that attend to and articulate infrastructural instability and the nonhuman growth opportunistically occurring alongside the instability and decomposition.

Power consistently rematerializes with every new intra-action. This case study has shown how structures of power thread amongst public health narratives, they cannot be separate.

Deforestation, palm oil use, corporatization of land, slavery, the chemical industry, and fossil fuels are among the players with power to act upon Dengue's course. Misdirected efforts led by the chemical industry orient Dengue as a natural cause of poverty. The reliance on atmospheric-technical strategies to improve public health and safety has historical roots in serving the profit and political interest of a small group of people with financial, socio-cultural, and political capital. Power structures, the forces, identities and beliefs that position some relations as an *acting over*, are always present and are important phenomena to notice in the intra-action. Being more explicit with language of inequity to include a discussion of power and oppression creates more targetable places to intervene. In this case study, the power that private fogging companies, wealthy residents, and international health regulations play important roles in who gets sick from Dengue and who decides the pesticide presence in Jakartan air.

Without consciously recognizing and paying attention to power, it is re-affirmed. I have paid attention to capital and it's movement in the epidemiological narrative. There are, as Foucault elucidates, a "multiplicity of force relations" (1990) at work in the creation of Dengue in Jakarta. Capital flowing in a growing capitalist structure in the early industrial, colonial time was a powerful force encouraging Haber to remarket atmospheric chemicals used in World War I to the pest control market. A complex mix of forces lead to urbanization in Indonesia, creating larger cities with more opportunities for *Aedes aegypti* to find their ideal home: blood and water sources abound. For hundreds of years, Dutch colonization had a vested interest in moving residents of what is today the Indonesian archipelago to urban centers. Condensed in an orientation more familiar and visible to ruling Dutch, Indonesians were easier to manage and fight. More recently, clearing land in rural areas, largely by palm oil companies and the worldwide consumption of an enormous and growing array of products made from palm oil

pushes many Indonesians toward the city. The promise of city life along with capital-driven land-privatization creates material and discourse encouraging urban growth. Rural areas lose refugia, as deforestation decreases opportunities for a diversity of life and livelihood.

The BASF company, the largest chemical producers in the world with prior Nazi involvement supply chemicals with the language of decreasing poverty through pesticide use. BASF advocates that by killing the mosquito, we create a wealthier, more equitable society. By digging deeper in our investigation of power, we see that wealth inequities co-create Dengue. Power difference is not only the result of disease, it is a co-constituting force. Reducing poverty and creating equitable societies is more complex than killing the *Aedes aegypti* species, even if it were possible. Instead, focus can be on wealth redistribution and abandoning efforts to displace kampongs that affect poverty.

In response to mosquito's resistance to pyrethroids the chemical industry offers stronger resistant-responsive pesticides. BASF and other members of the Industrial Task Force have countered efforts to produce a rich source of scientific research about the safety of sprayed pyrethroid use. Science articulates the chemical industry's concerns and interests as they work to make a risk invisible. Supervisors and managers in the Jakarta Health Agency know the methods and results of *Aedes aegypti's* resistance to pyrethroid studies conducted at the city's laboratories while sub-district health officials and the public do not. The political figures with a higher level of authority restrict access to efficient and clear results for citizens and fellow public health professionals to analyze, use, and help shape appropriate pesticide use protocols. The state hesitates to question or thwart its actions. Instead, it has placed the concern on the need for residents to alter their behaviors. It does so while continuing to fog without monitoring private fogging companies, improving trash collection, or curbing consumerist incentives. Leadership

continues to communicate the belief that fogging can and will be effective when the population all behave more sanitarily. While diverse classes of Jakarta residents request fogging, wealthy residents in Jakarta exercise their power by leveraging their fogging demand, either by the sub-district health agency or paying for fogging from a private company.

Biopower manages life from above and intra-action and natureculture show that along with that management there is inherently action occurring at every level 'below'. In the case of Dengue in Jakarta, biopolitics from below might look like becoming attuned to resistance and agency at every level, recognize and build from the recognition of power of mosquitoes, Dengue virus and those participating with less capital.

When power and agency are an open question (Mitchell, 2002), no simple technological solution appears assuring. The promise in and continued use of the fogging gun hinges upon nature divided from culture, science unclearly communicated, and a momentum that exemplifies the force and agency of matter, discourses, and feelings. This line of inquiry employed with Dengue in Jakarta asserts that the fog may not be a long-term solution. I am also interested in exploring how fogging can shift to be a risk in and of itself, a risky practice. I have discussed what creates the force of continued fogging, the momentum of application that has not been relieved since the year following Indonesia's first Dengue case in 1968. I have brought fogging infrastructure to the surface to critically notice presence and question its worth. From that point of recognizing the fog and questioning its value and promise, we can continue to see its risk.

The units of inquiry in this case study are relational, including the relationship of *power over*; power over knowledge production, dissemination, research agenda, purchasing plans, and fogging frequency. Power is included in the case study to notice how capital creates knowledge and intervention strategies. Dengue in Jakarta is a risk that continues to be amplified through

forced migration and wealth disparities. The risk of illness is addressed with fogging because of financially and politically vested interests.

Another way to explain the process is by shifting perspectives, or what Michelle Murphy (2006) defines as *regime of perceptibility*, "the way a discipline or epistemological tradition perceives and does not perceive the world" (p. 10). I suggest that broadening our *regime of perceptibility* to notice the agency of nonhuman plants and animals shifts what counts as evidence in the health sciences. Public health's typically employed evidence-based peer-reviewed scientific journal articles, biology, and interviews were usefully applied in this case study. I expanded the typical reach for evidence to also include newspaper articles, observations, philosophy, affect theory, feminist studies, history, physical sensations, and conversations. These perspectives provide a wider context. Through this case study I noticed mosquito's reaction and power structures contributing to atmospheric-chemical-technological choices. I attuned to language, feelings, habits, relationships, power and agency as ripe evidence for analysis. The evidence points me to notice fogging risks and pyrethroid risks being made invisible.

4.6 ARTICULATING RISK

In an intra-active lens, risks are material-discursive phenomena. They come to be through communication and matter woven together with power. The risk of fogging has been made invisible by its momentum and the forces contributing to its repetitive use and incomplete accounts of health risks associated with pyrethroid use. A shift in the ways we relate to Dengue and tell its narrative can make a risk more visible. Materially, I have noticed mosquito's relationship with pyrethroids as one of mutual multiplicity. With increased fogging, stronger,

more resistant mosquito populations expand while fogging increases in an attempt to kill always present mosquitoes. Discursively, global health bodies and health officials in Jakarta communicate that pyrethroid use is safe. It is only ineffective so long as residents fail to perform their task of the 3M behavioral technique to eliminate larval breeding grounds.

Risk making, shaping the uncertainty and probability of something harmful happening, is not a paradigm but rather a practice that comes out of paradigm. Risks, both discursive and material; are 'articulated' (M. Murphy, 2006). The concept of making a risk visible (Kuchinskaya, 2014) is useful here because we can investigate the origin of fogging's categorization of safe and notice the agency involved in creating a perception of safety or danger. There is power and action involved in infrastructure's continued use. Exploring the risk-making of pyrethroids as a safe, albeit ineffective, technology to use illuminates concerns. I have traced webs of power to see new lines of inquiry reveal a novel understanding of risk. In other words, risk analysis, weighing advantages and disadvantages comes after the shaping and holding up of those positive and negative components to a technological choice. Hands digging in the soil bed of intra-action will dig up things unique to that ground. An idea that is given a fertile place to grow, takes root.

The intra-active lens orients risk-making as a relational expression of agency and power. When we tell the narrative honoring the ways mosquitoes and humans have made one another what we are today, we can follow that line of inquiry to ask how the fogged mosquito makes us who we are, following actions and agencies multiple directions. I have explored fogging's history, current use, effectivity, and worth. By including mosquito's response to the fog, we see it as a risk in and of itself. By noticing finances, cultural and political influences, I have pointed to ways risks are made invisible.

Infrastructure articulates a risk. It works to make risks visible or invisible. In the case of Dengue in Jakarta, I am inclined to make infrastructure a risk in and of itself visible recognizing that there are infrastructural and power structures upholding fogging. Atmospheric-chemical sprays become a discernible risk when we look for and notice evidence in new places through an intra-action lens. Forms of risk-making, planning, and infrastructural choices get made and momentum sustained through dynamic arrangements of actors in relationship. I have noticed fogging in a diversity of relationships to recognize if is there harm in continuing to perform fogging. In the relationship between government and citizens, fogging conveys a biopolitical assuredness that life is controlled and taken care of from above. Citizens feel assured that something is being done, and they become uncurious about how to live with mosquitos in a way that reduces Dengue-human viral mixing. In the relationship between pyrethroids and mosquitoes, mosquitoes become more resistant with cyclical fogging and monthly generations. In the relationship between fogging and non-mosquito beings including humans (especially those administering the fog), bees, birds, cockroaches, and fish, life becomes unwell and face death. In the relationship between fogging and conceptions of health equity, fogging asserts that wellness for all comes from technological solutions that the wealthy develop and direct its administration while the mosquito folds into the lines dividing rich and poor, carving them deeper.

4.7 CONCLUSION

While exploring Dengue in Jakarta, this thesis included a wider range of actors, human and non-human, to paint a dynamic depiction of how epidemics emerge, how risks are seen and understood, and how strategies to mitigate illnesses materialize and rematerialize. As a vector of

disease, *Aedes aegypti* is risky to human health. I discussed the elements that intra-acted with mosquitoes in Jakarta to support their growth and make them who they are. Mosquitoes, technologies, senses, warfare, oppression, care, viruses and tools matter in creating experiences of pleasure and pain; they have agency in co-creating health and illness. To understand their epidemiological trajectory, I considered the role of nonhuman actors as active participants intimately involved in the manifestations of health matters. Working from this embrace of complexity and cross-kingdom relationality, I have presented a theoretical framework for re-telling an epidemiological narratives of how illnesses emerge and infect. I have presented a narrative focused on process rather than an end-point that makes it challenging to say where natural forces conclude and technology begins or to distinguish between human intelligence and worldly actions.

I am driven by a larger shift toward the relational approach to improve health. If problems are conceived in relational terms, solutions follow as relational units. The WHO's 1969 goal reorientation from vector eradication to vector management is one indication that our relationship with *Aedes aegypti* will continue. There are many possibilities for how we will become-with *Aedes aegypti*. I am curious how can we do so in a way that reduces painful and deadly viral mixing. I am inclined to move forward with a natureculture perspective and take a critical look at distribution of power and knowledge production. To guide possibilities of knowledge production, I offered an example of how Karen Barad envisions objectivity, "Instead of being about offering an undistorted mirror image of the world it is about accountability to marks on bodies, and responsibility to the entanglements of which we are part" (Tuin & Dolphijn, 2012). Through honoring the ethics inherent in becoming-with and acknowledging the inseparable participation humans have had in the current disease emergence and knowledge

process past, present, and future, my hope is to reduce the risk of viral mixing for residents in Jakarta.

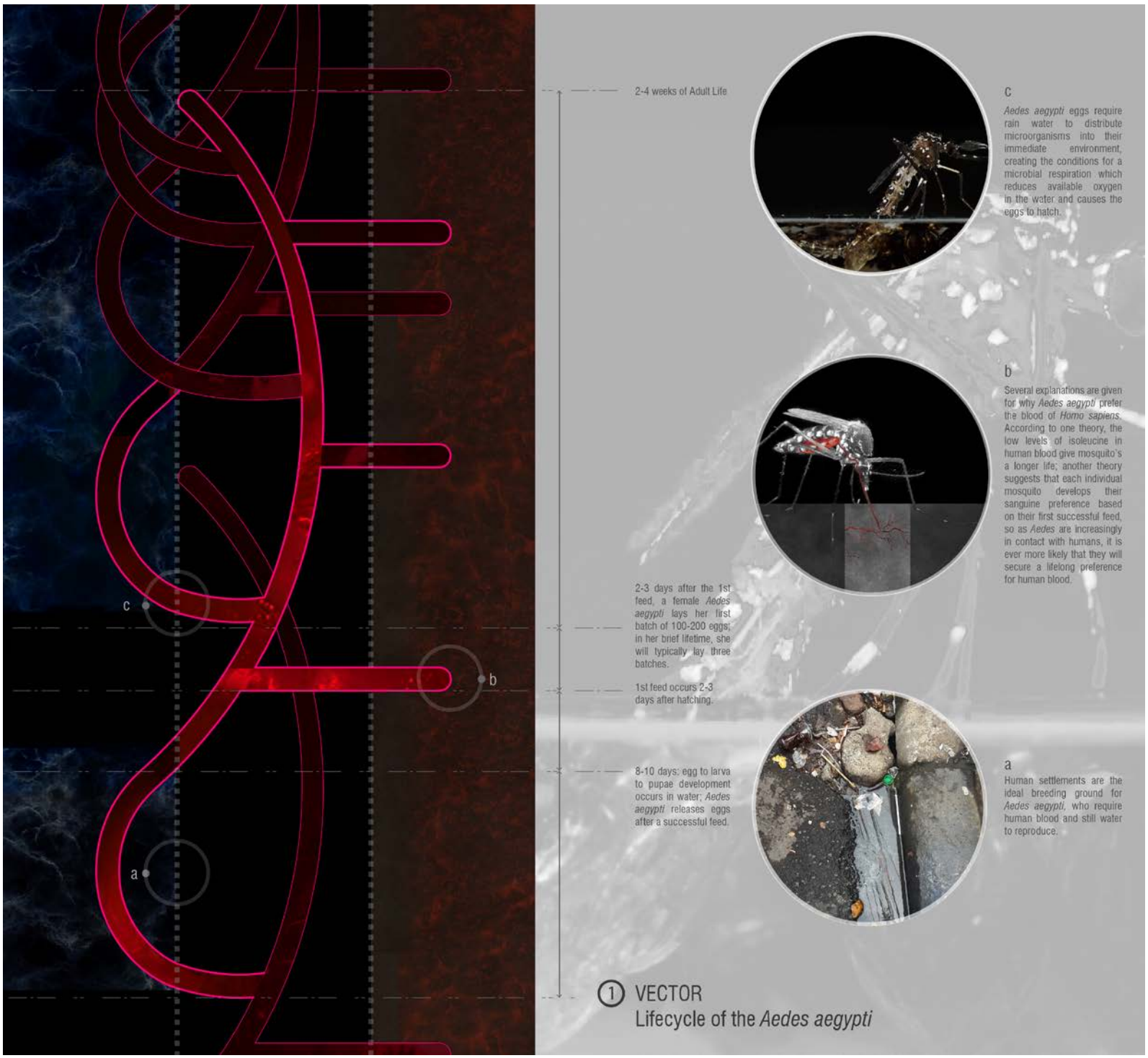
The continued use of fogging pesticides is an atmospheric-technical strategy to improve public health and safety that has historical roots in serving the profit and political interest of a small group of powerful people. Perhaps once effective, after decades of mixing with mosquitoes scientists study and citizens sense and observe its non-effectivity. The intra-action among pyrethroid pesticides and *Aedes aegypti*, Jakarta air, ungated and gated homes, and the Dengue virus for over a decade created an unanticipated and an unintended dynamic of *Aedes aegypti* surviving through the fog. The routine, embedded nature of fogging and the separation of humans from environment keep the fogging at arm's reach. The fog, intended to fulfill a lethal role toward mosquito co-dwellers has become a biopolitical performance with a forceful momentum. Intra-action accounts for nonhumans entities including animals and technology acting out agency in ways humans may not intend, control, or understand. It keeps us curious and attuned. Through my observation, I posit that fogging is a biopolitical performance instilling a sense of 'taken care of' that is showing disturbances as people feel ambiguous about governmental choices to mitigate 'natural' risk. The sense matters and materializes. It is a critical component to what creates momentum to continue the fogging infrastructure.

Power structures, the forces, identities and beliefs that position some relations as an *acting over*, are always present and are important phenomena to notice in the intra-action. In an intra-action paradigm, phenomena that are critical components in becoming ill will Dengue emerge through opportunistic growth in a particular power structure. Another way to notice infrastructural effects are to point to what opportunities for nonhumans exist. *Aedes aegypti* emerged and experienced population growth in historical movements of inequality, economic

growth, and power structures and acted advantageously in those ecologies. Fogging, classism, and colonialism are phenomena participating in the creation of an environment with a high Dengue incidence rate.

In this thesis I have explored Dengue in Jakarta through an intra-active lens that understands that entities come into existence through relationship. I retold epidemiological narratives that presented nature, culture and technology as inseparable co-created entities to notice the complexity of how things come to be. As Anna Tsing says, “Entanglements burst categories and upend identities” (A. L. Tsing, 2015, p. 137). By witnessing the knots and webs of multiple forms of matter, I acknowledged the diversity of factors at play to create an ecology of health and illness. Sharing a ‘view from somewhere’, Dengue has a historic and place-specific narrative in Jakarta. The virus nor the illness exists in and of itself as an object, even when it is identified in a laboratory as such. Every case, strand, and location where Dengue is present is a unique materiality. By presenting one narrative of Dengue, I hope to have shown that there are multiple Dengues and encouraged an exploration of zoonosis with humility, patience, curiosity and an attunement to relational units, agency, and power. Illness-involved interspecies ecologies come to be through knotted contacts between humans, nonhumans, semiotics, and power. We can explore those relationships more fully by asking and noticing how co-existing phenomena become-with one another, how they intra-act.

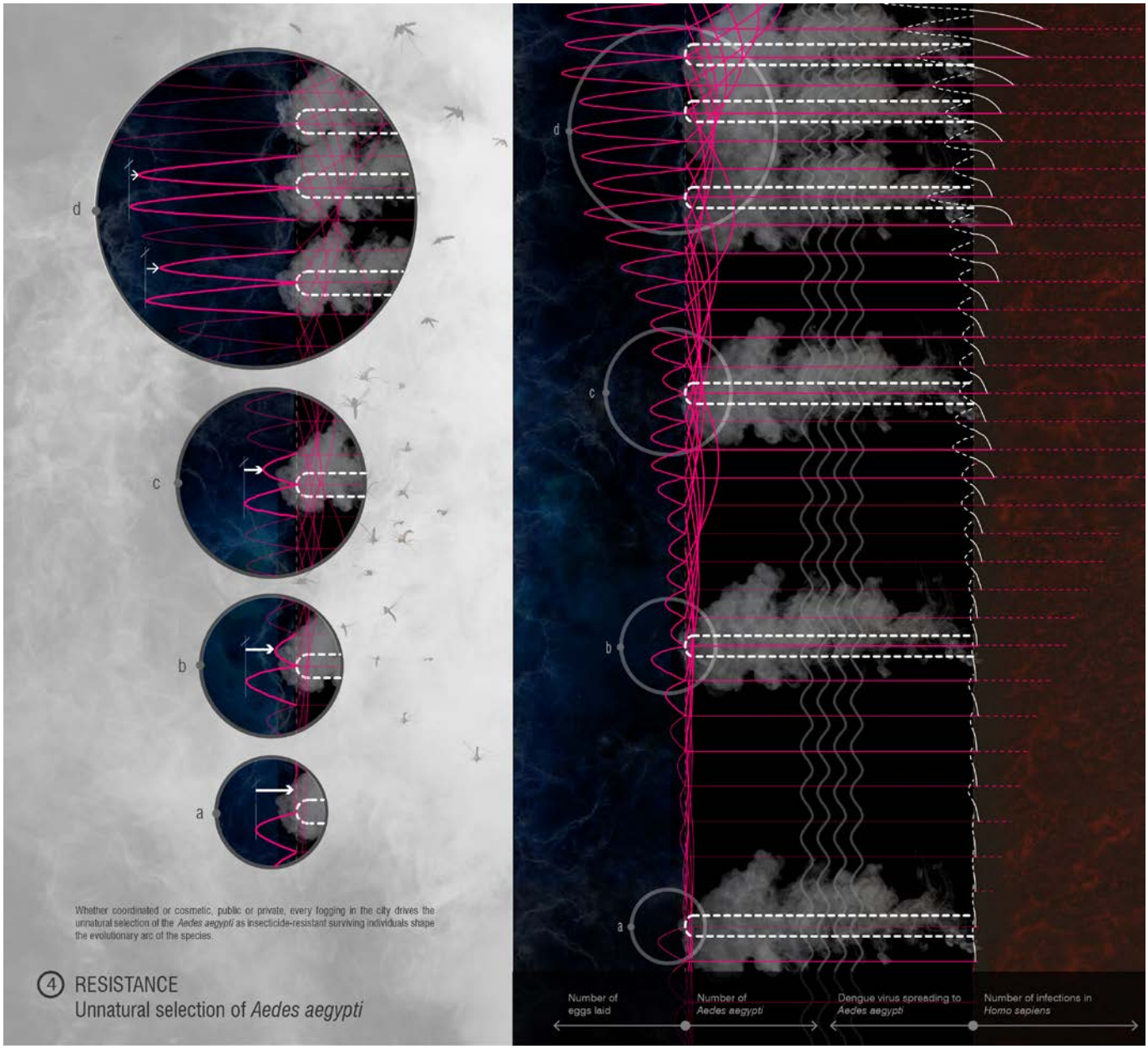
APPENDIX A: LIFECYCLE OF AEDES AEGYPTI



Graphic illustrator and architect Nashin Mahtani's drawing depicts the 2-4 week lifecycle of an *Aedes aegypti* in Jakarta. In the left portion of her drawing, the leftmost panel represents water, where *Aedes aegypti* pass through egg, pupae, and larvae stage, the center panel represents air

and viral exposure, and the right red panel represents human blood. With exposure to the virus, *Aedes aegypti* feeds more often and lays more eggs.

APPENDIX B: CLIMATE CHANGE, DENGUE, AND AEDES AEGYPTI



Nashin Mahtani visually represents the effect that fogging has on mosquitoes as an evolutionary pressure. The image is oriented as such: the deep blue is water where *Aedes aegypti* lay their eggs, the black part in the center is the Dengue virus, the four wavy vertical grey lines are the four Dengue serotypes that can infect humans, the dotted horizontal white lines represent a successful mosquito-human blood feed, the red part to the right is human blood, where *Aedes aegypti* feed and where humans receive the virus. In this image, Nashin Mahtani projects that as fogging (the cloudy image) increases, so to will (from left to right) the number of eggs laid, the *Aedes aegypti* population, the number of mosquitoes infected by the Dengue virus and the number of infections in humans.

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