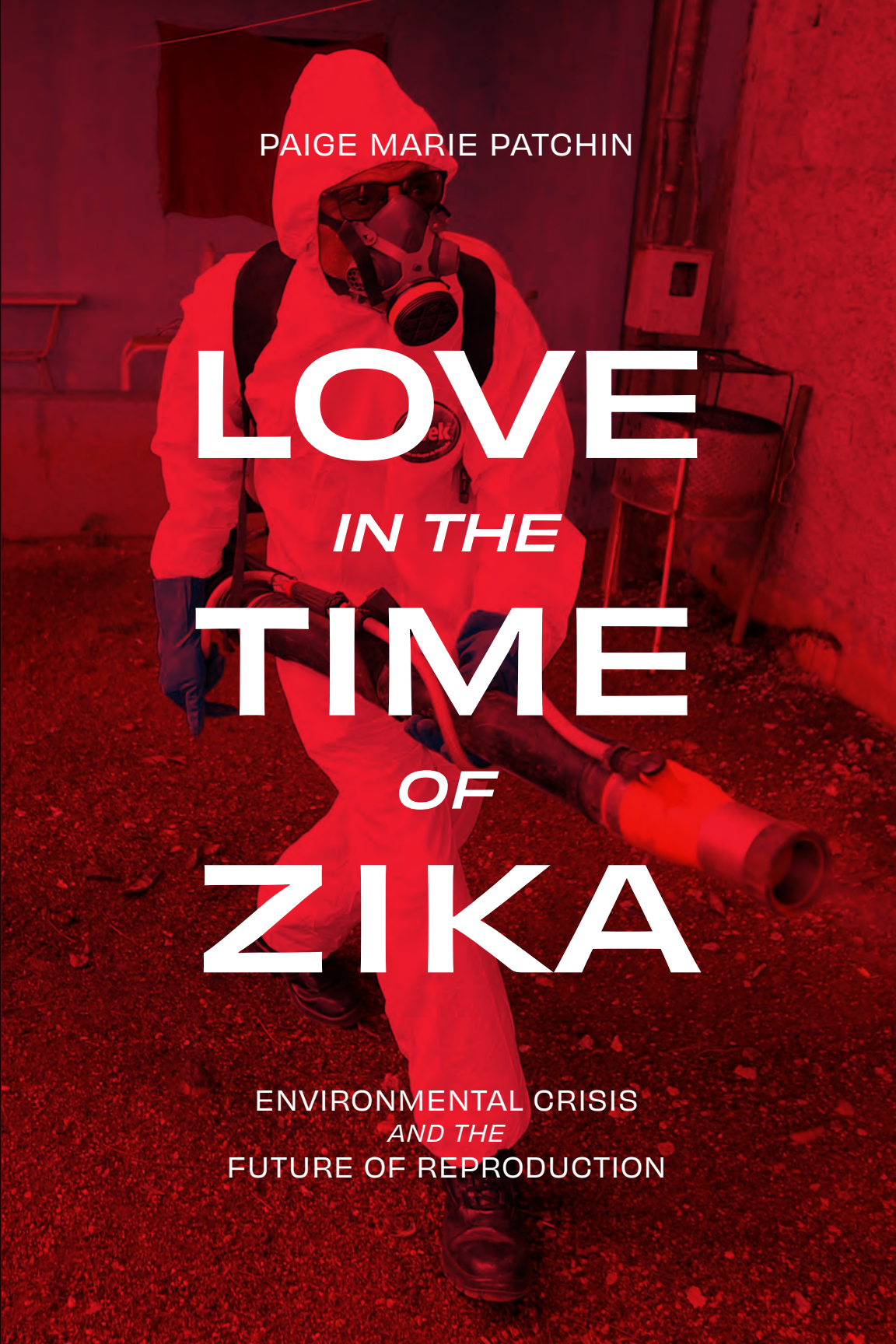

PAIGE MARIE PATCHIN

LOVE *IN THE* TIME *OF* ZIKA

ENVIRONMENTAL CRISIS
AND THE
FUTURE OF REPRODUCTION

Love in the
Time of Zika

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Environmental Crisis and the Future of Reproduction

PAIGE MARIE PATCHIN

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This one is for Sacha.

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Preface

How should the Zika public health emergency of 2016 be read? Was it a novel convergence of human, mosquito, and viral reproduction, resulting from evolutionary histories both inconceivably long (as in the history of human life on Earth) and extraordinarily compressed (due to the emergence and fast mutation of viruses)? Or was it the reduction of people's lives to their capacity to realize latent danger through the children they might have? Was it the reconstitution of reproduction by turbulent more-than-human worlds as the Earth heats at unprecedented speed? Or an instance of the persistent blaming of women's reproductivity for all manner of social ills, the denial of what Loretta Ross and Rickie Solinger have named "reproductive justice"?[1] How should we conceive of reproduction's natural histories vis-à-vis its social histories? What will reproduction look like as the climate continues to break down, and what *should* it look like?

These are the questions that guide this book, which explores the conversion of people and other forms of life into objects of reproductive management in response to mounting environmental uncertainties. It makes the case that in an age of environmental change of all kinds, reproduction must be read as a dense and planetary process, one that enjoins social, ecological, and evolutionary histories. But that process must also be apprehended as a stratified one: There is still so much to understand about how *power* works in reproduction, for how it works is changing.

While I do not dwell on my own experience in the chapters to come, it would be strange to deny the reader the conditions of this book's gestation. The research began a decade ago, when I began a project on the politics of love. The World Health Organization (WHO) had just declared Zika a public health emergency, and the stories of mothers giving birth to babies with microcephaly in South America, Central America, and the Caribbean were rife. My plan was to go to Puerto Rico to explore Zika's reworking of maternal and family love, and in doing so to contest the dominant style of health reporting in the United States, which subsumed both adults and children there in what Paul Farmer would call a "geography of blame."[2] This was supposed to be just

one part of that wider study on love, but the emergency immediately gripped me. On my journey there in the summer of 2016, the airport security agent greeted me with a warning about the virus and asked if I was pregnant. Zika signs stood out among the ceaseless streams of people; "DON'T LET THIS BAD BUG BITE YOU," they ordered, a monstrous *Aedes aegypti* mosquito bearing down from above, and below, a map dividing the Western Hemisphere into two discrete zones: the Zika-stricken zone and the zone that had, as yet, presumably been spared. All of this blended seamlessly into the rest of the security infrastructure. On my arrival, a Centers for Disease Control and Prevention (CDC) health advisory notice again asked if I was pregnant and informed me that "Zika is linked to birth defects"; another declared, "Protect yourself and your family from Zika." When I called my mom to let her know I'd landed in San Juan, she told me to use "bug juice"—US Marine Corps slang for insect repellent—and to think about my future self. It would be hard to overstate the extent to which I was, from the start, hailed as a Zika subject, my body a potential vessel through which the virus's dystopic horizons could be actualized. And as that subject, I turned my full attention to the virus, setting out to understand how various public health interventions were working in Puerto Rico and to reflect on their consequences.

In the following years the research would expand outward from the Puerto Rican archipelago to form an expansive map—of treetop scientific observatories in colonial Uganda, of factories producing novel genetically modified insects in Brazil, of commercial health databases that have no identifiable place, to name a few. After I started working at University College London, once home to the Galton Laboratory of National Eugenics, I would key the story of Zika into an expansive genealogy of reproductive thought on evolution, eugenics, extinction, and much besides.

This preface is an opportunity to declare something that I will elaborate gradually throughout the account to come: The way we think about reproduction has consequences far beyond those which we tend to associate with the reproductive processes of sex, gestation, birth, and early infant care. So when I ask how the Zika emergency should be read, from the vantage point of global concern now having washed away as quickly as it swelled, I can offer a promissory note of a response here: It should be read as something much more than what it was. The rise and fall of the emergency is a kind of test case for reproduction's futures as the Earth heats up, what Sally Falk Moore would call a "diagnostic event."[3] My diagnosis includes the rising tide of racist and fascist discourses of reproductive control and environmental crises as being caused by baby-making, as well as the proliferation of means through

which the meaning of human life is being emptied out of every area but the economic. We ignore these various scripts of climate crisis as a reproductive panic that is unevenly distributed across the planet at our peril, for they threaten to extend and escalate in the years to come.

This is also a chance for me to be unequivocal about my intentions from the outset. The book should not be taken as an effort to diminish the danger of Zika or the suffering it has caused. Microcephaly, the condition the virus sometimes produces in babies, is extremely painful, both for those it affects and for their caregivers, and that pain explains at least in part why the virus ignited so much fear across the globe in 2016. However, it is my hope that two positions can be held at once: (1) that public health concerns that can cause impairment must not be denied and care cannot be rationed or withheld; and (2) that illness and disability—as well as the body simply not functioning as you wish it to—are all central aspects of being human.[4] I think carefully about the permeation of Zika's reproductive matrix with eugenics in what follows, especially in depictions of some future children as divesting from the fates of others. This means holding on to the tension between Zika as a serious public health threat and Zika as a licensing maneuver with all sorts of cruel roots and outcomes—often through the lexicon of love for children. So in the end, it appears I haven't abandoned those difficult questions about love after all. I try to hold on to them in what follows.

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INTRODUCTION
Reproduction Redux

In a factory in Campinas, in the state of São Paulo, Brazil, mosquitoes are reproducing. Within the white walls of the facility set among warehouses, there are breeding cages that are buzzing sites of *Aedes aegypti* sex, and there are breeding trays in which eggs become larvae then pupae then adults. From the contact paper at the bottom of each cage of thousands of specimens, technicians harvest eggs and dry them out for days, sometimes weeks. The desiccated eggs are measured out by weight into trays and mixed with a splash of water and a dose of the antibiotic tetracycline. They hatch and, nourished by fish food, grow into swimming pupae. Technicians plunge the wriggly mass of pupae under a wire mesh. As they swim up in pursuit of air, the females, slightly more rotund, drown, while the males pass through to the surface: This is how they are selected by sex. The male pupae are stored in small plastic containers, about a thousand of them in each, as they continue to develop.

A van filled with the plastic tubs of male mosquitoes leaves the factory in the early hours for Piracicaba, a city about an hour's drive away. It circulates slowly through the neighborhoods. Every few minutes, a scientist in the back

of the van grabs one of the containers, opens it, and empties it out into a funnel cut through the window, a portal to the outside. A shake and a tap ensure that all the male *Aedes aegypti* are unleashed into the morning air. They become part of the city, entering the single-story houses that line the streets and flitting around human passersby, in search of female mosquitoes with which to mate. This cycle, from dry egg to natatory pupa to sexually mature, airborne urban male took a little more than a week, and it continued on repeat across a four-year period, in which an untold number of mosquitoes were bred and then released.[1]

The longstanding dream of Western public health has been to expunge *Aedes aegypti* from the face of the Earth. In the mid-twentieth century, military-style chemical fumigation campaigns nearly succeeded in eradicating the insect from twenty Latin American countries, including Brazil.[2] Why, a little more than fifty years later, were they being produced in a factory and let loose into Piracicaba? Why was mosquito reproduction being promoted instead of repressed?

One answer to this question is that the mosquitoes being churned out of the factory were a different sort of mosquito than the kind that would normally meet the wrath of your slapping hand. They were patented products, made possible by recent advances in the life sciences. Created by the British biotech firm Oxitec and marketed as "Friendly™ Aedes" (*Aedes do Bem*™ in Portuguese), their genomes were distinct. Inserted into the Friendly Aedes were regulatory genes from the common fruit fly, as well as activator genes from the common viral infection herpes simplex and genes from the mushroom coral that make the mosquito's belly shine red under fluorescent light. Genes from the cabbage looper moth were used as a carrier to introduce all of this extant DNA.[3] But what really defined the Friendly was the tTAV gene, borrowed from *Escherichia coli* (*E. coli*), which programs for offspring death. When released through the funnel in that van, Oxitec males set off to mate with wild females, and their tTAV genes ensured that their children would die before reaching sexual maturity. By successfully competing with wild males in copulating with wild females, and producing offspring with lethal genes, the masses of Friendly mosquitoes released in this ordinary Brazilian city succeeded in dramatically reducing the number of *Aedes* in the area. Mosquito reproduction here fulfilled its purpose through mosquito death, disturbing the assumed equivalence of reproduction and life.

A longer answer is the problem on which this book focuses: the Zika virus, which caused a global public health emergency that imperiled love, sex, pregnancy, childbirth, and the future—an emergency, I argue, that crystal-

lizes how reproduction is changing in the twenty-first century and impels a reappraisal of the idea of reproduction altogether.

The story of the Zika emergency began in earnest in the spring of 2015, when mosquito engineering in Campinas was in its infancy. (On the discovery of the Zika virus in the mid-twentieth century, see chapter 1.) Brazilian health officials noted the presence of the virus in the northeastern part of the country and, months later, reported an explosion in cases of microcephaly in human offspring: The number of babies born with small head size had multiplied by twenty. As Zika found its way into neighboring countries and then threatened to edge up into the United States, researchers rushed to ascertain the link between it and microcephaly. They reached two points of consensus. The first was that Zika could be transmitted by sexual intercourse and by the *Aedes aegypti* and *Aedes albopictus* mosquitoes, making it the first virus with both of these transmission mechanisms. The second was that when contracted during pregnancy, especially during the first trimester, Zika could severely impact fetal development. A mosquito-borne, sexually transmitted disease with a definite link to children's disability had emerged. In February 2016, in only the fourth such declaration in its history, the World Health Organization (WHO) named Zika a public health emergency of international concern.

Early on, Zika drew comparisons to another ongoing public health emergency of international concern, the West African Ebola epidemic (2013–16). Yet, despite the mortality rate of that strain of Ebola reaching 60 percent, WHO official Bruce Aylward stated that Zika was "much more insidious, cunning, and evil."[4] Such "quasi-theological tones," which Kevin Bardosh argues saturated the early global response, positioned reproduction at the heart of the meaning of human life, centering the vulnerability of babies to microcephaly and the women who gave birth to them—or could, or might.[5] Government and healthcare officials strove to mitigate the circulation of the virus through chance contact with the mosquito's proboscis or in the exchange of bodily fluids during sex, testing out all sorts of ways of regulating reproduction.

By way of introduction, let's consider just one. Under the sign of Zika's new and terrifying powers, the government of El Salvador exhorted its citizens to refrain from having children for a period of two years, a recommendation that the vice minister of health felt "obligated to make."[6] This official, blanket urging of a moratorium on procreation, reduced-duration versions of which other governments announced, was in many ways unprecedented. It was also issued in a context of high rates of sexual violence, limited access to contraception, speculation that Zika was being utilized as a Trojan horse for curbing popu-

lation growth, and a ban on abortion that carries a prison sentence of up to fifty years. This call for nonreproduction cannot be separated from persistent moralizing about female sexuality or from the history of institutions, from the hospital to the reservation to the plantation to the church, promoting, forcing, or precluding reproduction. That women's and girls' bodies have long been understood as a key site where the kinds and qualities of life could be politically shaped has translated into reordering and controlling their lives—often exposing them to premature death in the process.[7]

Yet Oxitec's intervention into the reproductive cycle of the mosquito, which in the years that followed would crescendo to the mass production of mosquito eggs for shipment worldwide, was another effort to regulate reproduction in the time of Zika. The emergency raised the profile and market value of the Friendly mosquitoes' deathly liaisons with wild females, bringing *Aedes* reproduction into collision with human reproduction and viral replication the world over.[8] *Aedes* were just one part of a dense network of reproductive relations that extended beyond the sexed human body and its political and cultural meanings and restrictions. The emergency conformed to leading climate-change scientists' predictions of fecund viral futures, emanating from expanding torrid zones, in which the reproductive pathways of both disease-bearing mosquitoes and dangerous viruses multiply and thicken. Further, it added to speculation about human extinction—or, stated differently, the end of human reproduction—in the midst of a broad ongoing extinction event caused by human activities. The plea for people to stop having children hinted at the ineluctable place of human reproduction within nonhuman worlds and histories. The asexual replication of the Zika virus, its movement between mosquitoes and human bodies, and its capacity to shape the human fetus are together exemplary of reproduction's charged and changing relationship with environmental uncertainty in the twenty-first century. The emergency's reproductive forms, each in its own way, speak to the gathering and building planetary crises of environment. They speak, in other words, to the changing shape of reproduction in what has come to be understood as the Anthropocene.

In her delineation of the concept of "distributed reproduction," Michelle Murphy has offered that reproduction "does reside in bodies, and lives become precarious in birth and pregnancy. But"—she asks—"does reproduction stop there?"[9] The Zika emergency, with its explicit recasting of both virus and mosquito as reproductive agents that threaten human fetuses and children, shows us that reproduction surely does not stop there: All were children of the Anthropocene. But how it does not, and why it does not, matters.

The opening contention of this book is that Zika, as global health crisis and as cultural object, is indicative of both the sustained grip of late nineteenth- and early twentieth-century understandings of reproduction on medicine, culture, and politics—which I will go on to describe as the *modern reproductive imagination*—and the future of reproductive politics in an age of environmental breakdown. To borrow from Raymond Williams, we find in the recent history of Zika dominant meanings, practices, and values concerning reproduction that have been in place for a long time, and we also find emergent ones that are enfolded in and constitutive of a planetary geography of environmental uncertainty.[10] Some of these emergent forms might actually be oppositional to dominant cultures, pointing to substantively alternative ways of thinking about, and doing, reproduction. Many of them, though, are simply new expressions of the dominant. Reproduction might be changing, yet the narration of those changes, and the principal responses to them thus far, recuperate and reproduce the main templates of dominant modern reproductive thought, namely, (1) the premise that human reproduction is an ideal site of social and ecological engineering for both public and private institutions, (2) the positioning of the sexed female body as the central point of intervention, and (3) the promise that both utopian and dystopian futures can be realized through reproductive tinkering.

If the virus's sudden imposition of an unruly nonhuman world on the human fetus and child evinced the entwinement of viral, human, and animal reproduction on a heating planet, the public health emergency that followed evinced the stratifications, abandonments, and life curtailments at work in today's reproductive politics more generally. Such inequality is shown, for a start, by the episodic nature of the emergency itself: Global interest in Zika disappeared just as precipitously as it rose. In November 2016, the WHO revoked Zika's status as a public health emergency of international concern on the basis that the "extraordinary cluster of microcephaly and other neurological disorders" which defined the virus's ascent in global awareness had not been sustained or replicated in other countries as the months went on. "Intense action" would still be required, but the emergency label no longer applied; instead, a "longer-term technical mechanism" was needed for managing the circulation of Zika and its suite of consequences.[11] For other global health agencies, Zika's recession from emergency consciousness was even more abrupt. The Pan American Health Organization, for example, denoted Zika a "neglected, tropical, and vector borne disease," bringing it into the collection of "forgotten" infectious diseases "that primarily affect the most vulnerable populations."[12]

This book explores the range of futures people were seen to encompass, and the range of interventions into their bodies that were realized in the name of future children, during Zika's brief period of cultural and scientific ascendency. Building on the work of geographer Becky Mansfield, it shows that in Zika's reproductive network, some women and girls (racialized, poor) in some places (the "tropics," the "territories," and others outside the overdeveloped world) were positioned as the threshold between nature's increasingly aberrant fertility and a future of limited wealth, and accordingly, subjected to intervention.[13] It postulates that this logic—which I call *thresholding*—will become increasingly clear, common, and harmful for the people at its center in years to come. Throughout, it demonstrates the sustained financialization of future life and eugenics amid climate crisis, and the persistent marking out of deserving from undeserving future children. Determinations, comparisons, and linkages of reproductive worth are a central feature of life under environmental breakdown.

In the remainder of this introduction, I trace a rough history of the modern idea of reproduction, from its formulation around the idea of social engineering, to its more recent shift to the grammar of economy, and on to its present-day reconfigurations through both advances in the life sciences and environmental crisis. Zika will appear at key moments in this history, showcasing how the emergency drew on the modern reproductive imagination as well as calling into question the ground on which that imagination stands.

Through the insights into Zika and the response to it that then emerge, I intend to suggest that modern reproductive thought—pressured by but ultimately able to absorb new environmental factors—continually makes two key distinctions, two cuts into humanity. It marks off the free, and therefore properly human, reproductive subject from the reproductive object. And it positions the fully human child as a surrogate for the future, endangered by the economic and ecologic drain on resources effected by another kind of child. These distinctions animated damaging and unethical policies and interventions across the Zika emergency, which would be resisted at every turn but which also stimulated some other ways of thinking about reproduction. My premise is not only that alternative conceptions of reproduction can and are being generated; it is also that perhaps they point us in the direction of a different kind of understanding of living together while temperatures, sea levels, and walls rise.

The Modern Reproductive Imagination

The use of the word *reproduction* to describe the making of new organisms, including human babies, is relatively new. Before this use was inaugurated by the French naturalist Georges-Louis Leclerc in 1749, debate about the coming into being of organisms (from immaculate beginnings, it sometimes seemed) turned on the concept of generation. How did generation work? Why did it happen? And was its origin male or female? These were the kinds of questions being posed. Chinese explorations of organism generation, for example, focalized the energy cascades of different networks of organs in male and female bodies.[14] In the West, Aristotle's influential proposition was that "bloodless" animals like insects were generated without any input (that is, spontaneously), while the generation of others, like humans, hinged on sex. His view that the female progenitor supplied, through menstrual blood, the matter for generation, while the male progenitor's semen gave that matter its human form, was replicated in Judeo-Christian and Islamic understandings of semen as baby-making's central ingredient.[15] For example, René Descartes, that famous theorist who wrote on the mind-body dualism while being cared for by others, described how semen "is fermented and cooked together by maternal heat, its parts entering a subtler mixture."[16]

The concept of reproduction, by contrast, had from the start connotations beyond the body and its organs and fluids. That Adam Smith had used it as a label for how economic value could be created and re-created demonstrates a link with the concept of production, but when Leclerc applied it to the making of new organisms, he named "a process of maintaining a species in time, a process that perpetuates the stability of form in organisms across generations."[17] Whether in moneymaking or in baby-making, the reproductive process was effected through the labor of work or birth and, reflecting the wider European project of cataloging and delineating plants, animals, and racial types that had been in motion since the sixteenth century, it was tied up with the concept of the species. Nick Hopwood finds the idea that there was a distinct shift "from a broader, premodern framework, 'generation,' to the more abstract, modern notion of 'reproduction'" a bit simplistic but nonetheless sees "much truth" in it.[18] By the eighteenth century, reproduction was taken to mean a stable process of re-creating species uniformity that enjoined the individual bodies carrying it out.[19]

Things started to change in the nineteenth century. Reproductive cells were distinguished from the other cells of the body, and a complementarity between egg and sperm, on which the sexual reproductive process hinged, was

first articulated. Perhaps more importantly, speculation that the appearance, disappearance, and reappearance of different qualities and features across generations occurred through a biologically discernable process emerged and provoked experimentation in several areas in the 1850s. One was large-scale agriculture, in which selective breeding programs of animals like sheep provided clues about the transmission of characteristics from parent to offspring. At the same time, it became fashionable for physicians in France to scrutinize the family trees of aristocrats to understand predispositions to certain illnesses.[20] The consolidation of the idea of inheritance in reproduction coincided with its dissolution in the realms of property ownership and monarchical power: Following the French Revolution, the traditional meaning of heredity was submitted to scrutiny both legal and philosophical.[21] Meanwhile, on the plantation, J. Marion Sims was conducting horrific medical experiments on enslaved women to develop the science of gynecology, and slaveholders were looking to reproduction as "expanded property-holdings" and "a form of speculative value."[22] By the late 1870s, the idea of reproduction had begun to harden around two things: heredity, or vertical biological transmission from parent to offspring, a notion recently migrated from religion and law to biology, and the image of the fusion of egg and sperm, which was observable under a microscope for the first time.

Charles Darwin didn't understand inheritance. (He mistakenly thought it worked through a blending of the traits of each parent.) Nor was he the first person to propose the concept of evolution. (Circulating in the middle of the nineteenth century was the idea of many parallel lines of biological development for each species; in this "pluralist" conception of evolution, different races each had their own origin and pathway to development, making white and Black people different species.) But it was his work, and the scientific and practical interventions it would go on to inspire in the ensuing decades, that was most impactful in the construction of the modern reproductive imagination. Darwin's early education included the socialization that came from being from a wealthy family of abolitionists and interacting with race science's worlds of skull comparison and phrenology as a medical student in Edinburgh. On his famous trip around the world on the *Beagle*, a vessel tasked with charting the South American coast for the British Empire, he collected a lot of samples; he also recorded horrified reflections about the slave societies and extermination campaigns he encountered. *On the Origin of Species* was released in 1859 and immediately made a splash, making the case that all life-forms shared a common ancestor and that, over the long stretch of evolutionary time, species evolve.[23]

Reproduction was key to these incendiary contentions. The book argued that life evolved through the competitive process of natural selection: "Fitter" organisms were more likely not only to survive, but to reproduce, producing viable offspring that would go on to reproduce themselves. Three elements of this argument sit at the center of the modern reproductive imagination. First, it hinged on the distinction between sexual reproduction and the mere duplication that defined other modes of reproduction. Jean Baudrillard has written that sexual reproduction, with its recombination of biological material, is a more advanced mode of reproduction than the replication of bacteria or viruses: "The resulting entity is no longer a copy of either one of the pair that engendered it; rather, it is a new and singular combination. There is a shift from pure and simple reproduction to procreation: the first two will die for the first time, and the third for the first time will be born. We reach the stage of beings that are sexed, differentiated, and mortal."[24] This is variation and differentiation. They remain with us today in *Merriam-Webster Dictionary*'s definition of reproduction, which includes "subsequent growth and differentiation into a new individual."[25]

The second element was population growth, or the propensity toward reproductive plenitude. Here, the influence of economist and demographer Thomas Malthus, active a half century earlier, is apparent in *Origin*'s stated aim of exploring the drive, universal and ceaseless, to procreate: Darwin wrote in his introduction about wanting to understand the "struggle for existence among all organic beings throughout the world, which inevitably follows from their high geometric ratio of their increase," later adding, "there is no exception to the rule that every organic being naturally increases at so high a rate that if not destroyed, the earth would soon be covered by the progeny of a single pair."[26] The flip side of this propensity was the possibility of reproductive cessation, or extinction, a concept that Darwin developed through correspondence with the geologist Charles Lyell to denote that less fit types would disappear across evolutionary time. Through a failure to compete to reproduce, types would die out. And, provocatively, so could entire species.

This final element of *Origin*'s contribution to the modern reproductive imagination—extinction—represented a significant divergence from the idea that the universe was conceived perfectly by God. Nothing could be subtracted from it through the cessation of reproduction.[27] By contrast, evolution indicated a world in flux, constantly being remade through the accumulation of reproductive acts over time. This unstable, open world meant consequences for not only those species that could disappear from the face of the Earth, but also for those with enduring reproduction: As Murphy argues,

"reproduction as an evolutionary process did not simply maintain species-kind but instead produced the difference that natural selection sorted."[28] It did not simply replicate life as it always was and always would be, but instead created differences, variations, only some of which would survive to themselves reproduce.

But what did all of this mean for the social life of humans? One person who tried to answer that question was Francis Galton, Darwin's cousin, who after reading *Origin* began to think about variation in domestic animal breeding and the survival of the fittest together. His 1869 book *Hereditary Genius* brought that analysis to bear on human development.[29] Darwin tried too: *The Descent of Man*, published in 1871, was his long-awaited commentary on human evolutionary development, where he made his case for the common origin of humanity explicit, tried to account for racial difference, and developed the theory of sexual selection as a subset of natural selection. Sexual selection operated through the tastes and choices of individuals—women, principally—and would actually shape the kind of human character and temperament that would live on in different populations.[30] Through reproduction, the futures of different peoples, races, and nations, and humanity writ large, could be shaped.

A few additional discoveries thickened the proposition that the composition of humanity could be intervened in via the reproductive process. In the 1890s, German biologist August Weismann further developed the idea of inheritance, outlining reproduction as the transmission of "the heritable essence of an organism . . . through sexual recombination, from one generation to the next."[31] Soon thereafter, the famous pea breeding experiments of the Austrian monk Gregor Mendel, which a half century earlier had posited a stable, particulate hereditary material, were rediscovered; Mendelianism "offered the possibility that the simple numerical ratios discovered in plants would be found in animals, and by extension, in the human species."[32] Genetics and evolutionary biology emerged as realms of professionalized science and expanded rapidly in the decades that followed, and they joined eugenics, the applied science devised by Galton that harnessed knowledge around inheritance toward "better breeding" (the word borrowed from the Greek *eugenes*, meaning "well-born"). Eugenics sought to improve nations, races, and species, either by coaxing "fit" groups or individuals to reproduce or by precluding "unfit" groups and individuals from reproducing. Apprehensions about racial and national futures became bound to fears of disability in a broad framework that surveilled, institutionalized, deported, sterilized, and euthanized women (and some men too).[33] There was an assuredness, too, that "inferior" races were fated to be-

come extinct over time, so that the benevolence of the "superior race" consisted of assisting them along that pathway.[34] By the early twentieth century, human reproduction had become an area of active technocratic intervention that focused on the sexed female body.

It wasn't only sexually mature bodies that occupied the heart of the modern reproductive imagination. Also there, gleaming as evidence of both the benefits of eugenicist improvement and the dangers of degeneration, and as both reproductive outcome and proto-reproductive subject, was the figure of the child. Carolyn Steedman has shown that the modern idea of the child and evolutionary biology emerged together in this period. The proper process of embryonic growth in utero, outlined by physiologists, mirrored proper progression of evolutionary forms. The child's physiological development was yoked to the development of the human species across time, a yoking that would help position human reproduction as a major focus for governments concerned with the biological composition of their populations. Out of the circulation of scientific knowledge on child development between experts and publics, the child emerged as a chronicle of the great biological past of humans as well as, crucially, a receptacle of a specific inheritance that would shape the future.[35] For this reason Rebekah Sheldon argues that children "exited the nineteenth century as the nexus point coordinating life, species, and reproduction with history, race, and nation."[36]

That nexus point was as practical as it was conceptual. Children would go on to star as the emblem of the future in eugenics programs, with both disability and racial degeneration lurking as palpable threats: "polluting the gene pool, or weakening the nation, or destroying a family's quality of life, or draining public services (or, often, some combination of the four)."[37] Note the links between children's degeneracy and the composition of future populations here: The modern reproductive imagination positioned these children as injurious to the future, and not just as a general problem but as a specific one that threatened the well-being of others, both children and adults, in the future. These understandings of child life cannot be filed away as part of a hideous past. Both the terms *degeneration* and *defect* were used throughout the Zika emergency: the former to describe the brainstem and neural cells in babies with microcephaly, the latter as shorthand for microcephaly itself. Even though, as I will go on to explain, microcephaly was the result of forces outside the body instead of a genetic condition, it was still effectuated by a kind of vertical passing down from mother to child during gestation, and the figure of the disabled "Zika baby" was the abject—the repugnant, the threatening—against which other children and their futures were defined.

Anchored in the new worlds of evolutionary biology, the modern reproductive imagination brought together sexual complementarity and recombination, vertical transmission from parent to offspring, the drive to reproductive abundance, and the previously unthinkable possibility of extinction. Concerns over degeneration emerged among imperial nations in competition with one another, preparing the ground for the main premise of interventionism. Earlier expressions of this premise can, of course, be found throughout the history of empire, particularly on the plantation. But the instantiation of the idea that the *wider social world* should be manipulated through reproduction is what I am interested in, as well as how this constellation of ideas around reproduction started to organize knowledge more broadly. We see a swelling of concern for infant health and motherhood practices in the early twentieth century, for instance, along with investments in education and public hygiene and the emergent science of statistics also situated in reproductive thought.[38]

I am also interested in the fact that the capacious interest in reproduction in science and governance was not matched in philosophy. Questions about what reproduction is and how to do it might have figured centrally into questions about human life and its purposes and values, if the people that were the modern reproductive imagination's central objects had been allowed space to think and write their place in the world. They weren't. One of this book's aims is to examine this gulf, both experiential and interpretive, between the social engineering of reproduction and those positioned as objects of that engineering.

Economies of Reproduction

None of these dynamics have remained unchanged. Understandings of and approaches to reproduction shifted in the latter half of the twentieth century, as overt race science gave way to different framings of future life. Michelle Murphy argues that a new logic emerged during the Cold War, when experiments in family planning became the dominant form of managing reproduction in place of the obligations of pregnancy or sterilization found in eugenic protocols. Fetuses, girls, and women—as well as the children they *could* have in the future—were classified by their projected impact on economies. "A new era of calculative practices designated both valuable and unvaluable human lives: lives worth living, lives worth not dying, lives worthy of investment, and lives not worth being born," Murphy writes. She terms this the "economization of life."[39]

The designation of valuable versus unvaluable future lives meant that reproductive interventions were not so much concerned with individuals as with an aggregate would-be life that could be assessed in the lexicon of cash. The approach pivoted on the notion that some people must not be born so that others might live more affluently in the future. In this way, it can loosely be traced back to the central tenets of both Darwin and Malthus: There are always too many organisms that are reproduced, so some organisms must die without reproducing in order for other (fitter) organisms to live. The major question asked in their "biological-spatial" conceptions of reproduction was this: "In local, national, and global human ecology, which humans died (or would ideally be prevented from being conceived in the first place) to make room for the rest?"[40] The economization of life tracks this question back in time, before birth, and forward to the future through a vocabulary of collective prosperity (or at the very least, stability), focalizing uteruses as the collective progenitor of future economic life, and therefore as sites of economic governance.

In practice, this meant that more and more development-oriented reproductive health programs were assembled with the ambition of cultivating future prosperity, and as Kalpana Wilson agues, they often mobilized feminist conceptions of choice.[41] These programs were authored and funded by governments, to be sure, but as we get into the twenty-first century, increasingly by large philanthrocapitalist organizations. Take the Bill & Melinda Gates Foundation (BMGF, now the Gates Foundation): With an endowment of USD $40 billion at the height of the emergency, which has more than doubled since then, it is the most powerful philanthropic organization in the world. Its influence in the WHO is particularly revealing: Providing 10 percent of the WHO's total budget, the BMGF has over time succeeded in moving the organization away from the task of bolstering national and community health systems and toward vertical technological fixes.[42] Its signature and highly influential initiative, Family Planning 2020 (FP2020), brought the foundation together with the UK Department for International Development, the United Nations Population Fund, and the US Agency for International Development to monitor the activities of governments and nongovernmental organizations (NGOs) toward the goal of "contraception acceleration." FP2020's language is one of female empowerment, and its promotional material is explicit in denouncing eugenic pasts. However, its aim of adding about 120 million new users of "modern contraception" across the Global South ("120 by 20") positions their fertility not only as an urgent problem but as a counterpoint to material comfort.[43] The BMGF has become a fundamental executor of the phi-

losophy of economic governance via the reproductive body—and, as we will see, played a prominent role in reproductive interventions and innovations during the Zika public health emergency, from fast contraceptive implant insertion drives to the manipulation of mosquito genomes.

Here is a striking example of the economization of life's general principle of reducing the not-yet-born but could-be-born to economy that is central to our story: Not long after Zika was named an emergency, experts priced a single case of microcephaly at USD $10 million or more across a lifetime.[44] This figure, which included direct medical costs and broad societal productivity losses, was soon repeated in medical and government circles and reported in major media, making the Zika crisis not only an issue of public health but also one of economy. Health, wellness, and economics flickered in and out of focus as government officials, scientists, and philanthrocapitalists expressed the urgency of "averting," in the language of Murphy, cases of microcephaly. Rapid family planning programs funded by the US Centers for Disease Control and Prevention (CDC), the BMGF, and various pharmaceutical multinationals were rolled out with the objective of birth aversion, which blurred with broad desires to protect the deserving children of the future from being undermined by the costs that would amass around babies with Zika-associated microcephaly.

While it is clear that the reproductive health projects of the late twentieth and early twenty-first centuries were distinct from earlier forms of population control, the turn from the biological framework of heritability to the framework of future economic potential has not entailed the full displacement of the former. This is true even within imperial hubs like the United Kingdom and the United States. The oeuvre of Dorothy Roberts is key to grasping this play between the philosophy of race and disability engineering and the now-dominant language of choice and financial prosperity in reproductive health, and between the state management of genetics at the population level and the individual management of one's genetic code in reproduction.

Roberts's first book, *Killing the Black Body: Race, Reproduction, and the Meaning of Liberty* (1997), examined the US government's longstanding assault on the reproductive capacities of Black women. In doing so, it contrasted policies that discipline poor women of color for having children, because those children are costly in the eyes of the state, with advanced biotechnologies that facilitate financially advantaged, usually white, women in their endeavor to gestate genetically related children. For context, the latter part of this juxtaposition showcases the dramatic transformation of reproduction by advances in molecular biology and genetics across the last few decades. Melinda Cooper has documented the rupture of the modern reproductive imagi-

nation by the invention of genetic engineering, which enabled the creation of beings like the Oxitec mosquitoes.[45] Indeed, it is now not unusual for fertilization and early embryo development to occur outside the body, while a $2 billion surrogacy industry enables wealthy consumers to have genetically related children through the labor of others. A new cluster of fertility scientists, specialists, and therapists wield unprecedented control over the various stages of human reproduction, with prenatal screening allowing for the termination of pregnancy based on the genetic conditions of an embryo, the selection of a favored genetic makeup for children, or germ-line editing.[46] On the one hand, these transformations have dethroned the sexed female body from its position as "our species' sole child-delivery system," dispersing reproduction across many bodies and places through cash exchange and institutional change.[47] On the other, they have strangely reaffirmed the modern understanding of reproduction as the transmission of genetic essence: Reflecting what Lara Choksey calls the "cult power of genomics," wealthy would-be parents think readily of genetic risk and optimization as key factors in their reproductive decision-making.[48] Thus, we might add the *optimization* of life to Murphy's economization of life as a key stream of reproductive thought and intervention in the latter part of the twentieth century and the early part of the twenty-first.

In more recent work, Roberts has reconsidered her antagonistic framing oppposing one reproductive regime that punishes poor women of color for having children with one that promises wealthy consumers, through biotechnology, children with ideal genetic profiles. She now sees these approaches as linked in consequential ways.[49] With Sujatha Jesudason, she shows how women are now broadly expected to regulate their reproductive conduct in conversation with their genetic inheritance, which could, when mixed with that of another, produce children with disabilities. That expectation, they argue, "may fall especially harshly on Black and Latina women, who are stereotypically defined as hyperfertile and lacking the capacity for self-control."[50] The thesis is that it is not necessarily elite and middle-class women who are more likely to undergo prenatal screening for genetic or congenital abnormalities, but rather impoverished women of color, because they are encouraged—or obliged—to do so in a broader institutional environment that deems disabled children, children of women of color, children of immigrant women, and children of poor women to be a societal drain. Economization and optimization work in tandem, the former put in service of the latter.

This dynamic returns us to the matter of children. Lee Edelman has argued that an all-pervasive image of future children (which he stylizes with delib-

erate capitalization as "the Child") serves, coercively, as "the telos of the social order." Distinct from "the lived experiences of any historical children," the Child is the figure without which we cannot conjure the future (despite the future entailing the denial of rights, resources, and care to the adults some children go on to become).[51] Ironically, the image of the Child devalues the real experience and value of childhood. This is because the future always recedes: Though we are obliged to act in its name, "it never comes; the horizon shifts and what matters is the next generation child, and the next, and so on."[52] In contrast, real children have value in the present. On this point, I am moved by the writing of the nineteenth-century Russian philosopher Alexander Herzen, who, when trying to come to grips with his son's death, defended the significance of his short life even though it did not bear any fruit in adult achievements: "Because children grow up, we think a child's purpose is to grow up. But a child's purpose is to be a child. Nature doesn't disdain what only lives for a day. It pours the whole of itself into each moment. . . . Life's bounty is in its flow. Later is too late."[53]

Though Edelman presents "reproductive futurism" as a transhistorical feature of public life, from the examples he develops I interpret the reduction of the future to symbolic children to be a recent phenomenon, which joins in our genealogy of reproductive thought that first began to configure a relationship between the child and the future in the nineteenth century. Reproductive futurism was certainly evident in early presentations of the Zika virus (that is, during the emergency, when it was projected to spread and shape fetuses and children everywhere): One epidemiologist proposed that Zika imperiled "love, sex, and babies . . . the foundation of human existence";[54] a religious philosopher surmised that it touched on "primordial—one could even say ingrained—anxieties: that invisible forces threaten the health of our children, the survival of our families, by extension the human species."[55] But despite the distinction he makes between the symbolic child and living children, Edelman misses the racial and geographical determinants of reproductive futurism. While it may be impossible to inveigh against the Child (as symbol and symbolic beneficiary of the future), inveighing against the living immigrant child or living disabled child is a well-worn path that evicts some kids from the kingdom of the future.[56] As chapter 1 will show, a line has been drawn between children with microcephaly and children to be invested in, with an adversarial relationship being set up between them bit by bit.

Indeed, there was a general transition in the way Zika was talked about as the months passed, from the symbolic child, a proxy for the future, as potential victim of the virus, to the real child as actual victim of the virus, which

constituted, in its own victimhood, a financial threat to the symbolic child. The public health emergency as a whole overlaid the modern reproductive imagination's calculations about degeneration with the language of reproductive cost. Longstanding eugenicist logics joined up with relatively new modes of calculating the cost of future life that were made to seem agnostic in terms of race and nation. But despite the general appeal to the meaning of life and the future of the human species, coupled with the vernacular of monetary value, race and nation were never far from Zika's matrix of reproduction.

Reproduction in the Anthropocene

So far we have tracked the assembly of a modern reproductive imagination from the advent of evolutionary and eugenicist thought to its economization and onward to its recent reorganizations by advancements in the life sciences. But where is reproduction now, as debates are increasingly viewed through the prism of ecological ruin, as popular culture speculates in the same moment about crises of overpopulation and infertility, and as we reckon with the incontrovertible position of human reproduction within nonhuman reproductive forms? What, in other words, is the state of reproduction in the Anthropocene?

The Anthropocene as Planetary Conjuncture

As a technical term, the concept of the Anthropocene came into regular use in 2000 after chemist Paul Crutzen and marine scientist Eugene Stoermer proposed a new geological epoch following the Holocene, defined by the "central role [played by] mankind in geology and ecology," which Crutzen would go on to elaborate in an influential piece in *Nature* in 2002.[57] At the risk of abbreviating much, the Anthropocene thesis is that, whether by the burning of fossil fuels, the march of technological advancement, or our sheer force of numbers, *people* have shaped the planet—detrimentally, indelibly, and on a geological scale. The nine candidates that the interdisciplinary research collective Anthropocene Working Group recently proposed as sites that best demonstrate the scale of human alteration capture the breadth of the thesis: From an ice core in the Antarctic Peninsula to a peat bog in the mountains of Poland, "signals"—microplastics, pesticides, radioactive isotopes, and ash from the combustion of fossil fuels, among others—have been trapped in the strata of the Earth, while two of the proposed sites, the West Flower Garden Bank in the Gulf of Mexico and Flinders Reef off the coast of Australia, comprise "living golden spikes" as coral exoskeletons ensnare toxic particles

in layers as they grow.[58] (The threatened use of the pesticide Naled as a Zika control mechanism, described in chapter 2, is especially resonant at these two sites, for it is known to be noxious to corals.)[59] As an umbrella term, *the Anthropocene* thus captures structural transformations of the planet and life on it as species extinctions accelerate. It has become a touchstone for all sorts of debates (scientific, political, aesthetic, moral), not only about the origins of climate crisis, multiplying forms of environmental turbulence, and potential future courses of action, but also about the perennial problem of how to define human life vis-à-vis nature. Rosi Braidotti writes, "The Anthropocene entails not only the critique of species supremacy—the rule of Anthropos—but also the parameters that used to define it."[60]

Scholars writing in Marxist and postcolonial traditions have taken issue with the way the Anthropocene thesis casts humanity as a single, uniform agent. Dipesh Chakrabarty was one of the first to contest its flattening language, asking why climate crisis would be attributed to humanity in general instead of to rich nations, rich classes, or economic systems, while Andreas Malm and Alf Hornborg argued that climate crisis is "sociogenic" instead of anthropogenic. And a number of alternative appellations—Capitalocene, Plantationocene—have sought to bring various power relations into the frame.[61] These writers seek to apprehend the Anthropocene in its historical fullness, insisting on the inextricability of the making of the modern world by colonialism and capitalism and the reconfiguring of the Earth by climate change. They creatively hold standpoints from the Anthropocene and from Indigenous genocide, the slave plantation system, and European overdevelopment in concert, thinking "simultaneously through historical periods and geological epochs, in time scales of centuries and across multimillennial spans."[62] And they do so in full view of the philosophical distinction between natural and social history—common in the West by the seventeenth century, dominant by the nineteenth—having melted away.

This melting has demanded a methodological promiscuity of sorts. Climate breakdown has meant that tried-and-tested tools for making sense of modernity are both radically necessary and radically insufficient. Of his own awareness of this, Chakrabarty narrates, "As the crisis gathered momentum in the last few years, I realized that all my readings in theories of globalization, Marxist analysis of capital, subaltern studies, and postcolonial criticism over the last twenty-five years . . . had not really prepared me for making sense of this planetary conjuncture within which humanity finds itself today."[63] Perhaps it is the case that our current predicament obliges the generative integration of what Chakrabarty calls "the human-existential category of power and its

sociological-institutional correlates" with newer kinds of materialisms that are alert to a vast realm of nonhuman or posthuman activity, from the atmosphere that envelops our planet all the way down to the molecular activity of viruses like Zika.[64] Ian Baucom has recently taken up this project in his search for a method befitting both the history of racism and capitalism and the projected four-degree rise in global temperatures that climate breakdown portends. Working with Claude Lévi-Strauss, he argues that understanding life in the Anthropocene requires thinking both "beneath" and "above" history. In this approach, things like the functioning and firing of neurons ("beneath") and carbon cycles, orbital wobbles, and tectonic plate movements ("above") resolutely *are* history and must be taken seriously as such.[65]

What would it mean to go beneath history and approach the Zika virus itself genealogically, instead of accepting it as a transcendental object that maintains a constancy throughout history? Looking at something like a virus in this way is tricky: As Ian Hacking has noted of tuberculosis, "only the most irresponsibly playful of writers (plus some fools who ape the playful) would assert that TB bacilli, or their baleful effects on humans, came into existence in 1882 under the gaze of Wilhelm Koch.[66] His point is that tuberculosis has an existence that is at least partially independent of human interpretation. But while Zika certainly has a history that preexists its isolation and naming by colonial health officials, which I narrate in chapter 1, the virus does not course through history in a simple sameness. Instead it has changed (mutated), as have the mosquitoes that carry it. Zika's recent evolutionary history must be analyzed along with its domains of knowledge, politics, and culture. Doing so requires rethinking scale and resituating human life and politics in the incomprehensible reaches of geological and evolutionary time.

Reproduction Under Environmental Breakdown

I have learned much from these theorists of climate, and the persistent intercourse in their work between Earth history and world history, between planet-centered and human-centered thought, and between historical and new materialisms ("Materialisms I and II" in Baucom's formulation) informs the analysis to come. But I have been struck by their general lack of engagement with sex and gender and, both more specifically and more broadly, with human reproduction—including its history (is it social or natural?), its role in looming environmental crises of all kinds, and its value for imagining new worlds. Suspending for just a moment that immense world of reproduction that exists beyond human life, which I will get to shortly, applying Baucom's beneath/above approach to human reproduction already opens up some fasci-

nating lines of flight. Beneath history, you've got the twists and turns of reproductive cells in motion, including the ineluctably agentic egg, which despite its recurrent framing as a "damsel in distress, shielded only by her sacred garments" in biology textbooks, harnesses its inner vestments to draw in and trap the sperm.[67] You've also got the brutal parasitism of the fetus—itself replete with parasites—which, in Sophie Lewis's reading of recent scientific work on human gestation, is even more rapacious than the parasitism of nonhuman fetuses.[68] Above history—where Lévi-Strauss refers to "the general evolution of organized beings," and where Chakrabarty points to the fact that evolutionary chronologies "run through our bodies and lives" even as they flounder in aligning with our internal sense of time—you get into reproduction's central role in the constitution of the human species on Earth.[69]

Note that, in this sense, reproduction is one of the few areas in which, long before the recent casting of humanity as a geological agent in the naming of the Anthropocene, Western thinkers have considered human life as part of a deep history, as the history of evolutionary thought attests. (Race-thinking is another closely related area.[70]) Note also that thinking about this need not necessarily lead us down the stream of social Darwinist and eugenicist thought running through the modern reproductive imagination. The work of creative thinkers like Pyotr Kropotkin and Dorothy Dinnerstein speaks to anti-essentialist understandings of human nature across evolutionary time. Kropotkin, an early twentieth-century theorist of revolution and evolution, looked to the animal world to theorize the role of mutual aid, showing that life shaped by evolution was much more than a violent struggle for reproduction and much more complex than endless domination across generations. Dinnerstein, working as a psychoanalyst in the mid-twentieth century, suggested that while distinct gender roles in reproduction did arise from evolutionary forces pressing down on early human life, resulting in particularly constrained lives for birthing people, these roles are not written in stone. Nothing in evolution is. That's the point. There may indeed be deep evolutionary roots to the modern reproductive imagination's collapsing of reproduction onto people coded as women, but the fact remains that reproductive arrangements are emphatically mutable. Her view was not only that prescriptive gender roles in the human reproductive process have outgrown their adaptive function (and may, in fact, bring about the destruction of the human species), but also that a key aspect of humanity, developed across evolutionary time, was the capacity to tinker with and change modes of social organization—including how we do reproduction.

Where there has been engagement in the question of reproduction in the age of the Anthropocene, it has focused on the matter of population; that is,

the number of humans on a dying planet as that number bears on the dying. The history of this debate is much longer than the denomination of our new geological epoch, tracking along the development of the modern reproductive imagination across the twentieth century: In the period of ascendent eugenics, population linked the fertility of land with the fertility of women in questions of racial and national futures, while in the second half of the century, it was positioned as an exploding "bomb" that would overwhelm the planet.[71] But public discussion about human population bloomed anew as anthropogenic climate change became a matter of shared identification and concern in the opening decades of the twenty-first century. We hear, for instance, Prince William talking about "overpopulation in Africa" at a wildlife conservation event, we see the mainstreaming of the position that the best way to combat climate change is to have fewer children, and we record a new environmentalist frame for the bounteous aid money flowing from various sources to family planning programs to curtail reproduction in the Global South. Contravening commonplace complaints that any discussion of population is taboo, baby-making is consistently being cast as a central driver of climate change.

These examples should not be taken as evidence of an exhaustive global remonstrance against reproduction in the last two decades. At the same time as contraception and abortion are being newly scripted as solutions to global environmental problems, so too is access to them being newly restricted. The overturning of *Roe v. Wade* in the United States, the circulation of the "Great Replacement" thesis, Italy's recent declaration of a national emergency over its falling birth rate, and the instantiation of selective pronatalist policies from China to Iran to Hungary speak to the eminently variable landscape of reproduction in the Anthropocene as fascist sentiments simmer and surge. What *is* clear is that the politics of reproduction are changing as the Earth changes, and there is a flourishing discourse of human *non*reproduction that sees human reproduction as an expansive and transhistorical procreative drive that threatens nature, but one that can and should be interrupted through careful planning.

It's a premise that is increasingly being tested out in scholarly circles, too. Most famously, Donna Haraway's *Staying with the Trouble: Making Kin in the Chthulucene* (2016) set out the ambition of bringing human population, in a numerical sense, into the purview of left feminism: The projected "9 billion increase of human beings over 150 years," she argues, is "not just a number."[72] Despite my work being quite obviously influenced by her creative approach to science as "cultural practice and practical culture,"[73] I am one of the many who disagree with her proposed reinvention of population-thinking, taking

issue with the naming of a number and the banishment from the field of analysis of uneven landscapes of production, consumption, and state violence. In the intervening years that reinvention has been contested by those working in Black feminist and Indigenous feminist traditions, such as Ruha Benjamin and Kim Tallbear, as well as by Jade Sasser and many others whose examinations of family planning programs expose the "dehumanized 'thingness' of population."[74]

These tussles are far from being settled. In fact, the new shapes and faces of questions about human population might indicate a shift in assumptions about right and left politics or point to synergies between the liberal and the fascist. Such questions are alive in this book, where the Zika emergency reveals how the philosophy and management of population are shifting under emergent and uneven environmental pressures. For example, I show how reproductive interventions that preclude births are increasingly overlaid with climatic forces—which are never purely climatic—that displace people from their homes and homelands. The politics of population are not limited to the number of people on the planet or in a particular region, nor the population-thinking of family planning programs; they are also about the depopulating currents of climate change and the abandonment of social reproductive infrastructures. But crucially, I do not contain the scope of these questions to human population per se. It is a matter to which I return in the epilogue, but the intervening chapters take their time, en route, in unraveling the nexus of environment and reproduction from a range of other perspectives that both capture the present of environmental crisis and hint at its futures.

Vital to our discussion is this fact: The bond between reproduction and life has become unsteady under climate breakdown. The modern reproductive imagination focalized the giving or making of life, instantiating the idea that life could (and should) be controlled, shaped, or optimized at the site of the reproductive body, while recent technological advancements have further enhanced the capacity to optimize, squaring with both the medicalization of aging and the rise of elite health-based consumptive cultures seeking to extend life across the overdeveloped world. Already we have had cause to question this correspondence between reproduction and life, or at least to see it as something particular rather than universal: The underbelly of the dominant conception of women as progenitors of life in the modern reproductive imagination, after all, is the ascription to them of the potential for negative impact over life, and therefore, deaths of all kinds.[75] Yet something else is going on in environmental breakdown, a deeper transformation of reproduction whereby the weakening of life, and indeed even death itself, has become

a main feature. As Rebekah Sheldon has argued, extinction, exhaustion, and enervation mark contemporary reproductive politics as much as enhancement and extension do.[76]

There are three senses in which this devitalization of reproduction is so. First, just as signals of the Anthropocene in the form of chemicals or particles accrete in land, sea, and layers of the Earth, so too do they accrete in the human body, and it is their detection in the *reproductive* body that tends to sound a particularly loud alarm. The concern is not so much for the present contamination that this accretion exemplifies, but for the attenuated constitution of future human life it threatens. Mansfield shows that guidance for pregnant women on seafood consumption spatializes their bodies as the threshold between a wider polluted environment and future population health. In urging them to modulate fish consumption, such guidance reduces pollution, a problem that is both ubiquitous and uneven, to one of individual conduct, yoking a weakened future to the women's present actions.[77] How environmental contamination's connections to industrial practices are remapped as fully under the remit of women's choices requires explanation, which chapter 2 undertakes by examining chemical-based Zika management. Here, dovetailing with the "new emphasis on permeability and plasticity during fetal development" in the life sciences,[78] it is enough to say that the wayward particles of the Anthropocene increasingly scan as having the potential to enfeeble human life in and through reproductive processes.

Next, concern about the future of human life is enveloped in a reproductive redistribution, both documented and projected, in which some modes of reproducing and some species wither, while others proliferate. Here, the sixth mass extinction of the Anthropocene could be narrated as an overtaking of the sexual reproduction that defines the modern reproductive imagination by other ways of making more biological matter. "Large branches of the tree of life that produce unique genetic individuals through fixed modes of heterosexual reproduction" have been obliterated by humans; asexual reproduction and other forms of symbiont transmission, such as those practiced by the Zika virus, flourish.[79] If Baudrillard's argument that the asexual order of viruses enabled the higher order of sexual reproduction did at one point hold true, it appears that environmental upheaval has begun to suggest a reversal of sorts, in which nonsexual forms of reproduction—or, to revive the eighteenth-century term, *generation*—overtake the sexual as the dominant form. (The singular individuals produced through genetic recombination in sexual reproduction have actually always constituted a small percentage of life-forms on the planet, making this more of a threatened reapportionment

than a reversal, but the point stands.) It is also the case, as we shall see, that even within the realm of sexual reproduction there is a reapportionment unfolding: a "biological annihilation" of a great many species, including extinctions and general species declines, simultaneous with the expansion of a few, including those that adapt well to heat and are well integrated with modern human life, like raccoons, cockroaches, and mosquitoes.[80] As just one illustration, the *Los Angeles Times* has reported that hotter weather prolongs the reproductive seasons of rats and other rodents, growing their populations in sprawling metropolises and rendering the people there vulnerable to bubonic plague.[81] This is not a straightforward efflorescence of those species that have, in the words of the authors of one study, an "admittedly bad reputation": In fact, one-third of parasitic species, which play a fundamental role in all sorts of ecological webs, are predicted to go extinct by 2070.[82] However, in what Colin Carlson and his team describe as a global parasitic "redistribution," the reach and reproductive pathways of some undesirable species—like *Aedes*—have expanded dramatically.[83] Reproduction in the Anthropocene is asymmetric, with some life-forms becoming hyperfertile or reproducing too much, with unforeseeable consequences for human life.

Building on this (as well as returning to the matter of human population in a roundabout way), suggestions abound in our historical moment that the technoscientific optimization of human life for some now proceeds under the portent of the *end* of human life in the teeth of climate breakdown. Alongside the proliferating apocalyptic stories of human extinction in print and on screen, for example, it has become commonplace to suggest that a human reproductive crisis is on the horizon, on the basis of a documented dramatic drop in sperm concentration. The numbers are stark: A 2017 study found that sperm counts in the overdeveloped world had halved in the last forty years, while another in 2022 confirmed drops of a similar magnitude in Africa, Asia, and Central and South America.[84] One of the researchers, Shanna Swan, has published a full book on the matter, which is clear in its diagnosis of Anthropocene signals like plastics and pesticides as fundamental elements of a global fertility demise. GQ narrated her work through both vertical familial descent and species atrophy: "We are half as fertile as our grandfathers were. And if the trend continues, we may very well reach a point where the human race is unable to reproduce itself"; *Newsweek* reported that this fertility demise could "spell the end of humanity"; the BBC, that it "could make humans extinct."[85] A collective scientific and aesthetic imaginary has begun to solidify around an increasingly disobedient nature which, having been degraded and defiled by Anthropos, will settle the score in reproduction.

A Primer on the Anthropocene, Reproduction, and Zika

What are we to make of the unsettling of the covenant between reproduction and life in the Anthropocene, and of its planetary compendium of reproductive reshufflings? As a start into this question, let's consider some of the ways the Anthropocene, as both a material reality (oceans surging, mosquito populations expanding, winds becoming more powerful, temperatures ascending) and an idea, manifested in the Zika public health emergency. In the first instance, following Baucom's approach, this investigation means sitting inside nonhuman reproduction *as reproduction*. We are already partway there when we consider the epidemiological concept of "basic reproductive rate." At first glance, this is a technical formula in which the transmission coefficient of a viral agent (the average number of susceptible people that one case infects per unit of time) and the average length of time of infectiousness are multiplied in order to estimate the number of further cases of a virus to be generated by a single one. Stripped back, though, the concept reveals the number of human bodies in which a viral agent will replicate on the back of that agent already having replicated inside one human body (which also explains its historical antecedents at the nexus of concerns over population growth and the practice of immigration control).[86] That is to say, it captures infection as reproductive act and reproductive process.

Viruses like Zika are one of the most plentiful things on Earth and "fundamental players in the history of life."[87] They are defined by their need for the machinery of others (plants, animals, humans) to reproduce, reconfiguring their host organisms in the process. Zika's main mosquito carrier, *Aedes aegypti*, is also a reproductive protagonist in its own right, whose mode of sexual reproduction, so smoothly imbricated with urban human society, prompted *National Geographic* to affix the label of "the most dangerous nonhuman animal on the planet" onto its elegant striped abdomen.[88] These intricacies of viral replication and mosquito reproduction, thoroughly interleaved with those of human reproduction, are analyzed by various methods as historical, rather than assumed or backgrounded, across the chapters that follow. Here, it is their positioning in the turbulent worlds of climate change that is worth highlighting, and the point is twofold. The first concerns speed: The reproductive cycles of both are much faster than the unfolding of human lifetimes. This is especially the case for the virus: In what immunologists call the "generation gap," viruses reproduce a half million times faster than humans. Fast reproduction means dynamic viruses whose shape and capacity change at every turn. For example, it is now thought that the Zika emergency was set in motion by a single genetic mutation, which rendered the virus capa-

ble of changing the methylation of human genes engaged in fetal immune response and neural development.[89] Defining processes of the Anthropocene, such as deforestation and the replacement of diverse ecosystems with monocultures, have smoothed over and streamlined the reproductive progression through which a viral mutation could become a viral epidemic.[90] The second concerns heat, the influence of which contributes to speeding up and complexifying diffusion courses for new and mutated diseases and to the expansion of the geography of so-called tropical mosquitoes like *Aedes*. Mosquito reproduction pathways multiply—resulting in more "life-cycle completions" of *Aedes aegypti* per any given location—which means that the replication pathways for mosquito-borne viruses multiply.[91] In these senses, climate crisis has been pivotal to the larger range of *Aedes aegypti* mosquitoes and to Zika's transformation from a virus that was generally innocuous until the 2010s, into one that could shape fetal neurological and musculoskeletal matter on a large scale. Or, in simpler terms, global heating amplified viral and mosquito reproduction to the detriment of human reproduction.

Can these natural histories of reproductive life, both protracted and condensed, be interpreted together with human history, politics, and culture? Just as it is imperative not to view humanity as an "undifferentiated whole"[92] (despite there being something important and meaningful about universal humanity), not all viruses have historically registered as public health emergencies (despite the centrality of viral reproduction to all other life-forms, including all human life). One reason Zika, as well as H1N1, Ebola, and COVID-19, did register as emergencies is that that they threatened to jump geography and cast risks beyond the borders of the areas where they first mutated or jumped species. Bruce Braun importantly argues that the contemporary politics of health is defined not only by the cultures of individual genetic risk management and optimization, such as through the moneyed reproductive decision-making I discussed earlier, but also by the risks people in privileged social locations feel in connection to a global field of microbial chaos. Imaginations of this chaos—long assumed to emanate from outside the overdeveloped world or to be attached to certain racial groups within it—have intensified amid what Alan Ingram calls the "radical dissolution of epidemiological space" in the twenty-first century.[93] "For every story in the US media that speaks breathlessly of advances in stem cell research and gene therapy, or that worries over the 'post-human' futures these might usher into being," Braun writes, "we find two or three other stories that speak ominously of migrating birds and backyard chickens, and that mix together Vietnamese peas-

ants, influenza viruses and homeland security."[94] A similar argument can be made about reproduction in the Anthropocene more generally, for the global, racialized field of microbial chaos invoked here was also taken as a global field of errant nonhuman reproduction.

Such divisive biosecurity imaginations were evident in science and media reporting on Zika. Early in 2016, in an influential piece in the *New England Journal of Medicine*, Anthony Fauci and David Morens mapped "the explosive pandemic of Zika virus infection occurring throughout South America, Central America, and the Caribbean" as "potentially threatening the United States."[95] When active Zika transmission was first reported in Florida, reporting focused on microcephaly as a shocking potential outcome for children in the United States that was made possible by a mosquito and a virus which had no place there. Discussions about the permeability of borders and aggregate financial speculation were churned up with those on expanding mosquito populations, the winds and rains of tropical climates goading on their reproduction, the sexual practices of people in Brazilian favelas, and the precarious procreative futures of North American honeymooners. In this mix, one image reigned: the underdeveloped craniums of children born with microcephaly, those Zika babies there threatening the child here. "When I saw the first picture of a baby with microcephaly, I burst into tears. It seemed so far away in the jungle, and then it was in my backyard," one pregnant woman stated in a long-form piece in the *Miami Herald*.[96] Reproduction in the overdeveloped world was perceived to be under threat from the over-reproduction of viral and mosquito forms in the tropical world—and in its racialized human forms, as I have already begun to explain. Across the months that followed, the possible futures of fetuses and children were positioned in antagonistic relation to one another in health and in wealth. Practically speaking, women and girls were understood, and intervened in, as if their bodies were thresholds between present circulations of Zika and economic futures. They were called upon to behave responsibly in sexual relations and in relations with mosquitoes in order not to become host organisms for Zika, and when perceived to fail, their bodies were obtruded in in all sorts of ways. Creative technical intercessions into mosquito sex expounded on these dynamics. The nonhuman reproductive politics of climate change return us, perhaps paradoxically, to the uneven *human* geographies of race, empire, and patriarchy, to a picture, riffing on Matt Sparke and Dimitar Anguelov, of inequality of reproductive incrimination and intervention amid a broad reproductive interdependency.[97] This is what all the chapters of this book explore in their own way.

Zika Cultures and Interventions

I must be clear that in narrating the explorations to follow, I do not aim to supply any concrete or practical solutions to Zika. The book makes use of the movement and transformation of the virus to critically reflect but proposes nothing by way of swiftness. While it draws on my reflections from four months in the Caribbean, it is not an ethnography. Instead, it is a philosophical proposition and a history of Zika, though neither an exhaustive nor a chronological one. (The chapters' respective forays into the philosophy and politics of reproduction do, however, build sequentially.) It is both documentarian and imaginative: documentarian, in that I show how various twenty-first-century styles of reproductive intervention work and point to their dehumanizing features and synergies with fascist thought; imaginative, in that I reach toward new understandings of reproduction.

Chapter 1 describes the making of Zika into a public health emergency, beginning with the identification of the virus in East Africa in the mid-twentieth century and following it to the first outbreak in the Pacific Islands in the twenty-first, before delving into popular and medical culture in the United States as the number of cases in South and Central America and the Caribbean grew. It shows how Zika was constructed as a threat to love, sex, and the human species, both through the capacity of the virus and virus-bearing mosquitoes to malform babies as well as through the lexicon of cost. Constructing the emergency in this way, with tropical nature as an amorphous source of danger and microcephaly as a tragic and costly outcome, public and medical culture set the scene for the reproductive interventions that are examined in the following three chapters. I argue that not one but two future child archetypes starred in the story of Zika, and they were constituted by racial and geographical location. One child, who was synonymous with the future amid environmental change, required protection from Zika, while the other, the Zika baby, was a figure of fear about degeneracy. The healthcare costs that would accrue to the latter child were seen to compromise the future of the former. The chapter thus begins to chart an emergent biopolitics which, embedded in and invigorated by ecological uncertainty, pits the possible futures of fetuses against one another.

The next part of the book proceeds with the contention that the necessarily planetary nature of questions about the politics and ethics of reproduction today can only be taken on through the specific historical experiences of the colony or postcolony. Here, I explore how Zika protocol actually worked in Puerto Rico, a Caribbean island with high levels of active viral transmission

during the emergency and one of the world's most climate-vulnerable areas based on peak streamflow estimates from hurricanes.[98] As Jamaican physicist Michael Taylor has argued, the data point to "the climate of the Caribbean region . . . already changing in ways that seem to signal the emergence of a new climate regime."[99] Moreover, to be located in the "Atlantic Hurricane Basin" is also to be located in the Black Atlantic, where life and landscape bear the marks of genocide and plantation slavery.[100] The increased incidence and intensity of extreme weather in the Caribbean, exemplified by the force of Hurricane Maria in 2017, is one example of the life-destroying nature of anthropogenic climate change tracking along the same map as the life-destroying nature of European colonialism, making its inhabitants perhaps some of "the first truly 'Anthropocene' people—the avatars of a fully globe-encompassing climate-changed world to come."[101] Puerto Rico's unique and more recent history as an "unincorporated territory" (read: colony) of the United States added an additional dynamic to the apprehension of the reproductive cycles of mosquitoes and the reproductive rates of the virus as they intersected with female reproductivity in financial and state surveillance terms. The archipelago's tropical position led to predictions that a significant proportion of the population would contract Zika by the end of 2016;[102] its geopolitical mapping meant abundant circulations of people between the Caribbean and United States, unfettered by border control. The former entailed heat and *Aedes aegypti*; the latter revolved around US citizenship rights, including various means of impacting US economic and health futures. These geographies overlapped in designating the reproductive conduct of Puerto Rican women and girls as risky and costly in public health expertise, focalizing their bodies as the principal point of intervention in public health practice, and speculatively linking those interventions to the financialized US child.

I look at two Zika intervention techniques in particular: synthetic chemicals used to obliterate mosquito reproduction and contraceptive devices for implantation inside people's bodies. These approaches appeared officially in scientific reports, intervention plans, and lawsuits, and unofficially in the crossing out and amendments of text in public health notices by passersby, speculations about covert fumigations uttered over the radio, women's nods on social media to having been refused the removal of contraceptives, and the persistent injunction for girls to wear insect repellent "like perfume." Puerto Rican women and girls were positioned as the bodily threshold between the hyperfertile emergency and the deserving and undeserving children of the future: inside the United States in terms of future reproductive risk but outside the United States in terms of reproductive and political rights.

Chapter 2 looks at US government chemical-based mosquito control at the scales of the sexed body, the home, and the island. When Puerto Rican women were perceived to fail in properly maintaining the separation of their bodies and homes from mosquito reproduction, aerial chemical fumigation was threatened in an aggressive display of US sovereign power. Resistance to aerial chemical fumigation, however, offers clues for resituating human reproduction in the material world, as well as for approaching the multiple temporalities of the Anthropocene's "chemical signatures."[103] This chapter continues along the track of peeling away at the normative biomedical scope of reproductive health to develop a conceptualization of reproduction as a system that is viral, animal, and chemical. In doing so, it critically shows that this system is structured by, and constitutive of, various human historical hierarchies.

Chapter 3 examines the mass distribution of contraceptive implants in Puerto Rico during the Zika emergency as an expression of modernity's long-standing translation of human life into speculative economic value that is ramping up in the twenty-first century. The Zika Contraceptive Access Network (Z-CAN), a public-private partnership, sought to equip women with long-acting reversible contraceptives (LARCs) like the intrauterine device (IUD) as a cost-effective way to avert the costs of microcephaly. The program importantly provided people with a contraceptive method of their choice for free but, as I show, came at the cost of reproductive autonomy in unexpected ways. Z-CAN worked by cleaving off the reproductive body (the body involved in what Sophie Lewis calls "gestational labor"[104]) from the body that sustains the more general reproduction of human life. This cleaving must be understood in the context of both Hurricane Maria and austerity. The chapter further articulates the pitfalls of centering the uterus as the singular site of life-making or life-precluding, marking out a path for thought and politics away from the reduction of reproductive women's lives to the children they may or may not have and away from the conversion of would-be children to economic value.

Because this part of the book concentrates on reproductive management as organized and orchestrated by the US government, transnational pharmaceutical firms, and philanthropic organizations, it does leave out much. It only dips a toe, for example, into the ways Puerto Rican government agencies attended to the dangers of the virus, and because it spotlights the way Zika interventions grouped women and girls into a reproductive mass, it runs the risk of flattening the differences of experience among them. But this is, at least in part, the point: I am interested in exploring the production of reproductive masses; I am trying to document and analyze the conversion of life into

reproductive objects to be managed as a response to environmental uncertainty. How Zika and fertility in Puerto Rico were apprehended by states and organizations has much to teach us about the changing shape of reproductive governance under climate breakdown. Furthermore, the tracking of the consequences of those changes along historical lines that predate the denomination of the Anthropocene and the responses of ordinary people to them suggest some creative ways of thinking about and doing reproduction differently.

Shifting the approach, chapter 4 moves to Brazil to discuss three genetic engineering projects funded by the BMGF that were proposed or carried out in the effort to reduce Zika's reproduction rate and avert the outcome of microcephaly. Here we return to Oxitec's *Aedes do Bem*™, those genetically modified mosquitoes whose unleashing in a normal neighborhood opened this introduction. The chapter examines this project's love stories in detail along with two others that programmed *Aedes aegypti* reproduction for death instead of life: one that infected *Aedes aegypti* with a bacterium that transforms the reproductive capabilities of its host organisms, and another that used gene drive technology to push a genetic change throughout a population of *Aedes aegypti* as it reproduces. I consider the possibility that experiments like these, which "play" with reproduction, can aid in dismantling the modern reproductive imagination: Modified mosquitoes certainly exemplify the mutability of the reproductive process as well as our understandings of it. However, in contravening the contingencies of sexual reproduction by compelling a certain gene to be passed along, and in courting the idea of deliberate species extinction in the middle of the sixth mass extinction, these projects rehabilitate the early twentieth-century racial thought that sits at the center of the modern reproductive imagination and elaborate on, via the unsuspecting medium of the insect genome, the eugenic dynamics I have been tracking throughout.

These are all preliminary sketches, of course. But it bears repeating that my motivation for writing this book is as much due to the *implications* of reproductive thought for the most pressing questions facing humanity today as to the prospect of changing the mechanics of reproduction itself. I pick up this point again in the epilogue, which is not to be missed. Reproduction, as Murphy argues, does not "stop" at pregnancy and childbirth and early childcare; it does not "stop" at the "larger structural conditions" that enfold those embodied human experiences, nor at the "smaller micrological entities" inside the body, like recombined DNA and doubling cells, that make them possible.[105] It is, instead, about the making-more of living matter, comprising a profuse and proliferative network of relations reaching far beyond the edges of the sexed human body. I am arguing for its relevance to wider questions

about what it means to be people living among other people and people living among other beings. This requires understanding how the politics of reproduction is changing under the diverse planet-centered and human-centered pressures of our time. And the story of the Zika emergency provides us with an abundance of leads.