Medical Anthropology Quarterly

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Living Waste and the Labor of Toxic Health on American Factory Farms

In the 1930s, erosion caused storms of dust to hurtle across the American Great Plains and Midwest. While agricultural conservation methods helped remediate this landscape, recent studies suggest the region is contending with a new type of particle cloud: desiccated fecal dust that renders the vitalities of factory farms airborne, potentially exposing those in their surrounds to various forms of illness while spreading antibiotic resistance genes. Thinking alongside these findings, and based on research within corporate hog farms, this article develops an ethnography of excrement by tracing the practices and knowledge of people who live and labor in proximity to late industrial lifeforms, such as confined pigs and resistance genes, and who are tasked with intimately shaping this unruly waste that has the potential to affect broader populations. In so doing, it analyzes the maintenance of American animals' toxic health alongside the politics of labor with complex anthropogenic materials. [animals, labor, toxicity, interspecies health, United States]

Living Dust

In the 1930s, erosion from a combination of drought and agricultural intensification caused massive clouds of fine black dust to hurtle across the North American Great Plains and Midwest. These "black blizzards" that appeared during the Dust Bowl snuffed out crops and displaced early waves of settler farmers, leaving in their path a shifting surface of friable, dead soil piled onto fields. Agricultural conservation methods along with the tapping of groundwaters helped keep the earth relatively moist and stable over the second half of the 20th century (Ashworth 2007). At least, that is, to the point where the enduring grittiness of the air recedes as ambient noise that is largely imperceptible, except for on windy days.

This is an environment, following Timothy Choy and Jerry Zee (2015, 214), where divisions between solid ground and gaseous air are tenuous. It is a region where "the earth is revealed as a mass of latent particulates, ready to distribute into the atmosphere," and return to the surface in a cycle of phase shifts. And over the past two decades, the composition of this volatile earth has been changing. The Great Plains and the Midwest, arching from Texas to Minnesota, has become what some locals call "the red meat capital of the world." In the 100-mile radius

MEDICAL ANTHROPOLOGY QUARTERLY, Vol. 33, Issue 1, pp. 80–100, ISSN 0745-5194, online ISSN 1548-1387. DOI: 10.1111/maq.12491

Figure 1. Manure Lagoon (Photograph by Sean Sprague). [This figure appears in color in the online issue]

pocket of this region where I conducted 27 months of ethnographic research, a series of corporations now birth, raise, and kill 7,000,000 hogs each year alongside a plethora of cows in feedlots.[1] One result of this concentrated animal life is a landscape that, when seen from a small plane, is cratered with deep pits the size of football fields. These hundreds of purple-hued open-air manure "lagoons" contain more semi-treated waste than is generated by 50 million people (see Figure 1). This small region pools more excrement than is annually made by the human population of California (FWW 2015, 12).

Moreover, microbiological researchers are discovering evidence that excrement may change the very vitality of the air. By collecting air samples twenty yards downwind from confined cattle feeding facilities, in a different but climactically similar region of the United States, these scientists are illuminating how sharp winds scour terrain and transport desiccated excrement and animal feed dust (McEachran et al. 2015; see also Gibbs et al. 2006). They have further found that this airborne particulate matter contains unmetabolized traces of multiple antibiotics, such as oxytetracycline and monensin, along with bacteria and genes encoding antibiotic resistance. Some 80% of all antibiotics sold in the United States in 2013 were intended for non-human animals (Maron et al. 2013), much of them functioning in practice as growth promotants administered via oral doses in feed to help animals quickly and consistently add weight despite tightly-packed living conditions (Finlay 2004; Kirchhelle 2018). In turn, these researchers believe larger particulate grades of living dust ($>10\ \mu$m) are settling adjacent to animal facilities while smaller PM10 dust is being deposited into nearby fields, streams, and homes at least 3.5 km away, potentially transforming regional microbial ecologies through horizontal gene transfer. They further suspect that the finest of these particles are swept up into dust storms, which could blow drugs, antibiotic resistant bacteria, and mobile genetic elements over cross-continental air currents (McEachran et al. 2015, 341). If true, these genetic winds may be yet another contributor to what Hannah Landecker (2016) calls the changing pan-species "biology of history" of anthropogenic antibiotic resistance.

Beyond the predictable expressions of disgust, these studies of aerosolized excrement garnered media attention because they suggest a novel route—beyond residues in meat, or manure runoff into groundwater—by which anthropogenic genes encoding antibiotic resistance can escape farm sites (Philpott 2015). This dust contains tetracycline-resistant gene sequences at a higher rate than is normally found in beef cattle manure lagoons. One concern is that some of these genes then have the potential to spread across bacterial species in the environment, including clinically relevant pathogenic microorganisms, and make human illnesses harder to treat (see Silbergeld et al. 2008). Granted, it is unclear what happens to the particles' cargo during transport: how antibiotics degrade in the atmosphere or whether bacteria survive solar radiation, for instance, and what happens when they settle back to earth (Berendonk et al. 2015; McEachran et al. 2015, 341).[2] There are also open questions about how distinct animal housing systems circulate excrement. The initial findings are based on open-air beef cattle feedlots, where the authors believe that feces and urine desiccate in the sun and are suspended into wind by cows' stomping hooves—leading to a density of airborne antibiotics twenty yards away similar to that found inside swine barns. But these studies also jolted my memories of the haze of that indoor hog production, which can be more porous than it appears (see Blanchette 2015; Gibbs et al. 2006). Reading them recalled sights of barn air thick with powder, mechanical exhaust fans propelling out plumes of dust, mists forming over sun-scorched fields fertilized with liquid manure, and—to get to this article's central focus—the various forms of excrement filmed on workers' skin.

I write this article as neither a microbiologist nor an expert in particulate dispersal. I am more familiar with varied forms of hog excrement than I am with cow waste, and my project is not to contribute new findings that can help clarify these uncertainties. Indeed, this article is only partially about antimicrobial resistance itself. Instead, I invoke the figure of living waste for two reasons: This unruly excrement suggests new ways of imagining industrial animals' state of health, and it points to how the nature of farm work and the politics of occupational health may be shifting alongside hogs' bodily conditions. First, this microbe-altering dust reflects how capitalist excrement is becoming an increasingly abject and complex substance over time. We will see that dust and other forms of fugitive waste becomes legible as a curious kind of pollutant that does not merely settle onto the surfaces of biological bodies so much as it merges with and passes through them (see also Murphy 2017). Moreover, antibiotic resistance genes are a contaminant, unlike some chemicals, whose environmental concentration does not necessarily diminish over time through degradation or sorption but are instead "capable of persisting and even spreading in the environment"; genes carried by "bacterial contaminants can multiply in their hosts, be passed on to other bacterial populations and be subject to further evolution" (Berendonk et al. 2015, 310). Industrial animal diets, bodily states, and health statuses start to become legible as a pollution source; the studies above suggest how the rapid and uniform capitalist growth of animals is becoming akin to an industrial emission that can aerosolize, accumulate, and reshape local and distant environments. Even so, non-metabolized drugs and antibiotic resistance genes are the tip of the iceberg in terms of modern excrement's unruly attributes. They are joined by a host of other properties that, while benign or even valued in some agricultural contexts, can be harmful to human and nonhuman beings when highly concentrated: nitrates, phosphorous, ammonia, hydrogen sulfide, methane, heavy metals, endotoxin, and various pathogens.

Second, this article follows some of these properties to unpack the technics and labor that are being compounded into contemporary excrement and, conversely, trace how this substance congeals new kinds of workers and industrial infrastructures as it overwhelms previous ways of being. What I do know well—and what is noted only in passing in the studies above, which quickly scale from cow stomps to continental wind currents—is how animal excrement is the product of expanding processes of labor. Farm workers are being made to reshape the materiality of animal excrement in terms of both its pharmaceutical contents and its state of relative liquidity or desiccation, and these tasks may affect how and where potentially harmful exposures are channeled. I call this waste "living," then, not only because of its biological contents, but also because of how it is animated in farmworkers' bodies and actions. This article thus argues that the microscopic chemical and biological agencies of modern excrement are partly mediated by the molar movements of workers who are made to shape excrement's contents and forms and, in turn, whose laboring bodies become shaped by waste in ways that are both physical and political.

As such, the status of the laboring human body is inseparable from how it is infused by the changing properties of modern animal waste and the concurrent demands placed on pigs' bodies to become ever-more prolific. At root, this article proposes methods for thinking about the politics of occupational health in a world of increasingly complex capitalist substances, developing ways of analyzing the "anthropos" in anthropogenic materials. This approach should be a familiar one to medical anthropology. Inspired by scholars of chemical toxicity (e.g., Agard-Jones 2015; Chen 2011; Guthman 2011; Roberts 2017; Shapiro 2015), I follow how racial capitalism brings poor white rural residents and migrant workers of color into disproportionate degrees of porous contact with potentially harmful things such as endotoxin or methicillin-resistant Staphylococcus aureus—which, in turn, can make racial and class hierarchy become embodied anew (see Pulido 2016). But this article's closing and ultimate aim is to describe uneven body burdens amidst precarious ecologies in a distinct guise from that of sheer physical harm. Public health practitioners have conducted groundbreaking research that reveals some effects of industrial fecal waste on workers' and neighbors' lungs, immune systems, and mental well-being (Donham 2000; Heederik et al. 2007). But they have not explicitly considered how these complex materials change the (political) nature of work itself. What is needed here is the development of questions concerning how large-scale industrial projects are investing poorly remunerated and allegedly "deskilled" jobs with capacities and powers to affect the life and health of both local and distant populations. Not only does this complicate traditional subject/object dyads of labor studies—the sense that the nonhuman world is passive and inert stuff awaiting human transformation—it requires us to think about laboring exploitation and excess in ways beyond standard analytics such as surplus value.

The pages that follow develop an ethnography of late industrial animal excrement, re-thinking the state of American farm labor through waste. They trace the kinds of ecological consciousness that fugitive waste spawns, its concentration in some places and bodies, the rising complexity of its contents, and the forms of work and specialized knowledge required to keep excrement from harming hogs or other beings invested with value. Aligned with recent calls to pay more attention to the matter of materiality (Choy and Zee 2015), I offer three ethnographically derived vantage points from which to inhabit the labor of hog excrement: as an unavoidable environmental *context*, as a substance with shifting *contents*, and as a series of distinct material *forms*. The first section details how residents who live downwind of factory farms narrate the liveliness of these aerosolized biologies, long before they appeared in microbiological studies. I then give a brief history of late industrial excrement, articulating how economic demands on pigs' bodies alter the contents and quantities of their waste. Third, examining new kinds of fecal workers, I detail examples of how people are made to biopolitically protect industrial pigs—legally and biologically—in ways that can have the effect of augmenting other kinds of exposure to industrial waste.

Living in Fecal Contexts: The Dover Bubble

In 2009, a local newspaper ran a report titled, "Experts Say Dover Bubble Not Real." An acquaintance named James Hodgkins introduced me to the story, keeping a copy on his dining table. The writer enlisted meteorologists to discredit a popular belief that rain clouds were diverting in a circle around the operations of Dover Foods—one of the world's largest pork corporations, which annually raises some 5,000,000 hogs. Many residents believed Dover's operations result in droughts that require additional irrigation and affect cattle ranchers by desiccating pastures. While a few meteorologists claimed that there were no statistically significant changes to regional rainfall since Dover Foods' slaughterhouse opened, others insisted they must be mistaken. For one middle-aged male bartender, it was some "chemicals from those pig factories (slaughterhouses) out there," that were interacting with rain clouds around the slaughterhouse, causing the moisture to dissipate. For James, it was the evaporation of "all that pig shit" in terms of the "methane gas, ammonia, and everything"—from the roughly 300 manure pits next to the company's 1,200 separate hog barns—that resulted in an understudied form of air pollution that "screws the clouds up," and can lead to biospheric reordering for all the other forms of life that exist within this Dover Bubble.

I invoke this idea of the Dover Bubble for two reasons. The first is that, meteorologists' statistics aside, it does reflect something very real for people like James Hodgkins who grew up in an agricultural community. Manure, whose nutrients once made it a cherished substance for fertilizing crops and nurturing agrarian life, is no longer the same thing that it was for centuries (see also Schneider 2015). Moreover, this local "myth" is one that draws attention to the factory farm's effects over the entirety of a regional atmosphere—the Dover Bubble gives people like James new ways and vocabularies for interpreting real changes to their rural surroundings. The Dover Bubble figures excrement on the Great Plains as an overriding context: an atmospheric medium that holds all other beings in suspension (Choy and Zee 2015; Lowe 2010). Above all, it is a commentary on imbalance in the setting of an agricultural economy, one where porcine nature is produced on such a massive scale—and located indoors, ostensibly capable of independent existence from the local environment—that it depletes the life-giving rain required for more traditional forms of agriculture including corn and pasture-based beef cattle. The Dover Bubble frames the region as a water-parched dead zone, one paradoxically decimated by the overproduction of porcine life.

The second reason that I find this Dover Bubble striking is that it represents a regional sensitivity to living with industrial excrement, an attention to how fecal matter manifests in this more arid climate. The Dover Bubble emphasizes that excrement is not the same substance across the United States—hog waste is materially different, and its risks are distinct, in dry Nebraska versus humid North Carolina. While there is no shortage of activist and scientific concern over airborne pollutants, the threat of industrial excrement has been conceptually formatted, at least in the United States, through something of a relatively more liquid or fluvial bias. It is primarily regulated under the Clean Water Act. Its many ecological devastations are most thoroughly documented in the form of fertilizer run-off causing dead zones in the Gulf of Mexico, and as phosphorous and nitrogen causes oxygen-depleting eutrophication and algal blooms in surface waters rainy North Carolina (FWW 2015). There, the world's largest pork corporation, Smithfield Foods, has been engaged in decades of "accidentally" killing large quantities of aquatic life when storms cause lagoon overflows. Moreover, two-thirds of 36 sampled manure lagoons in that state also exhibited evidence of leaching into groundwaters (Spellman and Whiting 2007, 230). For this reason, a great deal of agricultural science is dedicated to keeping pig waste dry and immobile, leaving it to rest in shallow soils rather than flowing into streams or seeping underground.

Yet, animal manure also generates between 50 and 85% of the United States' airborne ammonia emissions, which contributes to the acidification of soil and water (Spellman and Whiting 2007). Forms of agricultural exceptions—ostensibly in place to protect small family farms—have blocked many nuisance suits by neighbors over stench,[3] and, until a court order in 2017, made most animal facilities exempt from reporting airborne emissions despite manure's release of substances otherwise regulated under the Clean Air Act such as hydrogen sulfide, methane, and nitrous oxide (Heller et al. 2017). In 2018, the U.S. Congress passed the FARM Act, which again exempted most reporting (Erickson 2018). Perhaps due to the relative lack of official consequence and state regulatory concern with airborne waste, Dover Foods managers with whom I studied insisted that the region was ideal for managing large populations of pigs because the arid atmosphere was so dry. I did not bat an eye when they told me that they had to empty their lagoons via field spraying less frequently than companies in other places. It all just evaporates. Everyone said the same thing: This is a perfect place to raise pigs. They suggested that all this waste, and the residues of hog life on the landscape, was cleanly scrubbed by the air. The Dover Bubble, in part, marks an insistence that this is not true. It depicts a unique place enveloped apart from others, a sort of digestive ecology infused with waste, where fecal chemicals cause divergence from predictable natural laws.

James was a retired farmer when we first met in 2010, and even before I had read of fecal dust storms I was struck by his strong-willed efforts to give solidity and materiality to the air that he had been breathing for almost two decades. He spent many of his waking hours sipping Cokes and staring at the 10 barns across the road, adjoined by two manure lagoons. He mused about how he had never seen anything unusual happen over there as he watched. Workers' vehicles would arrive in the morning, trucks would show up to load hogs, and then everyone would leave for the day. The laboring routine was almost too normal and regular, a stark contrast to how he saw traces of human and hog activity in those barns radiating out in the form of strange features on his property. James would not be surprised by studies of living dust that suggest alternative local biologies are forming along wind currents. Hog excrement infuses biological species in unpredictable ways.

James passed me a copy of a letter that he sent to Dover Foods a few years previously, detailing how fecal vapors are debilitating his asthmatic wife. She was tied to a respirator, bed-ridden, during my visit to their home. He recounted how lagoons changed the place where he lived for 80 years. "I've seen about all of it. From the dirty thirties to the days of Dover. Ten thousand five hundred and sixty hogs in there," he tells me as we stare over the horizon at shimmering manure pits and the gleaming metal sheds. In his younger days as a farmer, James welcomed the blooming effervescence as the season changes from winter to spring, and brings with it another year's crop. Yet, this temperature shift now heats up the liquid of lagoons, resulting in waves of smell that take on a fog-like materiality. Rain, once prized, now brings with it the need to seal windows once the surfaces of manure pits are disturbed.

The wind, blowing furiously across the flat landscape, used to be a burden since it silenced outdoor voices and flung trash across yards. But now James encounters a welcome pounding gust that keeps air moving quickly, and what he called "the wind": a slow-moving breeze from the west that drowns his property in thick clouds of odor. He struggled to describe this invisible stench, describing a tactility to the air that "just makes tears run out of your eyes." It permeates his house to the point where "you can have your head stuck in a plastic bag and you could still smell it," a deathly substance "that you could cut with a stick it [gets] so thick out there ... it just makes you want to quit breathing." Pushing back against air's alleged immateriality, he was trying to communicate how corporations' olfactory compounds are physically intruding on his private space. Even more so, in telling of how he can no longer host barbecues or welcome family gatherings on his property, his words suggest how his very social rhythms were now reoriented in relation to hog waste.

The olfactory intensity of excrement vapors at least is expected.[4] But it is the more inexplicable things that preoccupied James in our discussion. He says that he sees more jackrabbits scuttling about his property these days, in a muted reference to the thousands of critters running from storms of black soot during the 1930s. And he points to an orange fly swatter with a quarter-sized black substance smashed onto it, discussing the mystery of what he calls the Dover Flies that swarm his porch.

> Flies. I've spent hundreds of dollars on big old cans of real powerful dairy barn spray. Because they'll just coat the inside of that [the patio] to get out of the sun. . . . And it'll keep them away for two or three hours. And then they'll come floating back. And I know they're *Dover Flies* because there's not anything out here that produces that many flies. They grow big flies. Your thumbnail, you couldn't see [it] if you had one land on it. . . . The freeze don't help at all. Maximum so far: it was minus 1.3 [degrees fahrenheit] and we still had flies. You just can't kill them! Naturally it used to be that when the weather got cold, they'd die. You never used to get flies in the winter time.

You just can't kill them! The factory farm's manure in-fills these Dover Flies with a super-charged vitality impervious to seasonality, weather, and the natural cyclicity of death. They are something of a post-agricultural form of being, external to the seasons. For James, these Dover Flies have mutated by taking on facets of industrial confinement into their very bodies, surviving as if they are indoors in the middle of winter. They are figures of how the industrial pig's toxic health unpredictably leaches across species—describing an airborne ecology of excrement that is supported by studies that propose insects as vectors of antibiotic resistance, finding genes from lagoons in their intestinal tracts (Zurek and Ghosh 2014). James's point is that waste does not just melt into air. It becomes atmospheric, such that it is difficult for any being downwind from barns to *not* be exposed. This is a manifestation of animality so infused through a region that everything in this place, from seasonal rhythms to insects' lifecycles, is undergoing a slow process of transformation alongside pigs' eating and digestion. People who live in towns away from fecal wind currents chide James as melodramatic, responding with a phrase that denies the mutational toxicity of excrement and insists this is still the natural manure underpinning rural communities for centuries: "It's pig poop, not plutonium."

Yet, in retrospect, James's interpretation of how feces saturate a place is resonant with living dust and the logic of horizontal gene transfer. Enlivening histories of knowledge that emerged from efforts to control microbial life, Hannah Landecker (2016, 32) illustrates how the global rise of antibiotic resistance has led to the scientific realization that the bacterial world is not reducible to a collection of discrete species. It is instead more akin to a connected multicellular organism that is constantly chattering and exchanging genes within single generations, and one that records a kind of archival history of prior antibiotic treatment events within mobile genetic elements such as plasmids.

As opposed to notions of vertical inheritance within bounded individuals or species—a view of life as a series of separate organismal containers—antibiotic treatment and resistance illustrates porosity, or how an organism's "bodily condition bleeds into the environmental condition" (Landecker 2016, 20). Resistant bacteria, mobile genetic elements carrying resistance traits, or antibiotic residues pass from treated bodies to radiate through surrounding microbial communities. They then appear off-target in untreated bodies and even in proximate material forms like hospital sinks. This, in any case, helps clarify what James was expressing: a landscape that increasingly reflects porcine bodily states, one that is pulsating with the residues of heavily worked hogs. It also gives a striking glance at anthropogenic activity itself if we consider excrement to be (in part) a product of labor. For this is a form of work that keeps on working—the effects of laboring actions in barns and feed mills continue to ripple through an ecology, long after they directly engage pigs. Labor may mediate the contents and movement of waste, but feces' properties take hold of workers by extending their actions' spatial and temporal reach.

Making Fecal Content: A Compounding History of Late Industrial Excrement

The agrarian philosopher Wendell Berry (2010, 47) starkly frames the pivotal moment that enabled the rise of fecal environments. He writes:

> [O]nce plants and animals were raised together on the same farm—which therefore neither produced unmanageable surpluses of manure, to be wasted and to pollute the water supply, nor depended on such quantities of commercial fertilizer. The genius of American farm experts is very well demonstrated here: they can take a solution and divide it neatly into two problems.

Plants and animals on a plot of land formerly acted as arbiters to each other's growth: The size of the pig herd was conditioned by the available crops they could consume, and the crops planted were partly tied to the quantities of manure for fertilizer. As animal and vegetal life forms came unbound during corporate consolidation starting in the 1940s—which was itself tied to the rise of medicated feeds, sciences of bodily growth, and the use of animal diets as sinks for industrial waste products (see Finlay 2004; Landecker N.d.)—and intensifying through the late 1980s, dramatic changes ensued. Pigs were confined indoors, requiring scientists to relearn the micronutrient requirements of swine once they did not supplement their diets by rooting in soils. The need to return investments on buildings and automation technologies led the quantities of American hogs raised and killed to soar, outstripping demand. Prices, in turn, collapsed in the 1990s and bankrupted a large swathe of the remaining independent farmers (Key and McBride 2007). Profit margins often remain miniscule. Unlike in typical industrial operations, where the primary cost is labor, feed can account for some 70% of input costs. This puts pressure on swine nutrition science to find ways to create more growth using cheaper ingredients, while necessitating new specialists who work on pig digestion and metabolism. Simply put, it means excrement became newly subject to processes of labor and production.

A company the size of Dover Foods—one that raises and kills 5,000,000 hogs per year—might employ roughly 1,000 people in slaughterhouses, and 1,000 workers in breeding and growing barns. But another 500 people work in what is classed as "support" functions, such as trucking or human resources. Many of those 500 support workers are based in feed mills, commodities buying offices, or lagoon maintenance roles that interact, in some way, with hog eating and excretion. Most social scientific and historical research focuses on how genetic breeding or mechanized slaughter technology underlies the intensification of animal agriculture. Yet, as Landecker (N.d.)argues in a forthcoming historical analysis of the industrialization of animal metabolism and microbial biochemistry, along with the early medicated feed sciences that led to the inclusion of antibiotics in pigs' diets, much knowledge and capital has been directed between these poles of life and death. The manipulation of feed consumption and conversion rates using additives to corn or soy—including antibiotics, but also comprised of an array of vitamins, arsenicals, amino acids like lysine, enzymes, trace metals, minerals, or taste enhancing substances—is part of what made animal confinement possible in the first place (see also Finlay 2004; Kirchhelle 2018).

Kim Fortun's (2012) concept of "late industrialism" is a useful way of characterizing the present as being stuck in a rut, or an impasse, where similar processes keep piling up—in addition to being insightful about the materiality of anthropogenic hog excrement. The term suggests that, despite the scarcity of industrial jobs remaining in the United States, it is premature to call that country post-industrial. Everything from transportation infrastructures to everyday objects still emerge from industrialized locales. In Fortun's framing, the late industrial present is instead a moment of increasing complexity marked by an absence of attention: industrial paradigms unable to deal with the compounding ecological feedback and pollution they have wrought, collapsing infrastructure and emerging industrial accidents, and incredibly specialized divisions of labor and expertise that distract from any systemic intervention. Industrialization becomes not a discrete, bounded event or an epoch, but a potentially interminable process—especially given its planetary effects (see Murphy 2017).

The modern hog—and, by extension, the quantities and qualities of its waste—is an icon of compounding industrial practices. Since the late 1890s, large-scale animal slaughter companies have often broken even on meat to undercut the prices of competitors (see Cronon 1991), a process that continues to this day as the move to indoor confinement, efforts to beat back organic producers, and even the use of drugs themselves keeps lowering the market price of flesh. Some companies tend make their slim profit margins by finding uses for the other parts of the pig. During the primary period of my fieldwork in 2010, there were 1,100 product codes coming from each hog. Many of those are special slices of meat for wholesalers. But hundreds have nothing to do with human food: cat food flavorings, gelatin for industrial manufacturing, organ-derived pharmaceuticals, or biodiesel made from hog fat. While these change with time, thousands of demands and preexisting claims have compounded in hogs' bodies across the 20th century. This deep evisceration of the animal into scores of distinct commodities is premised on massive and concentrated scales of death. As Miendertsma (2009) shows, it makes little sense to burn the skeleton of a single pig to generate a few grams of specialty black bone pigment, or build a biodiesel plant to gain energy and glycerin from the fat of 500 hogs. The lungs, pancreatic tissues, heart valves, or blood are more easily transmogrified into new kinds of valuable stuff when concentrated in millions of pounds. This, in turn, has greatly augmented the sheer *quantities* of fecal matter that any one corporation must manage within a particular geographic locale.

Antibiotics, in this highly concentrated context, are hard for corporations to do without—at once a poison and a cure. Though in use since the 1940s, antimicrobials arguably remain necessary to maintain a modicum of animal health and growth in massive barns with endemic diseases, where bacteria are so dense that they can rapidly infest sores, and where there is so much particulate excrement and ammonia that many hogs exhibit deep lung scarring after their brief six-month existence (see Michiels et al. 2015). At the same time, one could also argue that drugs' near-universal adoption has only made the price of pork even cheaper—driving down margins in ways that require yet more throughput, animal concentration, and novel uses for pigs. Most antibiotic use on hog farms is administered through routine doses in feed pellets and water. Agribusinesses do use muscle injections of penicillin or lincomycin to heal acutely sick or lame animals. But most act in effect as growth promotants—the biological mechanism of which is not fully understood—by ensuring pigs convert feed ingredients to fat and muscle at a higher and more predictable rate, using less feed to gain weight, or decreasing rates of illness across barns (McKenna 2017).

Industry public relations discourse obfuscates this pharmaceutical consumption as a moral matter of "preventing or treating disease" for the animals' well-being, using the language of health as an alibi (see Metzl and Kirkland 2010).[5] But antibiotic use for capitalist growth and bodily consistency versus health prophylaxis can be hard to separate (Kirchhelle 2018). Most countries that have disallowed small subtherapeutic doses for explicit growth promotion purposes, including the United States since January 2017, still use higher oral doses for disease-prevention purposes, and these policies have often failed to decrease countries' total quantities of pharmaceutical consumption (Kirchhelle 2018).[6] And it is not clear what industrial animal "health" means, given that pigs are at once sick and not sick, prolifically growing yet prophylactically dependent on over a dozen different antibiotics (Silbergeld et al. 2008, 155), and pathogens in their waste reflect an ambivalent state. One older textbook claims up to 10% of bacterial populations in animals routinely administered antibiotics are resistant, while a normal baseline is 2% (Spellman and Whiting 2007, 226).

To step into a contemporary animal feed mill, however, is to glimpse where the *qualities* of excrement are made. The walls are lined with pallets of 100-pound bags of powdered antibiotics, vitamins, amino acids, and lean muscle promotants such as ractopamine, massive amounts of grains and minerals are stored in silos, and the floors and rafters are taken up by automated machines loudly grinding ingredients sourced from geographies across the globe. Nutrition managers were fond of repeating the well-worn aphorism that "you are what you eat," as they discussed how every feed ingredient—along with the textures, shape, and density of feed pellets—affects microscopic qualities of hogs' fat, cartilage, and muscle. And if our diets become us, then industrial pigs contain multitudes. This company's feed mills produce 30,000 tons of pelletized pig feed in a week, composed of grains, different pharmaceuticals, beef fat, dried blood plasma from other hogs, minerals sourced from 10 countries, and a shifting array of expired industrial foods such as candy or breakfast cereals that can be purchased at a discount (see Sapkota et al. 2007 for a longer list). If the Great Plains, following James, is a fecal ecology then it is a landscape composed of landscapes; vast global regions and labor processes are sutured in feed (see Lien 2015).

One can nonetheless provide a generic portrait of contemporary feces' contents in terms of potential pollutants. Manure lagoons contain some 331 odor-causing compounds, nitrogen, phosphorous, potassium, methane, hydrogen sulfide, ammonia, endotoxin, trace metals, salts, pesticides, unmetabolized drugs, antibiotic resistant bacteria, resistance genes, along with the various properties of feedstuffs that are 50–90% digested, and the 3–5% of unconsumed total feed that spills into barn pits as animals eat (see Spellman and Whiting 2007). But it is also not completely clear what composes animal excrement today. Feed rations are themselves closely guarded trade secrets, and the purchase of drugs or other additives is often not closely monitored (Sapkota et al. 2007). There is not even a single hog feed or kind of feces. Dover Foods uses 11 distinct rations cued to maximizing consistent growth or breeding fertility across the species' life cycle (see Finlay 2004), and different ages of swine do not excrete waste with identical proportions of nutrients and chemicals (Spellman and Whiting 2007).

Nor are the contents of swine diets stable over time. Commodities buyers source a changing diet of hundreds of ingredients that can both cheaply and rapidly grow hogs without affecting the carcass qualities required to carve thousands of commodities from pigs. Take biodiesel. The fat in the 2006 version of the Dover Foods hog contained acids that made high-grade certification expensive—a required purity for blending into commercial diesel at the pump. Nutritionists determined that they could incorporate additives into hog diets to minimize these properties of the fat, but only if they had no effect on the other 1,099 product codes that were already reserved within its carcass and may require their own qualities of fat.

Waste is being industrialized in this manner alongside pigs' bodies. Both quantities and qualities of fecal matter emerge as an index of the countless human labor processes that ripple through hogs' bodies from pelletizing feed to trans-esterifying fat into fuel. The material–chemical properties of any given hog's fecal waste index some of the hundreds of products it will become after it dies, and the partially digested and spilled substances in manure at any moment are financial reflections of market commodity prices. As new products and sites of value are carved out within the body, or as cheaper ingredient substitutes are found, it can change the composition of waste, and can even affect feed pellets' consistency and their tendencies to generate dust. This "healthy" pig, whose fecal biologies are transforming regional life, depends on vast global ecologies, must be uniform and predictable in its chemical makeup to enable the planning of these extraction processes, and must be able to grow quickly without being stalled by unanticipated illness that requires the consumption of additional (drug-laced) feed. It is an animal whose intensifying demands on its body requires the ingestion, over time, of additional agricultural commodities, global ecologies, labor processes, supply chains, and pharmaceutical products—all in ways that appear to layer complexity into its waste.

Molding Fecal Forms: The Life of the Poor

The resulting fecal matter has itself become a labored industrial commodity to offset profit margins. For instance, since the founding of factory hog farms in the early 1990s, agricultural colleges have tried to invent schemes that would turn this waste into "the new black gold" (i.e., petroleum). These capitalist ideals of simultaneously farming both pork and feces are framed in a language of environmental solutions, of mitigating the damage of fecal waste by imbuing it with value and giving it a purpose. In North Carolina, for instance, Google is in the early stages of funding methane biogas extraction around hog farms' lagoons to capture carbon offsets (Mahony

2011). In coming years, the rocks in American highways' asphalt may be bound together with bio-adhesive from oils in hog feces (Anderson 2016). Before scientists found evidence of possible continental fecal storms, there have been plans afoot to make us all increasingly intimate with the wastes of factory farms—becoming-with them every time we run a web search, investing their world-forming and decaying substances with value when we drive—such that everyday life, whether we realize it or not, would be lived as a subsidy to cheap meat. Hog feces are *late* industrial, then, because they are overworked—infused with compounded engineering and activity—at the same moment that they are an emerging site of value once there are so few non-capitalized dimensions of swine remaining.

Yet, waste is itself also a site of intimate work in another sense, one that is increasingly necessary to maintain the confined pig as a biological and legal entity. Robert Gordon was an environmental scientist for Dover Foods, though he also went by the title of "nutrient manager." A former environmentalist and agronomist, Robert started working in animal agribusiness after a family economic crisis. His task was to manage the corporation's fecal holdings along with 600 farm fields—roughly 96,000 acres of terrain— where the company had easement rights to empty lagoons. Robert once described his office before he was hired as haphazard. The manure lagoons would be sprayed onto fields based on a rotational schedule—or by emergency reaction to an overflowing pit—without attention to seasonality and soil hardness, the nitrogen requirements of a given crop, or regional climate. He described an environment where nutrient run-off was possible and water wells were at risk. Robert's innovation was to pay more attention to rates of evaporation as they differ across the 100-mile radius region, and study GPS systems over the seasons to read vast tracts of land through manure: learning of terrain gradations and former streams that can concentrate pollutants over time, or seasonal wetlands in fields. Robert's (laudable) goal was to make the manure valuable to farmers as crop fertilizer—rather than just using soils as a dumping sink—and mitigate the liquid movement of waste off properties and into waterways.

We might say that Robert's "nutrient management" office is tasked with *formatting* waste, managing its textures (Choy and Zee 2015). Their job is to shape waste's forms—in terms of states of relative solidity, gaseousness, and liquidity—in ways that do not legally and economically harm these operations, whether by spurring water well contamination lawsuits or spreading disease across barns (see Blanchette 2015). To do so, his office creates fecal workers: people who specialize their labor onto states or manifestations of excrement. One of the striking patterns of American animal agribusiness is how divisions of labor and animality grow concurrently over time, with people exclusively tending to increasingly delimited ages or portions of the porcine species. Some employees now work primarily on reproductive instincts, delivering piglets, or slicing one tendon in the left ham. This was true even in states of late industrial waste, as a novel parsing of complex matter came to manifest new types of workers with specific knowledge—emergent skills needed to maintain the fast-growing health of swine.

I met one man who had spent years testing over 700 microbial additives for lagoons in an attempt to break down their solids and control odors. A person at a competing company had become an expert in wind patterns and fecal aerodynamics. He planted and managed species of foliage around farms in an effort to trap particulate matter and propel volatile compounds higher into the air away from neighbors. There are grounds-keepers who manage the grass and site cleanliness outside of barns to discipline the movement of rodents and roaches through feces, which carry bacteria that can infect other pigs. Others kept the planted grass on lagoons' perimeter moist, combating airborne erosion of soil mixed with excrement. Still others spend their days reading the meaning of fresh feces across dozens of growing barns, diagnosing herd health in terms of its moisture and coloration, while truck washers spray transport vehicles to ensure that swine diseases are not passed between batches of hogs being moved across barns.

I myself was assigned to work as a power-washer for a week in 72′ x 24′ farrowing rooms where sows give birth, providing a flash of insight into how careful labor with toxic excrement leads to different apprehensions of the world (see also Rich 2008). In-between sets of 24 sows being moved from gestation crates in another barn, the rooms are washed with soap and very hot water. It takes two or more hours for two yellow rain suit and goggle-adorned people to fully disinfect one small room, giving a tedious apprenticeship in the ways that fecal dust fully saturates a three-dimensional environment. Excrement particles cover every roll of a farrowing crate metal bar, become lodged anywhere there are screws, or coat the curves of a light bulb or water feeder hoses. The most efficient power-washers have gained a profound embodied knowledge of these spaces and all of their possible crevices—being in tune with the material architecture of a room in ways that few of us will ever experience—and are able to navigate them by memory despite dense steam and splashes of water bouncing off excrement-ridden surfaces onto their goggles. Yet, even this is but one of dozens of highly specialized attunements to fecal matter's materialization that are required to maintain swine immune systems in a region saturated with countless states of waste.

For the purposes of this article, perhaps the most pivotal of the new generation of fecal workers are the sprayers. They empty the slurry of lagoons onto crop fields using spray irrigation systems, according to schedules devised by Robert Gordon's office. Research on this disposal practice near Wisconsin dairy barns, where its recent emergence has proven controversial, suggests the multiple factors and environmental complexities that confront sprayers (Genskow and Larson 2016). The height of irrigation equipment, application rates, nutrient uptake by plants, the size of the spray nozzle, aridity, sunlight, evaporation and its effects on droplet sizes, and especially wind velocity: They all affect droplet drift, ammonia volatization, odor, and pathogen spread beyond application sites and into neighboring air, property, rivers, or wells. Each of these jobs reflects a bodily knowledge of properties and phase-shifts of waste as they manifest in different industrial ecologies; each reflects how the unruliness of excrement generates historically-specific but unique senses of place. And each position expresses regional hierarchies of value and corporate legal culpabilities; each task is a biopolitical act of shaping feces to expose certain species and some types of humans less than others in a context, following James Hodgkins's reading of fecal winds, where *something* must be exposed. What I find jarring about these acts of labor is that the only thing deemed unproblematic—which is locally undiscussed—is worker exposure.

My coworker in a breeding barn, Felipe Marquez, was an artificial inseminator. In the morning he rubbed the backs of hundreds of sows in estrous, stimulating their uterine contractions so they would draw in semen through a foam-tipped straw. However, as a knowledgeable worker with a decade of experience in confinement facilities, he was often assigned to fix equipment breakdowns during the afternoons. These tasks would frequently place him amid the vast pool of feces and urine that fills every day under the concrete slats where hogs stand, prior to it being emptied for storage into a lagoon. Sometimes a mistakenly dropped syringe or a plastic bag of semen plugs a drain, other times a chemical imbalance in the slurry unleashes high levels of tear-inducing vapors into the barns. In practice, and though it was not an official title, Felipe would often spend some of his afternoons as a "pit skimmer," ensuring the space under the floor consisted of pure and well-flowing hog excrement.

One afternoon, while I was sitting in the break room of a breeding facility, Felipe kicked through the door that led to the animal holding barns. An extremely fit cowboy with a perfectly coiffed thin mustache, originally from rural parts of northern Mexico, he usually carried himself with an intense sense of purpose. On this day, his shoulders dejectedly slouched as he ambled over to the sink along the wall. His bare arms, protruding from his blue coveralls, were thickly covered in glistening brown muck. As he started washing in the metal basin, his body hunched over to get his left bicep under the running tap, he looked at me with an expression of sadness. "*La vida de los pobres*," Felipe muttered, as he scrubbed away layers of hog feces. His sad words—"the life of the poor"—rang through my ears. It was something he would repeat, a haunting quip, as we showered out of the barns at day's end and watched streaks of brown water run down our legs into the drain. I heard it as a declaration that this job does not define him as a person, even if he otherwise took deep pride and a sense of identity in his proficiency to work with animals. It was a minor note of defiance at the symbolic indignity of spending days caked in a corporation's waste, of a vivid materialization and metaphor of racial capitalism that tends to place white managers in air-conditioned offices while he—after working in factory farms for over a decade, progressively gaining skills and expertise—only seems to become more deeply embedded into muck.

Felipe Marquez's words loom large in my memory because he was, in retrospect, one of my only coworkers who was not desensitized to animal waste. Fecal dust piled up on every surface of a barn, forming a haze in the air that darkened the ambient light. Though the stench from the liquid slurry that pooled beneath our feet under concrete slats entered the nostrils like a waking jolt at the beginning of shifts, my olfactory sense was numb after 20 minutes. Sitting on the backs of sows during artificial insemination, I would catch myself thinking that the flaky brown substance dried to my arms was dirt—in this case, I suppose, meaning matter *in* place (see Douglas 1966). But there is no soil in indoor confinement.

Felipe was the only person with whom I worked who consistently commented on the waste that enveloped us, but even his words are symptomatic of the situational banality of this substance. "The life of the poor" turned industrial hog feces into a metaphor, a symbol of the plight of rural migrants of color. But every moment of being in those barns was remaking the very biological life of the poor. What I did not realize then—and nor, I think, did my coworkers—is how the rapid growth that ripples through pigs' metabolism passes through workers' lungs, skin, and microbial compositions. In some Midwestern barns, mean winter levels of airborne respirable dust, endotoxin units, carbon dioxide, ammonia, and total microbes were found to be at least two times the maximum concentration for human health (Donham 2000, 563). Chronic fatigue and bouts of fainting are commonly reported. Thirty-three percent of confinement workers may be afflicted with flu-like symptoms of organic toxic dust syndrome. Sixty percent will experience acute bronchitis, and some 25% will develop chronic bronchitis. Twenty-five percent of people who stay in barns for over six years may develop nonallergic occupational asthma (all figures from Donham 2000). Others might only detect their ties to hogs' bodily states after they become sick, as their nasal cavities have been shown to persistently carry elevated levels of antibiotic resistant bacteria (Nadimpalli et al. 2015). It illustrates in stark relief how the health of some people—especially those disproportionately placed in intimate relations with abject manifestations of animality—is co-constituted by the lives and deaths of other creatures (Lowe 2010; Porter 2013).

The Many Exposures of Toxic Health

Perhaps, however, exclusively focusing on the indignity of muck, or physical harms to individual working bodies in farms, risks missing what is more distinctively magnified by this situation. At least, that is, as it pertains to developing debates concerning how to critically approach industrially altered biological and chemical environments and the changing politics of labor, health, and justice that could foment from within them (Holmes 2013; Horton 2016; Murphy 2017; Nading N.d.; Saxton 2014). Picturing planetary changes to geology and biology tends to push attention away from small routine events and towards massive scales of accumulation (see Nixon 2011). It evokes unfathomably large things: compounded carbon dioxide emissions, plastics built up in waterways, the oceanic dynamics of melting glaciers, or something like the 369 million tons of manure annually produced by American agribusiness—13 times more than the human population. But the regional particularities of fecal environments remind us, following Anna Tsing (2016), that planetary transformation is patchy and uneven, erupting more intensely in some locales—such as low-lying coastal communities—than others. Even more so, shaping the mobilities of late industrial waste trains attention to how this eruptive patchiness can take hold of formerly banal things and bodies in minute ways: where foliage is planted around a farm, the design of a confinement barn's exhaust fan, the height of an irrigation machine, a sprayer's attunement to wind gusts, or even the stomp of a cow's hoof.

What is crucial to emphasize here is how mundane working-class laboring actions and tasks are gradually appearing to harbor added weight, as anthropogenic materials augment their capacities to have effects, however gradually, at indeterminately broader scales. This fugitive waste can make poorly paid workers' activities have, for lack of a better word, "anthropocenic" qualities in ways that are riveted with contradictions. The injustice that could be politicized in this context is not only the real exploitation that marks the life of the poor—that workers' learned attunements to fecal environments buffer waste (including, perhaps, from us), and make American cheap meat possible, even as that profound knowledge is unrecognized in wages and by a society that insists this is entry-level work. It is not only the unremunerated injuries that people bear in producing animal flesh to nourish others (but see Stuesse 2016), or the structural powerlessness that ensues from agricultural exception laws that make it hard for farmworkers to unionize in some U.S. states. It is, instead, also the radical powers and agencies to mediate proximate and uncertainly distant space that are being, often unknowingly, foisted onto the actions of the rural working poor such as field sprayers. Whether other beings are slowly affected through ammonia volatization and acidification, or the spread of non-metabolized antibiotics, what needs politicization is the sheer amount of life that is being put in relation to the tasks of the working poor.

Some discussions of contemporary ecological instability, including who is to blame and what is to be done, have seemed to lurch between broad poles of culpability (e.g., Chakrabarty 2009; Moore 2015; Nixon 2011). On the one hand, words like the Anthropocene itself suggest that planetary transformation results from the more-or-less undifferentiated cumulative actions of the human species as a whole. On the other, more critical orientations underline that responsibility for planetary devastations is not uniformly shared by all of humanity but is the product of specific populations and systems of accumulation, even if privilege enables the primary benefactors of such arrangements to avoid many of the burdens. Critical ethnography of labor might provide attention to the ground between these binary poles, however insidious, examining and confronting ways that the nature of exploitation itself is changing alongside environments—in this case, how the actions of some people are made to more directly and disproportionately bear the weight of remaking and maintaining volatile worlds. Doing so, however, requires the ability to imagine and discuss political affinities not only among human workers and the conditions of these subjects' lives, but also with the conditions of material "objects"— prolific hogs and fecal microbes alike—that make work as it is today.

Notes

Acknowledgments. The Ciriacy-Wantrup Visiting Scholar Fellowship from the Department of Geography at the University of California, Berkeley, provided the time to begin writing this article. The article was refined during presentations at the 2017 American Ethnological Society annual meetings in Palo Alto, the 2017 Anthro-Zoonoses Network meeting in Durham, the 2017 Earthly Matters / Volatile Futures conference in Bennington, the 2017 AAA meetings in Washington, and the Center for the Humanities at Tufts University. I thank the many participants and organizers in those venues for their input. This article has benefited from critical commentary by Tatiana Chudakova, Susanne Friedberg, Chisato Fukuda, Stefanie Graeter, Julie Guthman, Lisa Hofshauer, Hannah Landecker, Lisa Lowe, Amy Moran-Thomas, Sarah Pinto, and Jerry Zee. I thank Sean Sprague for his photographic contributions, along with two anonymous reviewers' helpful suggestions. Most of all, thanks to Hannah Brown and Alex Nading for their editorial work and suggestions.

1. Company names in this article are pseudonyms, providing a degree of anonymity for the many executives, managers, and workers with whom I studied. Similarly, I am unable to state with precision the region of the Great Plains and Midwest where this is taking place. Each major pork corporation centers its operations out of a distinct state. Similar operations exist in the Dakotas, Illinois, Iowa, Kansas, Missouri, Nebraska, Oklahoma, Texas, and Utah.

2. Modeling the environmental spread of resistance genes is complicated even when antibiotic-laced manure is consistently deposited in a known location. See Jechalke et al. (2013) for an analysis of changes to soil bacterial populations after the repeated field application of manure from swine treated with sulfadiazine. Certain antibiotic residues and resistance genes are unlikely to affect the efficacy of medicines intended for humans—such as ionophores like Monensin, one of the five antibiotics found in the study of cattle feed yards' particulate matter. But the U.S. Food and Drug Administration reported that 19.6 million pounds of antibiotics that are consequential for human treatment were sold for use on American farm animals in 2012 (Seltenrich 2015).

3. Only very recently, in North Carolina, have nuisance suits for impairments to quality of life started to become successful. See Blythe (2018) for a summary of these issues, including state lawmakers' ongoing efforts to insulate agribusiness corporations from liability.

4. For further research on quality of life and health impairments amongst nearby residents of swine confinement operations, see especially the work of Steve Wing (e.g., Wing et al. 2008).

5. See the industry-sponsored website togetherabx.com. Ramsden (2018) offers a defense of prophylactic antibiotic use on industrial farms.

6. For a discussion of possible changes arising from new U.S. antibiotic policies, see Dall (2017).

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