3. Data Citizens: How to Reinvent Rights

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Chapter 3

DATA CITIZENS

How to Reinvent Rights

Air pollution occurs not just from petrochemical industries in rural sacrifice zones, but also accumulates and intensifies in cities. Diesel vehicles, the burning of fossil fuels, construction dust, industry discharges, and drifting agricultural emissions generate particulate matter, nitrogen oxides, ozone, volatile organic compounds, and sulfur dioxide. These pollutants cause and exacerbate conditions ranging from asthma to heart disease and stroke.[1] While cities worldwide suffer from poor air quality, pollution levels greatly vary across disparate sites. Air-pollution levels in London often exceed both World Health Organization guidelines and EU Air Quality Objectives.[2] Still, these exceedances are typically less extreme than air pollution experienced in major cities in Asia and Africa.[3] During occasional air-pollution events in Delhi, for instance, instruments have topped out at "999" and could not register further increases in pollution levels.[4] The environmental crisis of air pollution overwhelmed the devices and data used to measure and govern it.

The numbers that record pollution levels and mortality rates provide one way of assessing the problem of air pollution. Yet within these numbers, many stories often go undocumented about how pollution circulates, sediments, and accumulates in bodies and environments. Such toxic exchanges tend to concentrate in communities where people of color and low-income residents live. Air pollution is unevenly distributed and experienced.[5] The regulatory instruments and data that monitor and mitigate pollution are also sparsely located along the fault lines of environmental injustice.[6]

Although the official infrastructures and techniques for monitoring air pollution are meant to assure urban dwellers that constant monitoring, control, and even care are given to the air they breathe, ruptures in the systems and technologies of governance regularly occur. The expert data, technologies, and practices

that would indicate that urban air is breathable become a target for questioning and frustration. Urban inhabitants at times doubt the accuracy of the air-quality data made public, or they rail against the inertia within urban and national governments that they feel do little to improve air quality even when monitoring data indicate that air is polluted. The urban-environmental burdens of air pollution and the unequal distribution of toxic air lead to challenges and disruptions to expert data and infrastructures.

In response to governance regimes that might be at turns inept or rigid, people take up low-cost and DIY air-quality monitors and apps to measure air pollution. Citizen-sensing practices are proliferating worldwide as people document pollution, assess their exposure to air pollution, adjust everyday routines, tackle polluting activities, and transform urban environments. Whether checking apps that collect data from citizen networks of sensors such as PurpleAir or installing or wearing sensors to track air quality in their immediate environments, people are building and referring to expanded and parallel monitoring infrastructures to create alternative ways of sensing and acting on air pollution. Citizen monitoring of air quality, and the citizen data it generates, become a way to document and respond to harmful environmental conditions. These practices express a right to breathable worlds.

Responses to air pollution form through a complex mix of regulatory monitoring networks, air-quality indices, mortality and morbidity statistics, public-health guidelines, citizen sensing, political protest, air-quality campaigns, home filtration systems, breathing technologies, low-emission transport routes, and policy proposals, along with international and local dynamics in the movements of air and pollutants. Within these multiple approaches to air pollution, this chapter examines how citizen-sensing practices of monitoring urban air pollution activate citizens as data citizens. In collaboration with the Citizen Sense project, residents, workers, and volunteers in the Deptford and New Cross neighborhoods of South East London took up sensing technologies to monitor air quality. They located citizen-sensing technologies adjacent to traffic corridors and construction sites where rapid urban development was underway to document pollution. And they worked with the findings from their data to attempt to intervene in and reshape processes of urbanization that were contributing to polluting conditions.

By discussing specific citizen data practices tuned to urban environmental change, I investigate how data citizens form through the collection and operationalization of data as a potential medium for democratic engagement. I investigate how sensor-based data practices constitute and activate data citizens. More specifically, I consider in what ways environmental monitoring practices and

infrastructures mobilize rights—to data, air, and breathable worlds. Based on this approach, this chapter then examines how pluralistic data practices could circumvent and reinvent rights by making more breathable worlds.

This chapter investigates how practices of using digital sensor technologies to monitor air quality in South East London generate pluralistic and uneven formations of citizen data and data citizens. While data are often viewed as something collected *about* citizens—typically by large technology companies in the form of surveillance and tracking—this study describes how there are now just as many instances of data generated *by* citizens to address environmental problems. Whether to sense air pollution, narrate lived experiences through online platforms, challenge governmental readings, or document conflict in areas of development, people are collecting, analyzing, and acting on data to support and remake urban environments.

I suggest that when they use sensor technologies to collect data about air pollution, urban dwellers express a *right* to a certain standard of air quality. These practices activate the right to data and the right to clean air. Indeed, multiple rights potentially form through citizens' monitoring of air pollution, including the right to breathe, the right to monitor, the right to environment, the right to the city, the right to health, the right to data, the right to participate, the right to research, the right to be political, and even the right to experience. Some of these rights are established in law yet are not readily enforceable. For instance, the "right to breathe clean air"[7] is variously observed within some urban environments through regulations that establish a legal right to a certain standard of air quality.[8] At the same time, when exceedances of official standards occur, the process whereby these rights might be enforced can seem to be opaque and ineffective, even when legal challenges are mounted to ensure that pollution limits are observed.[9]

Rights are often integral to expressions of citizenship. Yet it can be somewhat unclear whether and how rights factor into emerging citizenships. These might be "new rights" that are not settled into law.[10] Such rights are in the making. They are sociopolitical formations that materialize through data practices. The right to data is not simply the right to collect and communicate a bundle of evidence, however. It also comprises the right to mobilize findings to provide different observations, challenge expert findings, and work toward more just and livable environments. Even more than providing evidence of pollution levels, however, documenting pollution expresses a demand to change the environmental conditions that cause pollution, from excessive traffic to constant construction and fossil-fuel consumption.

To complement the previous chapter's investigation of practices that evidence harm, this chapter considers how data practices form rights to breathable worlds.

People struggle to be in exchange with their milieus in ways that sustain them as citizens of worlds. Such practices express a right to constitute and be constituted by worlds in the making. In this sense, citizens are activated through political relations that compose worlds. Rights, moreover, are distributed within environments and infrastructures that mobilize and support distinct modes of political engagement and inhabitation.

Citizen data do not guarantee a remedy to the problems documented. Instead, data become a medium through which to figure worlds by monitoring, documenting, narrating, and analyzing conditions of disenfranchisement and dispossession.[11] Citizen data practices are likely to lead to additional struggles to address environmental pollution. They are contingent and ongoing encounters with urban political life. This chapter discusses different formations of data citizens, and considers how environmental sensing practices give rise to citizens, rights, and worlds in the making. I then document how the Citizen Sense project worked with community groups and residents in South East London to generate and collect data about urban air pollution. I explore how the expression of the *right-to* gives way to a multitude of *how-to* practices, including how to mobilize citizen-sensing infrastructures, how to figure citizen data, how to pluralize data practices, how to make urban worlds with citizen data, and how to reinvent rights. The citizen data generated through these air-quality monitoring practices express rights to monitor, inhabit, and cultivate less polluted environments, even when such rights are unevenly realized. As potential practices of combat breathing, they become a way to reinvent rights by working through concrete struggles not just to evidence harm, as discussed in the previous chapter, but also to build more breathable worlds that push against the constrictions of lived environments.

CONSTITUTING DATA CITIZENS

"Data citizen" is a term that is in widespread use across research, activism, and industry to describe how technopolitical actors are constituted through data practices. As discussed in the Introduction to this study, "citizen" is often applied as a democratic veneer to digital technologies. Within the tech industry, "data citizen" circulates as a term to suggest the relative accessibility of data technology and data-analysis techniques to nonexpert users. Rather than a political subject, here a citizen is rendered as an amateur who should have easier access to data and its devices.[12] While "data citizen" is variously deployed to refer to the intersection of data and subjects, it can be somewhat unclear how data contribute to the formation of citizens as political subjects. The processes whereby data constitute citizenship or enable political participation remain rather vague in

this formulation of the data citizen. Citizens could materialize through practices of data collection and acting on political problems. They could also form through the necessarily political infrastructures of data collection and mobilization. In other words, citizens—and their possible collectivities—are programmed and formatted through distinct data practices.[13]

In one characterization, science and technology researchers Judith Gregory and Geoffrey Bowker suggest that data citizens are assembled through particular quantitative techniques such as wearable technologies. In their estimation, data citizens are constituted as distinct technological subjects with and through "an ecology of microdata."[14] Here, subjects with wearable technologies are not necessarily undertaking a deliberate plan of participation; instead, they form as data citizens through the ecologies they plug into. This is a very different characterization of citizenship, which forms through the conditions and relations of technological infrastructures.

Indeed, such data citizens might find that their "rights" to data are restricted if they attempt to access and use their data or the data of others in these ecologies. Data citizens, in this sense, are not necessarily working in a deliberative or democratic vein. Instead, they are activated through participation that does not lead to a "right to" anything as such. Here, participation could become the basis for further de-democratization, even while the term "data citizen" is mobilized to suggest otherwise. One of the more sinister uses of the term "citizen" is analyzed in Ruha Benjamin's discussion of the mobile app Citizen, which allows users to undertake community surveillance in their neighborhoods. Such practices typically exacerbate racial profiling, where the "norms" of social discrimination can become encoded in the use of this "citizen" technology to monitor urban activity.[15] At the same time, the makers of this citizen-oriented app present it as contributing to the "democratization of the 911 call," where assistance is only a watchful neighbor away.[16] Here, a citizen is less a democratically engaged subject and more a surveillant node reinforcing inequalities.

Many studies on data citizens focus on technologies and data generated through social media or wearables, through which particular formations of surveillant operators or consumer–subjects materialize.[17] While citizen-sensing technologies could as easily reinforce these modalities of consumer–subjects, there are other ways of engaging with the possibilities of data as they support data activism and generate counter-data actions of resistance and self-determination by contesting the "truth" of prevailing forms of data.[18] Data can facilitate social organizing and advocacy.[19] Such practices can generate different subjectivities and affective engagements with the conditions observed and acted upon. They also form power dynamics and spark calls for data justice.[20]

As discussed throughout this study, citizen-sensing technologies are meant to enable particular forms of data citizenship by encouraging involvement in environmental problems. Plugging in, activating a digital toolkit, and joining a disparate community of users: these are seemingly the steps to follow to mobilize the right to clean air. Yet the processes of sensing environments, collecting data, documenting, and addressing environmental harm do not typically lead to such well-equipped political subjects. While considerable work can go into collecting and analyzing data sets, citizen data can easily be overlooked and ignored. Rather than unfold a frictionless form of engagement, citizen-sensing toolkits and the citizen data they generate can lead to even more complex struggles with urban environmental life. Data citizens are, then, figures of struggle.

Indeed, even the right of citizens to monitor environments can be thrown into question, with practices, protocols, and devices subject to legal intervention and scrutiny. The right to monitor environments is not guaranteed, and in some countries the practice has been deemed illegal. In the United States in 2015, the state of Wyoming attempted to outlaw many forms of citizen monitoring, including photography, after concerned citizens documented *E. coli* in water samples from streams, where the source of pollution was from grazing cattle.[21] The bill sought to forbid the collection of "resource data," including data from air, water, soil, and vegetation, by designating this activity as trespassing, even if occurring on public land. However, the Tenth US Circuit Court of Appeals sent the case back to the lower courts, where the pending law was thrown out on the basis that it violated the right to free speech, which includes the right to petition the government.[22] While the right to monitor in this case was upheld, many state-level ag-gag laws in the United States still prevent documentation of meatpacking plants, for instance.

Yet the right to monitor instantiates more than a right to speech. It also instantiates a right to participate and a right to environments.[23] Such rights often do not feature in conceptions of citizenship that are based on a detached if deliberative subject. Data citizens form through evidentiary practices that document worlds of experience. In this sense, data citizens do not materialize as processors or objects of data. Instead, they form through struggles over the right to data and the right to environments that such practices would activate. Citizen sensing and the data it generates can document individual and collective grievances about pollution, development, displacement, and dispossession. Data citizens are not identifiable here through the usual membership categories of nation-state or consumer technology. Instead, they form as particular political subjects, relations, and collectives by working with and through data. Such data practices co-constitute distinct political subjects and worlds that would be sensed.

Data citizens are as likely to materialize through struggles with the erosion or absence of rights as through the inability or futility of appealing to rights. Evidentiary techniques become a process for materializing data citizenship. Such techniques can transform in urban worlds, especially when rights fail to materialize. Citizen data that document urban change and conflict can rework both data citizens and processes of urbanization. It is at these sites of struggle that multiple other forms of data citizens proliferate, less as fully formed political actors and more as persons and milieus attached to, yet haunted by, the promises of democratic life.[24] Data citizens materialize in this way as another version of citizens of worlds that, in resonance with the atmospheric, instrumental, and speculative citizens discussed in previous chapters, require exchanges with milieus to come into formation. In other words, data citizens are distinct expressions of citizens of worlds. These citizenships form not just by gathering and circulating data but also by mobilizing data to make more breathable worlds.

Rights, Citizens, and Worlds in the Making

Rights often manifest in digital and social-media technologies as the right to privacy, the right to be forgotten, the right to data protection, and the right to open data. However, this discussion proposes another way of thinking about how rights to breathable worlds, along with multiple other rights, materialize through citizen data practices. The use of environmental monitoring technologies can activate different rights in the making. This process of remaking and creating rights changes the relation and constitution of the "citizen" in "data citizen." Data can become a way to track, document, and concretize lived urban experiences. Rights can also encompass relations that signal distinct ways of being in and for worlds. Such an approach expands rights beyond a discursive claim[25] to constitute rights as spatial-material practices and formative relations for making and sustaining worlds. The right to relations, the right to collective life, and even the right to responsibility might materialize in these recast ways of forming rights.[26] The power relations that inform the becoming of citizens are not just exchanges with those who would govern.[27] They are also shaped through exchanges with more-than-human entities and environments, where power is situated, lived, and potentially transformed.[28]

If rights can be characterized as more than discursive claims, then they might be differently approached as relations, dispositions, orientations, infrastructures, collective feelings, atmospheres, and distributed practices that encompass more than an individual rights-bearing citizen. Here, political subjects form by tuning in to and activating environments and environmental problems. These are citizens of worlds. Citizens could form through the conjoining of multiple entities

that make possible the conditions of political subjects, as in the case of citizen sensors (where sensors could be technical or organismal in form, as discussed in the next chapter). The citizen–subject materializes through relations with worlds: this is a condition of sense-ability and breathe-ability. Data citizens express a right to data and a right to worlds. Different possibilities for being and becoming citizens of worlds are constituted through these exchanges with worlds. To be and become citizens of worlds requires the development of practices and relations that are in constructive and formative exchange with those worlds.

Citizens, rights, and worlds are all together in the making. Practices that express a right to make breathable worlds remake environments and inhabitants. If data practices contribute to the formation of citizens as political subjects, then they are also fused with the articulation of rights and worlds in the making. This is one way of articulating what Étienne Balibar has referred to as the "continued invention of democracy" that unfolds through struggle and the pursuit of justice.[29] Such invention necessarily extends to citizens and worlds in the making. Sensor-based data practices constitute and activate data citizens through engagement with data and devices and through the struggles that data support and mobilize.

Evidentiary practices create and operationalize citizenship not only as an articulation of preexisting rights to be upheld but also as the ongoing formation of social, political, and environmental struggles. The pull toward rights not yet realized can shift the usual way of designating and engaging with problems. Rather than operating as a guarantee of an abstract and stable condition of citizenship, citizen data that document air pollution make evident how rights materialize as *prospective* practices or as sought-after relations.[30] The right to clean air indicates how to work toward transformed and more equitable collective atmospheres as worlds in the making, and how to become citizens of worlds.[31] "Citizens of worlds" is a concept that signals these prospective practices of political engagement, where the formation and exchange of subjects and worlds are a central part of what constitutes the sense-ability and breathe-ability of sociopolitical life.[32]

The Right-To as How-To

The *right-to* gives rise to multiple practices of the *how-to*. As discussed throughout this study, how-to consists not simply of following instructions but also involves developing practices that engage with the multiple struggles, techniques, and strategies that unfold through working with data and attempting to sustain, create, and transform urban worlds. The *right-to* proposes *how-to*, including how to be in exchange, how to generate environmental actions, and how to sustain

political engagements. In this way, the imperative mood of the how-to invokes collective responsibility rather than a command for how to undertake such projects. The right-to is a form of how-to that works toward more democratic conditions. Distinct modes of citizens and citizenship form through pursuing the right to as a practice of how-to.

Within this context, sensor-based data practices can propose rights that become instruments for making more breathable worlds. Citizen data can generate open-air instrumentalisms, where rights are claimed, instantiated, circumvented, and reworked as part of the conditions of more livable and just environments. Such reworkings occur through practices that generate different forms of data, implement or challenge the observational techniques and infrastructures of experts, and make alternative proposals for urban environments. The right to data and the right to breathable worlds contribute to tools and toolkits that seek to make openings, lead struggles, and work through practical situations in and through which urban projects form.

Rights are another sort of instrument that contributes to the open-air instrumentalism of this shape-shifting toolkit. Yet while the right to data can co-constitute the right to make breathable worlds, such rights can also be difficult to realize for those who are pushed to the edges of urban life. In the context of citizen-sensing practices, the right to data and the right to breathable worlds are not established political or legal conditions that would serve as simple levers for fixing polluted environments. Such rights indicate, but do not guarantee, additional ways of working toward more livable environments. Instead, they are part of a broader open-air toolkit that seeks out strategies to cultivate more breathable worlds.

The right to breathable worlds raises the question of praxis, of how to engage in different configurations of theory and action. Citizenship is a sited, collective, and relational practice that activates environments in different ways. "Citizenship is the practical site of a theoretical existence," as Lauren Berlant notes.[33] The practical sites of citizenship involve the active forming, testing, challenging, undoing, and remaking of political engagements and political subjects. This research on citizen sensing forms a collective inquiry into the conditions of practical engagement that materialize along with experiments in different urban inhabitations.

These practices further demonstrate commitments to struggle for worlds that might be more livable, but they are unevenly available. Within these struggles, failure is likely. Failure, however, is not the flip side of success but rather a recognition of the pitfalls in praxis, where struggle can encounter the "impasses of the political."[34] In these moments of impasse, the reinvention of citizenship,

rights, communities, and the worlds that are made and sustained can appear more viable. As Berlant writes, "It may be a relation of cruel optimism, when, despite an awareness that the normative political sphere appears as a shrunken, broken, or distant place of activity among elites, members of the body politic return periodically to its recommitment ceremony and scenes." Such recommitment can involve paying attention to how political formations hold together, how they fall apart, and how they might be remade toward a "more livable and intimate sociality."[35] Rather than bundling rights into a practice available to a universal if diverse grouping of citizens, such an approach might instead tune in to the plurality of political subjects and the struggles they encounter when attempting to invent, articulate, materialize, or transform rights. In this way, struggle becomes the basis for realizing even more—and expanded—modes of citizenship.[36]

The open-air aspect of this investigation necessarily involves questioning rights-as-instruments to consider how different approaches to breathable worlds materialize or are thwarted. Although various rights might be claimed through the practices of data citizens, there are many ways in which rights do not generate more democratic environmental engagements. Practices of citizen sensing of air quality in South East London do not so readily realize the rights they pursue. However, they do potentially reinvent rights and modes of citizenship through alternative political engagements. Such practices are often less utopian or triumphant. They turn up at the frayed edges of citizenships that are denied or never realized, often because of inequalities that include but are not limited to conditions of gender, race, or economic status.[37]

Data citizens might in this way become less oriented toward the overt ambitions of rights and more engaged with finding provisional techniques for staving off and surviving dispossession, pollution, and injustice that often accompany increasing urbanization. A right to make breathable worlds and a right to data offer powers of engagement and transformation that can seem out of reach for many urban dwellers. Such rights in the making could promise democratic participation that is difficult, if not impossible, to realize.

Citizen data can at once displace and reinvent rights, especially as they fail to address environmental problems. Rather than claiming rights, citizens could mobilize data as a persuasive tool for making arguments in support of urban life. When, for instance, an appeal to the right to housing seems too complex or politically impossible to undertake, urban inhabitants might instead demonstrate how new construction is not affordable to local residents. Data-based observations and arguments about unlivable urban conditions become a stopgap measure to sustain urban ways of life that are continually under threat but for which rights are often not enforceable or do not exist. Some researchers suggest

that rights are a way to guarantee environmental protection in a way that citizen data cannot, since citizen data can be readily challenged as inexpert and imperfect.[38] However, environmental rights are often difficult to enforce and uphold, even when supported by the most "expert" forms of evidence. Indeed, the perceived ineffectiveness and unevenness of rights could mobilize data collection. In other words, if rights were effective, then people would not necessarily be so inclined to undertake environmental monitoring, since presumably states and other institutions would perform these functions to uphold environmental rights. While an abstract designation of rights might promise an ideal condition, it is often through more contingent practices such as citizen data that rights differently mobilize as subjects and worlds in the making.

Data citizens might be most likely to materialize in situations when the right to clean air becomes difficult to sustain and where rights fail to support struggles for more breathable worlds. People who may not feel that rights are a clear point of political attachment create evidentiary practices to challenge the dispossession, environmental damage, and injustice of neoliberal urbanization. Citizen data could, in this sense, be a practice that manifests where rights break down or are not yet established.

Data for Black Lives is an example of such a movement that involves developing alternative data-collection and data-analysis techniques to create new narratives about Black people's lives while also demonstrating how systemic racism attempts to maintain inequality.[39] As these practices demonstrate, rights are not always self-evident, since there are many rights that Black people have that are often not protected or observed. Many data-oriented arguments could be made that do not clearly reference rights. Instead of data configured to support "universal" rights, data could instead be mobilized to support struggles for everyday survival and dignity in the absence or partial enactment of rights. This is what Data for Black Lives founder and executive director Yeshimabeit Milner refers to, in the spirit of W. E. B. Du Bois, as a way to rework data practices away from the destructive uses to which they have been put to reinforce and propagate racism. By creating new data practices, including analysis and visualization, Milner suggests that other possible ways of evidencing Black people's lives might be sparked.[40] These practices of computing otherwise could activate protest, accountability, and collective action while forming different narratives and rights.[41]

By documenting air pollution, people come up against the inertia and failures of politics. In multiple and diverse struggles to engage in urban democratic processes, the right to data becomes one way to express a right to breathable worlds. Yet these pursuits can also be derailed through sclerotic urban governance structures, rigid formations of expertise, or exclusionary processes of

urban development. Such data practices can then constitute and propose ways of being data citizens. By undertaking environmental monitoring, citizens mobilize rights to data, air, breathable worlds, and political life. These practices observe, document, and remake urban life. They propose conditions for being and becoming citizens of worlds. As propositions, they unfold as open-air instrumentalisms and how-to practices. In this way, such practices are guides for working toward more breathable worlds that have been tested, implemented, and that are still in the making. In the next section, I discuss how the Citizen Sense research group worked with communities in South East London to sense the air and to undertake practices for pursuing the right to breathable worlds.

CITIZEN DATA IN PRACTICE

Following the research focused on fracking and pollution described in the previous chapter, this second phase of Citizen Sense research studied citizen sensing of air pollution in urban environments. During nearly two years, from spring 2016 to late autumn 2017, we collaborated with residents of the neighboring wards of Deptford and New Cross in South East London to monitor air quality in relation to traffic, development, and industrial emissions. These neighborhoods are sites of former industry—dockyards and a historic naval shipyard—as well as community markets, housing estates, and an incinerator. An area that has been marked by economic deprivation and inequality, unemployment and limited job opportunities, Deptford and New Cross also have larger Black and minority ethnic populations than many other parts of London.[42] The area has been the location for ongoing struggles over environmental injustice, including the siting of the incinerator in New Cross in the 1990s that continues to operate today.[43] As has been well established in the UK, air pollution tends to affect people living in lower-income areas, and incinerators are also far more likely to be sited in deprived areas.[44]

However, the area has an even longer history of its residents engaging with the problem of urban air quality. While living in Deptford in 1661, John Evelyn wrote one of the first texts on air pollution in London, *Fumifugium,* a text that some residents and community groups continue to reference when making a case for mitigating air pollution and improving the urban realm.[45] With a rich history of organizing for social justice, communities in Deptford and New Cross have undertaken projects to respond to, or intervene within, processes of development and the problem of environmental pollution.[46] A 1999 study, *Surviving Regeneration*, documents the looming threat of increased development in the Deptford area and proposes how to mitigate the effects of environmental damage. "For

Figure 3.1. Low-emission-zone boundary sign and traffic camera on the Old Kent Road; traffic in South East London. Photographs by Citizen Sense.

some time," the study notes, "South East London has been characterised as 'the soft underbelly of the capital,' a place of industrial dereliction, cheap sites and demoralised labour."[47] The text documents how, in this area of "tides, wildlife, dereliction, rubbish, hope," numerous surveys were undertaken to attempt to guide regeneration toward less socially and environmentally destructive outcomes.[48] These surveys incorporated assessments and environmental monitoring of the area, including rubbish in the creek; archaeology and history; the biodiversity of birds, mammals, vegetation, fish, and invertebrates; the toxicity of creek water and mud; flood defenses; and community heritage. The text also documents how engagement with local people was an uneven process, often thwarted by the relative absence of policy makers at community meetings.

Twenty years later, Deptford and New Cross continue to experience waves of development and densification that contribute to significant changes in the urban environment, along with struggles related to unequal participation in political processes. The urban fabric in this location continues to be reworked and gentrified through new development schemes, master plans, and public–private initiatives.[49] Meanwhile, the increase in traffic and housing in this area and throughout London has led to further congestion and air pollution.

Within this context, and seeking to learn more about the environmental monitoring practices already being undertaken in these two wards, we researched and contacted community groups to learn about local initiatives that sought to address urban environmental problems. Through multiple projects and campaigns, residents were engaged in monitoring air quality, counting traffic, assessing the state of urban trees, and documenting disruption to green spaces and biodiversity. In the process of learning more about the projects and campaigns underway, we met with people caring and advocating for parks, high streets, and housing estates, as well as those campaigning for better transport conditions across the wards. In our conversations, residents brought up environmental changes they had experienced and told us about environmental monitoring they had organized to contest road use and to monitor dust pollution across construction sites. Concerns about air quality were intertwined with wider urban environmental problems related to the rapid pace of changing land use within the area, primarily through the development of high-density, high-end housing.

These practices came together to support cases for improving the urban realm, which were made through local meetings, planning applications, and campaigns. For one citizen-monitoring project, "Don't Dump on Deptford's Heart," residents installed diffusion tubes for monitoring nitrogen dioxide in order to contest the proposed development of a Nationally Significant Infrastructure Project, the Thames Tideway Super Sewer, constructed to update the decrepit

Figure 3.2. Dustbox monitor and installation at participant location in New Cross Gate; *Deptford Is Changing* text documenting study of the urban realm. Photographs by Citizen Sense.

Figure 3.3. Signs documenting local community organizations and protest against new development. Photograph by Citizen Sense.

Figure 3.4. Deptford Lounge and Library, where Citizen Sense held a monitoring workshop and made Dustboxes available for loan. Photograph by Citizen Sense.

London sewage infrastructure that contributes frequent wastewater discharges to the Thames.[50] With the data they collected with these analog monitoring devices they were able to document the poor state of air quality throughout the proposed development area and surrounding context.[51] Despite these efforts, the Super Sewer was approved for development, and construction began on the project. While the Super Sewer is meant to mitigate the problem of water pollution, especially in the River Thames, residents feared it would exacerbate the problem of air pollution by producing emissions both during construction and during operation of the sewer at pumping stations and ventilation shafts.

Indeed, multiple development sites were and continue to be actively contested by residents. One small area, Creekside, located on the eastern edge of Deptford, had at least five separate development sites under construction during this monitoring study. Residents suspected that such developments were likely contributors to increased air pollutants throughout the development life cycle. From demolition and site clearance to construction and heavy-goods vehicles, as well as increased density and traffic once development is completed, the environmental effects of construction can be felt for years. At the same time, the impacts of construction are inevitably bound up with the relative economic and social injustice related to new developments as people are displaced from rented and public housing and often not able to afford to live in the area once the brunt of negative environmental effects from development has been endured.

In order to contest development, as well as to seek compensation from developers in the form of community development funds, many residents and community groups had undertaken environmental monitoring projects to demonstrate the ill effects of living with constant construction. From traffic counts to air-quality studies using diffusion tubes, local citizens generated multiple forms of data about their environments. They also encountered, analyzed, and used data from governmental entities and industry, including in the form of planning documents in online portals; community meeting minutes; environmental impact and environmental assessment reports; official air-quality data; construction-company self-reporting on pollutant levels (including air, noise, and light); utility-company data on pollutants from national infrastructure projects (including air and noise); tree-map data designating tree locations and numbers; tree-removal applications; social statistics on population, density, and income; social-media data (including Twitter and Facebook); crowdfunding data; petition data; word-of-mouth data (often about proposed development schemes); and many more types of data on the London Data Store and the Lewisham Borough website.

In these numerous engagements with environments, data, and governance, people became data citizens in part through wrestling with multiple forms of data

and attempting to articulate a right to clean air, a right to participate, a right to the environment, and a right to make breathable worlds. Data became a means to express and materialize rights or create rights in the making. Citizens analyzed publicly available data, sought data through FOI requests, documented events and environmental disturbances by creating their own data sets, and communicated and contested changes to the urban environment through these multiple data sources. They also produced their own data to counter or qualify government statements and industry claims. They did so in the absence of official monitoring networks or where data were not sufficiently analyzed or acted upon, often because of austerity measures.

These multiple data practices constituted data citizenships by creating new citizen data and by linking different data sources to create particular accounts of urbanization that could intervene in these processes. These practices attempt to materialize rights—both as claims and prospective lived conditions. They present evidence even when appeals to rights are not heard or realized. In this context, the Citizen Sense research group collaborated with residents to develop a citizen-led air-quality monitoring network to research how data citizenships might materialize or transform by generating and integrating data into these multiple data practices.

How to Mobilize Citizen-Sensing Infrastructures

Along with learning more about community concerns and campaigns in the area, we worked with residents to develop a toolkit that could grow into a citizen-sensing infrastructure for monitoring air quality.[52] Our collaboration with community groups, residents, and workers involved learning more about their diverse data practices, whether in the form of environmental monitoring or analyzing government data sets, while also engaging in meetings, workshops, walks, and site visits to explore the particular uses of citizen-sensing technologies in this part of South East London. Far from acting as experts with a singular way of accounting for urban environments, we contributed as co-researchers to data practices that joined up with existing community initiatives.[53] We were, in the process, also becoming data citizens as we collaborated with inhabitants and learned more about their concerns for and ways of documenting the area.

For this second phase of research, we were in part drawing on our previous work on sensors and air quality developed in relation to fracking in rural Pennsylvania (described in chapter 2). Yet we were also responding to the area by developing sensors specific to this urban location. Rather than use an off-the-shelf device such as the Speck, we built a new prototype device, the Dustbox, which monitored $PM_{2.5}$. As previously discussed, $PM_{2.5}$ is a particularly hazardous air

Figure 3.5. Installing and repairing Dustbox monitors in Pepys, South East London. Photographs by Citizen Sense.

Figure 3.6. Setting up a Dustbox at Besson Street Gardens in New Cross Gate. The lowest levels of air pollution were documented in this highly planted and garden-based monitoring location. Photographs by Citizen Sense.

pollutant made up of a range of different materials that can lead to cardiovascular, respiratory, and neurological diseases, among other conditions that are in the process of being studied and documented.[54] However, there was a relative absence of regulatory infrastructure for monitoring particulate matter in Deptford and New Cross, and so the development of a citizen-sensing network offered the possibility to better understand concentrations and potential sources of this pollutant.

We created the Dustboxes based on the form of pollen and contaminated soil particles when magnified under an electron microscope. Fabricated through a 3D-printing process and cast in black ceramic, these small plug-and-play monitors used the widely available Shinyei PPD42NJ particle sensor unit, installed in numerous low-cost and DIY monitors in circulation at the time. The Shinyei particle sensor applies heat and an infrared light scattering technique to circulate and sense particles with a diameter of 1 μm or larger.[55] A receptor receives the scattered light from the particles to measure the relative opacity of air entering the sensor chamber, which is transformed into a pulse signal that can be further converted into particle concentration. The Dustbox monitor also included a custom-printed circuit board, an Electric Imp Wi-Fi module, and a fan for circulating air. We developed the Dustbox as an affective and tactile device that would resonate with the often gritty environmental conditions of this area in South East London while also circulating as an engaging citizen-sensing infrastructure.

Along with investigating the citizenships that might be activated or mobilized through setting up a network of Dustbox particle sensors, we were interested to understand how the Dustbox could operate in an urban setting where there was a well-known problem with air quality but not necessarily a single emissions source that could be readily identified. Yet air pollution was just one of many urban problems that people sought to address. In contrast to visions of the smart city that imagine the urban setting as a blank canvas for implementing digital designs and wiring up citizens, these were spaces where citizen sensing and sensors operate among an already sedimented and established set of processes and concerns. Our project sought to investigate how sensors and data practices could establish the relative intensity of pollution in the area, while proposing different ways of activating rights and citizenships in relation to ongoing urban struggles.

As part of the collaborative development of the Dustbox as a citizen-run air-quality monitoring infrastructure, we worked not only with community members but also an array of collaborators, including atmospheric scientists, so that we could calibrate the Dustbox in relation to the "official" air-quality network in London. This process involved co-locating the Dustbox with regulatory-standard
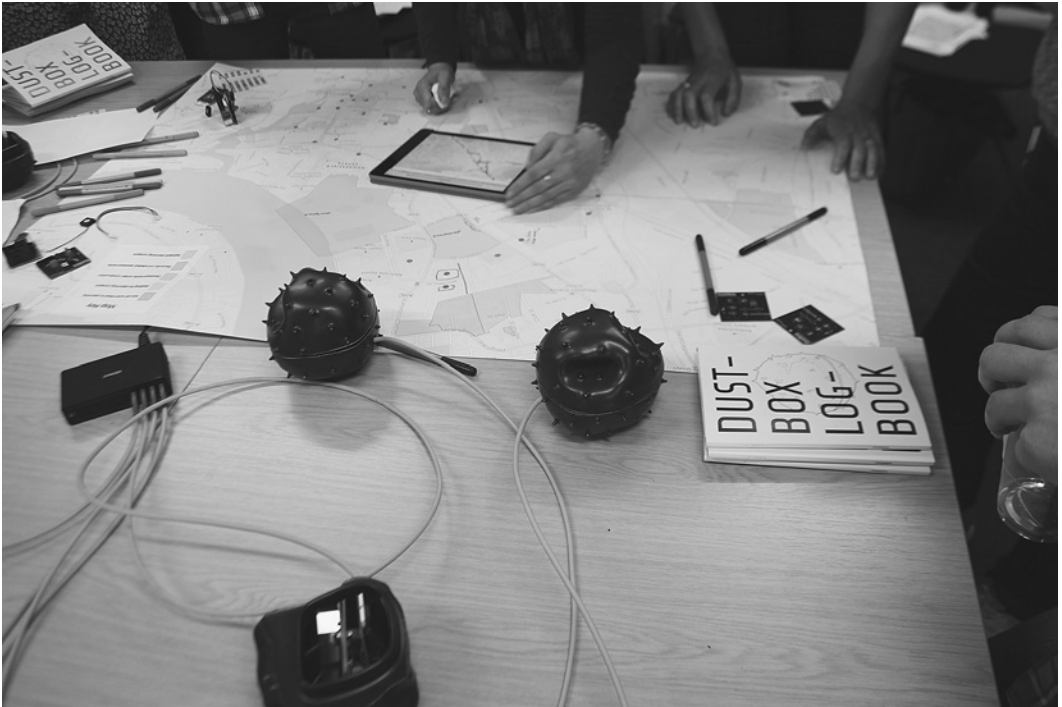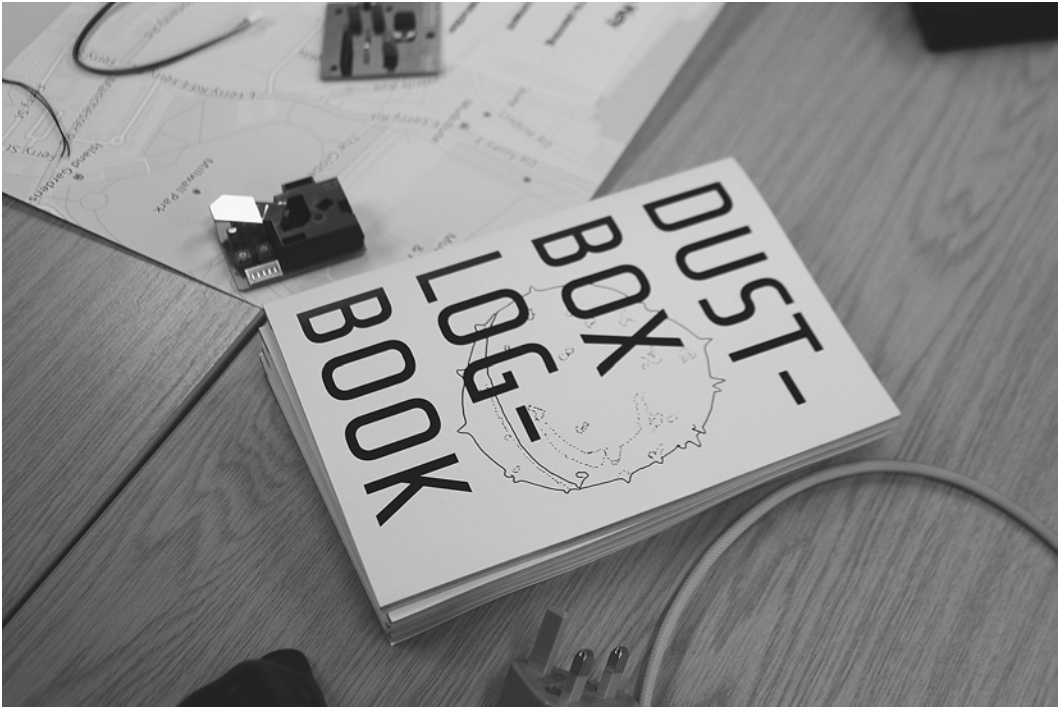
Figure 3.7. Dustbox Logbook with monitoring instructions and space for recording observations; Citizen Sense workshop for mapping where Dustboxes could be set up in the Deptford and New Cross areas. Photographs by Citizen Sense.

instruments at the Marylebone Observatory run by the London Air Quality Network and the UK's Department of Environment, Food, and Rural Affairs (DEFRA).[56] We compared the relative particulate-matter measurements across Dustboxes, as well as comparing levels with measurements from regulatory devices. This colocation and calibration process allowed us to make a notional conversion of raw particle counts (as a measure of voltage) into micrograms per cubic meter, a unit of measurement that would allow participants to make indicative comparisons between the Dustbox and the official monitoring infrastructure.[57] While citizen data express multiple registers of urban experience, the calibration techniques also created one register for comparing data across different monitoring sites and instruments.

As the Dustboxes were assembled into provisionally workable sensors, we built on methods developed through our fracking-based research to organize a public workshop and walk in late October 2016. The workshop brought together residents, community groups, health researchers, and an assembly member of the Greater London Authority to discuss air quality in relation to the changing urban environments of South East London. During the workshop, we described the Dustbox and related tools for analyzing data, discussed previous monitoring efforts in the area, and identified additional monitoring sites based on community knowledge of emissions sources. Participants mapped locations they intended to monitor as they noted likely pollution hot spots and sites of changing land use. We also considered how different observations of air quality might be recorded, since sensors could provide a more real-time and quantitative way to tune in to air quality, while recorded observations of sound, smell, construction activity, traffic, and other urban events could provide parallel ways to configure data as evidence. We provided a Dustbox Logbook where such observations could be noted, which as parallel forms of data would later inform the analysis of citizen data and composition of data stories.

During this introductory workshop, we also set out on a walk to look at key sites of construction activity, roadways clogged with traffic, and industrial sites so that we could discuss where to monitor and how to study changing land uses.[58] As part of the walk, we looked at existing sensors and monitoring infrastructure installed in the area, including air quality and noise monitoring underway as part of the Super Sewer development in Deptford. We discussed whether we could access the data from these monitoring sites, since the Thames Tideway data were not readily accessible to the public, even though this was a national infrastructure project. Although environmental monitoring was taking place in multiple forms in this neighborhood, the data were rarely open to wider use. In the absence of such data from small developments to large infrastructure projects

Figure 3.8. Walk in Deptford to investigate proposed monitoring locations and possible sources of air pollution. Photograph by Citizen Sense.

Figure 3.9. Air-pollution monitoring infrastructure sensing wind speed and direction with air pollutants in Deptford to document possible emissions from the Thames Tideway Super Sewer construction. Photograph by Citizen Sense.

across London it could be difficult to gauge whether local pollution events might be occurring. Participants considered how they might request data at meetings with the Tideway organization. They also assessed which other air-quality data might be available nearby, since at the time the borough of Lewisham had just three air-quality monitors installed over a large area, which would provide only a rough estimate of air pollution at the actual sites of major construction projects.[59]

After walking around these development sites, we moved to a local pub to distribute Dustboxes and talk through how to use the devices and where residents might monitor. Many participants borrowed Dustboxes during this workshop event, while others checked monitors out of the local library or contacted us directly to pick up a monitor. The Dustbox Logbook included setup instructions so that participants could install the devices themselves, although we ordinarily arranged visits to monitoring sites to help participants install and troubleshoot their devices.

The Dustbox infrastructure grew into a changeable and fluctuating infrastructure. As new people began monitoring, others paused or stopped monitoring. We set up a citizen-sensing network that included up to thirty Dustbox sensors monitoring $PM_{2.5}$. However, the number of Dustboxes running varied throughout the monitoring period spanning nearly ten months from December 2016 to September 2017, with consistent monitoring at eighteen locations over seven months. We made numerous visits to monitoring sites to install devices, connect them to Wi-Fi networks, find suitable outdoor space for monitoring urban air, and make adjustments along the way as devices went offline or required repairs.[60]

The loaning of devices was just the beginning of a more extensive process of setting up Dustboxes, since each monitoring spot had its unique requirements and idiosyncrasies, from unusual Wi-Fi router configurations to complex siting arrangements. Dilemmas arose about where to place the Dustboxes so that they would not become soaked in rainstorms or be nicked by passersby but would also be located at suitable heights for detecting pollution.[61] Technical investigations ensued to seek the best arrangement for the monitors in what were often collective outdoor spaces. Dustboxes became part of the furniture in instances of home placements and were also stealthy yard and patio ornaments lurking under out-of-use barbeques and other garden architecture. And the logbook took up residence along with other everyday items, marking and expressing commitments to working toward collective practices for building breathable worlds.

The collective process of setting up a citizen-sensing infrastructure became a way to materialize rights to data, air, and breathable worlds. These practices of building and connecting monitoring infrastructure express a right to constitute

Figure 3.10. Dustbox installation and setup in the Creekside area of Deptford. Photographs by Citizen Sense.

and transform modes of citizenship through attention to and engagement with urban milieus. Rights in this sense are expressed less through legal challenges and more through collective inquiries into the "state of the air," where the "state" is not a nation but an ongoing sociopolitical project of atmospheric citizenship as it meets urban, environmental, and data citizenships. While data citizens in part materialize through sensor-based data practices and infrastructures, they also mobilize along with the activation of rights that might help mitigate and address air pollution.

How to Figure Citizen Data

Inevitably, the question arises about what can be done with data from these sensor devices, especially given the considerable effort involved in setting up monitors. How might it be possible to figure citizen data into forms of evidence that can support and mobilize rights to breathable worlds? Citizen data do not merely replicate or challenge official data sets. Instead, citizen data can figure different worlds and call them into being by expressing lived experiences, recasting approaches to air pollution, and proposing different configurations of urban environments.[62] I build on Donna Haraway's discussion of figuring to consider how this is a way of configuring, numbering, narrating—as well as creaturing—data.[63] "Creaturing" is a concept that I previously developed to express how data obtain relevance through the distinct worlds in which they are generated and have effect.[64] Data in this sense are not simply descriptive of worlds. Instead, data and worlds are co-constituted as distinct modes of inhabitation and conditions where data have relevance. Citizen-sensing practices creature and story air-pollution data by generating problems to which data can respond and attach and for which data come to have significance. Creaturing is a process whereby data can come to figure, or in other words, to matter. But as I suggest here, different creatures of air-pollution data can also create sites of struggle in terms of the pluralistic data and urban worlds that matter or are sustained, overlooked, or extinguished.[65]

In this investigation into how citizen data can contribute to the formation of citizens of worlds, we then considered how to build on and develop analysis techniques that might distinctly figure and creature citizen data by connecting that data to extended infrastructures and practices. Based on our earlier fracking research, we adapted our Airsift data-analysis platform so that Dustbox data could be viewed and analyzed in relative real time. Monitoring sites were mapped with fuzzy locations, and data were open and available for viewing, analyzing, plotting, graphing, and downloading. We pulled in data from the London Air Quality Network API (application programming interface) to compare citizen-sensing locations with nearby regulatory monitors. With this toolkit, people could

investigate, review, and analyze their own data as well as other data in the network. In this sense, we developed the Airsift toolkit to enable DIY data analysis. This approach extended the attempt to democratize monitoring by testing ways to democratize data analysis, while keeping in mind the pitfalls of democratization as a techno-political process and promise.

Because the air-quality data were not necessarily easy to analyze for people new to atmospheric science, we collaborated with participants to host data workshops and drop-in data tutorials to look more closely at patterns emerging in the data. In these meetings, we introduced the Airsift tool, worked through analyses of citizen data sets, compared data across different monitoring sites, and strategized about where else to place monitors and gather data in support of community projects. These exchanges elicited questions about how to engage with pollution in ways that connected to experiences, while also developing techniques for analyzing data and making atmospheric science legible within broader forms of urban engagement. We found that this spatially dense network of citizen-sensing devices allowed us to zero in on particular urban patterns, processes, and distributions of pollutants. Often working at the scale of one-hour and twenty-four-hour mean levels of particulate matter, we could analyze the specific and comparative timing and distribution of pollutants in the area, which allowed us to gain a much more detailed picture of urban activities underway.

With these analysis techniques, we discussed how data could assemble into different forms of evidence that might be useful for informing policy, neighborhood plans, or other initiatives that responded to development, construction sites, and transport in this rapidly changing part of London. Using our Airsift toolkit we plotted times of day and week when pollution was occurring. We often found increased pollution toward the end of the week, with a decrease on Sundays (no doubt related to traffic, the primary source of pollution in London). Events such as Bonfire Night become clearly visible as elevated episodes in the data due to fireworks. And shared pollution patterns were spotted across local and regional sensors, depending upon pollution sources.

As a register of urban environmental processes, the Dustbox data began to unfold in relation to everyday urban life. Moments when air pollutants registered at particularly high levels became an event where we would pool collective knowledge about industry activity, fires, pollution drifting in from Europe, or intensive construction might help to explain peak readings. We also worked together to collect and analyze data from the London Air Quality Network (using air-pollution data and alerts), from Lewisham Council (in the form of planning documents and air-pollution apps), the UK Environment Agency (to document

industrial monitoring sites), and the Greater London Authority (to incorporate tree maps and other data). In this sense, quantitative sensor data did not provide an absolute or definitive figuring of urban events. Instead, citizen data featured most significantly when multiple observations and other forms of data came together to corroborate and transform lived urban experience.

If people collect data but those data are closed down or inaccessible to analysis, then this practice might more accurately be referred to as crowdsourcing, since the data are owned and mined by actors other than the citizens who collect the data. Here, participants generated their own data that were open for further use, including through Airsift as a DIY data-analysis toolkit. But data were more than "open" in the usual sense, since they were not simply a .csv file made available by a government entity in a data repository. Instead, the data were embedded in situated monitoring and data-collection practices, as well as available for open analysis and mobilized within projects to advocate for the urban environment. In this sense, data are less an enumeration of individual behaviors or conditions and more a collective resource and infrastructure that can support exchanges across citizens and worlds. Such practices express a breathability of data as much as a breathability of worlds.

Based on the multiple meetings, workshops, and conversations with participants and residents, we collated our collective findings from the ten months of Dustbox monitoring in seven online and print-format *Deptford Data Stories*.[66] We crafted the data stories as a collaborative method for figuring citizen sensor data in the form of numerical measurements, maps, on-the-ground observations, images, and narratives about activity in the urban environment. The data stories composed the citizen data into distinct accounts of air pollution that could narrate overlooked urban experiences while enabling collective proposals for transforming environments toward greater livability.[67]

In analyzing the citizen data, we found that major traffic intersections and construction activity, as well as the Thames, all showed up as likely pollution sources, often at levels well above the WHO twenty-four-hour guideline of 25 μg/m³ for $PM_{2.5}$. We also found that green spaces and sheltered gardens often had much lower levels of $PM_{2.5}$. The process of arriving at these findings involved discussions about urban activity and likely emissions sources, queries about distinctive patterns in the data, site visits to inspect pollution activity, and negotiations about how and when data might be more widely circulated so that conversations could be held with local government and community groups.

Processes of collecting data generated ways to figure, creature, and materialize rights in the making, including the right to data, the right to clean air, and

the right to make breathable worlds. And yet these rights were unevenly acknowl-edged by local and national government, industry and developers, and other "stake-holders." While such rights are often not enforced or even recognized, data can aid attempts to counteract the failure of rights or to activate the possibility of such rights in the making. The next section considers more specifically how the right to breathable worlds—as a prospective right—materialized through data stories and community projects. Within this context, data practices differently addressed social, political, and environmental struggles by attempting to reinvent rights.

THE RIGHT TO BREATHABLE WORLDS

As we collaboratively analyzed citizen data and developed data stories, these citizen-sensing practices folded into ongoing community projects to defend and transform urban environments. Here, data citizenships materialized through practices that expressed the right to collect and analyze data and the right to advance proposals and implement projects for transforming urban environ-ments as an expression of the right to breathable worlds. The data accumulated from multiple Dustboxes in South East London began to inform the co-constitution of citizens, rights, technologies, and material conditions. Before we publicized the findings from the citizen data, we hosted a workshop to review the draft data stories. In this event, we worked with citizens to review initial find-ings, make sense of data patterns, and compare plots and graphs with observa-tions and experiences. As a key part of the workshop, we coauthored actions and proposals to address and mitigate air pollution in the area. Spanning from pro-posals for transportation experiments to the development of green infrastruc-ture, air-quality monitoring campaigns, and construction controls, the actions responded to air pollution patterns by outlining concrete measures that con-nected to and supported ongoing projects and campaigns. The actions also formed a wish list for additional work that could be done to improve conditions of social and environmental justice. Here, citizen sensing joined up with citizen design, where democratized environmental evidence generated proposals to shape urban environments.

We published the completed *Deptford Data Stories* online in November 2017 and circulated a press release to local councilors, policy makers, the press, and other air-pollution researchers. London newspapers took up the findings, includ-ing the *Evening Standard*, which led their story with citizen data findings that pollution levels were more than six times the WHO's twenty-four-hour guideline
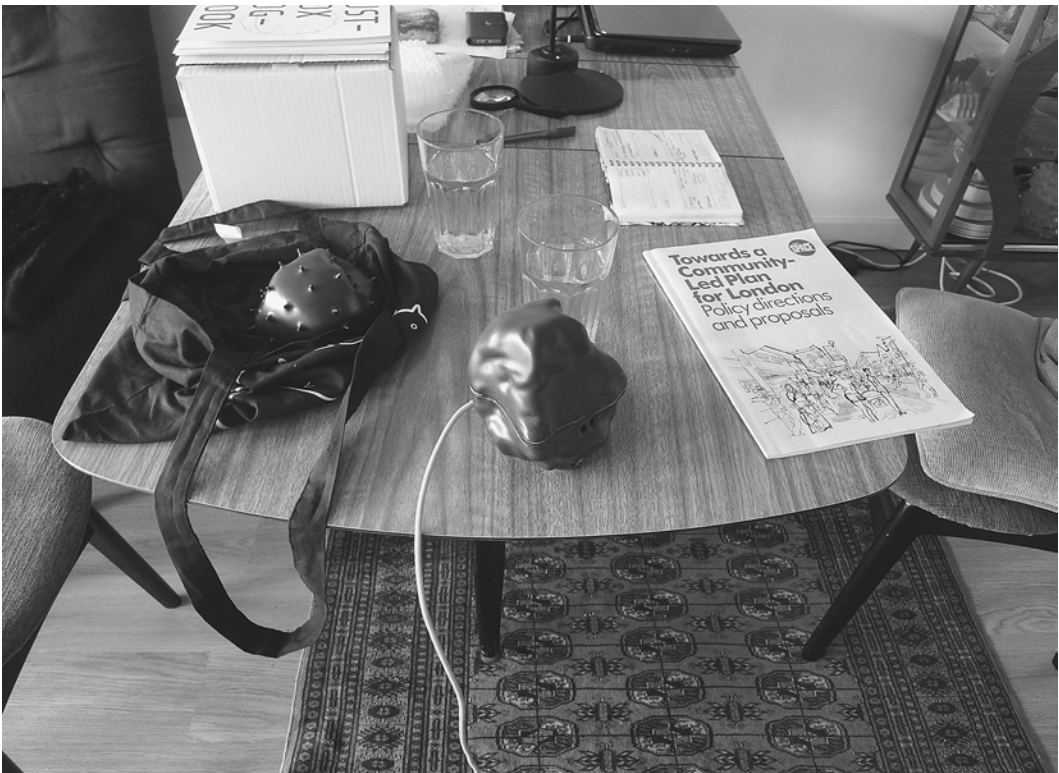
Figure 3.11. Dustbox installation near the Old Tidemill Wildlife Garden in Deptford; community-planning guidelines for establishing a neighborhood plan. Photographs by Citizen Sense.

for PM$_{2.5}$.[68] While the newspapers focused on moments when pollution was exceptionally high, the data stories emphasized the spatial and temporal patterns of pollution and how these could inform and support actions to improve air quality in a sustained way.

Nevertheless, the news about excessively high pollution levels compelled the local Labour MP, Vicky Foxcroft, to take up the citizen data findings and bring them to the House of Commons for a debate. She put her concern and question to the Leader of the House, Conservative MP Andrea Leadsom: "Research carried out by the Citizen Sense project at Goldsmith's [sic] in my constituency shows that pollution in south-east London reached six times the World Health Organisation limit on several occasions during the past year. Can we have a debate on this important public health issue?"[69] In response, Leadsom noted that "the Government are determined to tackle the problem of air pollution" and action was being taken to "encourage and help local authorities to pay for new pollution-free zones." At the same time, Leadsom noted that the Mayor of London should be "putting in place measures to reduce the poor air quality in our great city."[70] Here, citizen data circulated to the center of the UK government. While it presented a persuasive and even alarming record of air pollution, along with a set of proposals for how to address this problem, the evidence was met with relative platitudes when Foxcroft asked what action the Government would take.

For community groups, the local and national government's attention to air pollution in the area was a welcome development. At the same time, the findings and action points led to variable outcomes. Data here did not seamlessly unfold into action. Instead, the process of mobilizing data generated additional complexities. Far from the frictionless connections between data and action that some citizen-sensing devices promise, here citizen data became ensnared in ongoing struggles over urban environments, ways of life, and local governance. Yet the difficulties of taking action could, in another way, register as the very conditions that form citizens and citizenship. Democratic engagement requires possibilities for exchange, as part of what constitutes the breathability of political life. But these exchanges are also impeded, blocked, and shut down, even as people attempt to observe, contribute, listen, and be heard when communicating how their worlds matter. Action materializes through struggle as political subjects try to realize these formative exchanges. Struggle, however, is a condition that the promises of citizen-sensing technologies often gloss over when promising more streamlined democratic engagement.

Despite the news of elevated pollution levels, the data stories provided a way to figure citizen data as narratives and experience, rather than only present quantitative measurements. Citizen data did not seek to fulfill a regulatory function,

Figure 3.12. Air-pollution sources in Deptford and New Cross, including river vessels burning ship diesel; and traffic on the A2, a major South East London thoroughfare. Photographs by Citizen Sense.

Figure 3.13. Old Tidemill Wildlife Garden and community-generated architectural plans and proposals for the space. Photographs by Citizen Sense.

but asked different questions and provided alternative perceptions of air-quality pollution that connected to concrete proposals for action for urban environments and social justice. In this sense, citizen data practices did not merely demonstrate that air pollution was occurring or often exceeded regulatory guidelines. Instead, citizen data supported campaigns and projects for transforming the urban realm. These trajectories of data and action were mobilized to demonstrate attempts to address urban pollution and inequality, and to make more breathable worlds. The "findings" of the data stories became ways of figuring, creaturing, and proposing actions for worlds where this data might register and become relevant.

How to Pluralize Data Practices

Among the multiple sites where citizen sensing took place in Deptford and New Cross, we identified seven clusters of monitoring locations that became the basis for each of the seven data stories. One of these locations, Old Tidemill Wildlife Garden, was an area where many people were interested in monitoring, since they hoped to demonstrate that the green space was beneficial in mitigating particulate matter levels. Old Tidemill Wildlife Garden was originally a school garden that was turned over to the public when the school moved. The space became a wild green oasis within a heavily developed and polluted urban area, where community groups hosted forest schools and biodiversity workshops, organized community picnics and music festivals, built adventure playgrounds and tended vegetable gardens, and generally fostered the creative and activist energy for which Deptford is well known.

But in 2016, developers sought planning permission to build a range of market-rate and social housing in the place of the Old Tidemill Wildlife Garden. Peabody Housing Association developed plans to raze the garden and nearby block of council housing to build flats to address a housing shortage in the area.[71] Residents and workers were especially concerned about losing the community garden and adjacent social housing to high-rise (and more expensive) housing developments that would significantly alter the area. Here, the city was being made and remade, less as an expression of the right to build breathable worlds and more as a set of development projects that led to ongoing struggles over urban environments.

Residents, workers, and advocates for the Old Tidemill Wildlife Garden, including community groups Deptford Neighbourhood Action and Voice for Deptford, among many others, began a campaign to save the green space in response to what they felt were inflexible and unjust development plans. They worked with a design and architecture group to develop an alternative plan for the site that would preserve the green space and existing council housing while also

allowing for new housing. The campaign and plans to save the space unfolded through a protracted struggle with the local council to draw attention to the significance of the green space, existing housing, and community ties built up over decades. People lobbied the local council, attended planning meetings, raised concerns at local ward assembly meetings, developed online campaigns on social media and websites, set up crowdfunding initiatives, worked with artists and designers to make films and host events, and publicized garden openings so that more people in the area would visit and learn about the space.[72]

In this context, several people who were engaged in the struggle against the development of the garden took up air-quality monitoring with Citizen Sense to develop yet another form of evidence that might aid their campaign. They sought to establish whether pollution was occurring on busy roads nearby and if lower levels of pollution could be detected within the garden area. As a result, we located monitors on balconies and outdoor spaces adjacent to the garden. Over a several-month monitoring period, the sensor data demonstrated a clear pattern of lower pollution in areas sheltered by the garden, and higher pollution in areas exposed to busy roadways on the perimeter of the garden. These findings spurred proposals, which the data stories included, to protect the garden as an important green space in the area and to augment and extend green infrastructure to address and mitigate pollution in the area.

Despite the soundness of the citizen data and the creative scope of the proposals put forward for how to preserve the garden while accommodating new development, the council remained unmoved by the findings or proposals. It voted to approve the development plans and to terminate its lease on the garden. While the council cited the need to address housing shortages as a rationale for developing the site, many dissenters noted that the development would not provide affordable social housing, yet it would remove access to a biodiverse green space. Here, citizen data did not facilitate or improve rights to data, environment, participation, or breathable worlds.

With the council's decision to forge ahead with the new housing and the turning over of the garden site to developers, multiple protests ensued. In August 2018, campaigners began to occupy the garden site, which included numerous mature trees, to attempt to halt its demolition. Protestors, as well as news reports of the garden occupation, frequently cited the findings from their citizen-sensing data, noting the problem of air pollution in the area and the role of green space in providing relief from pollution. Mitigation of air pollution became a key rationale for saving the garden, among other points related to protecting its biodiversity, preserving local housing and the community that had been established, and providing affordable housing.[73]

Figure 3.14. Save Reginald! Save Tidemill! campaigners photographed in the Old Tidemill Wildlife Garden in Deptford in October 2018. Photograph by Andy Worthington.

Donning gas masks and holding placards with phrases such as "Deptford Needs to Breathe!" and "Lewisham's Plans Cause Asthma," protestors voiced the need to address air pollution in the area and to make more breathable worlds not just by reducing pollution levels but also by safeguarding limited green space. People seeking to protect the garden made a film to persuade viewers of its unique characteristics while documenting how it made the area more breathable. The interviewee in the opening film sequence notes, "I just take a huge, deep breath is the first thing I do when I come in here," in reference to entering the garden and being immersed in other urban encounters and experiences that do not require sealing oneself off from harsh, traffic-clogged, and polluted environments.[74]

Despite these objections to the destruction of the garden, along with appeals to citizen data and multiple other forms of evidence mentioned throughout this chapter, the council persisted in turning over the site to developers by removing occupiers of the garden in October 2018. To do so, it hired the security firm

Figure 3.15. Protest installation at the demolition of Old Tidemill Wildlife Garden and nearby trees along Deptford Church Street and the Thames Tideway Super Sewer. Photographs by Citizen Sense.

County Enforcement, which had also participated in enforcement activities during the UK miners' strike in the 1980s. Many residents, workers, and protesters found this to be a particularly brutal and reprehensible measure taken by this Labour-dominated council.[75]

In February 2019 the garden was leveled and trees were demolished. Residents continued to monitor this destruction, using photography and video to document scenes of trees being ripped from the ground and cast aside as the site became a staging area for another London high-rise.[76] This was only one among many additional sites up for development in this compressed area. Shortly after developers leveled the garden and its trees, an additional seventy-four plane trees were felled to make way for the Super Sewer, and further trees were planned for demolition to build housing in which residents would not be able to open their windows during peak hours due to the elevated levels of air pollution in the area.[77] People continued to lodge ongoing objections to these relentless developments, appealing to their evidence gathered about air pollution. Councilors, however, did not review the citizen data and in some cases are purported to have boasted that they had made up their minds about the importance of housing development, irrespective of citizens' concerns about pollution and other damage to the environment and community fabric.[78]

When the local council failed to heed arguments about the unaffordability of the proposed urban housing—on the basis that there was neither a specific "right" to affordable housing, nor did people feel as though rights would be respected—citizens combined further data about air pollution to document the impacts from construction and traffic and loss of green space. Yet despite the established right to breathe clean air, as well as the right to participate in environmental decision making, these apparent guarantees of democratic engagement did not ensure that citizens would have a voice or be able to inform the shape and process of development in the area.[79]

The difficulty of mobilizing rights and the likely failure of attempts to realize rights can lead to the use of other tactics that attempt to contribute to the exchange, cultivation, and breathability of environments. Data citizens form through these practices of mobilizing evidence to support more democratic exchanges. Similar to the discussion in the previous chapter, at times the citizen data collection can offer alternative forms of evidence that enable exchanges with regulators and developers, politicians and the press. Data can document and generate different registers of experience, and enable possibilities to be and become citizens of worlds. The citizen-sensing practices and proposals narrated within the data stories developed in response to impasses experienced, and attempts to advocate for different approaches to urban environments.

Figure 3.16. Thames Tideway Super Sewer construction. Photograph by Citizen Sense.

Yet data can also produce their own disappointments, and rather than serve as a corrective to rights, they can compound problems of democratic unaccountability. Data do not always perform as expected. Data can be difficult to work with and analyze, but they can also lead to inertia and indifference on the part of regulators and policy makers who have fixed agendas and undemocratic practices. Some data count more than others, and data need to operate—and be creatured—within particular registers of relevance to be heard, apprehended, and mobilized. Data inequalities can take place not only in terms of whose data counts but also whose data can register as legitimate and significant.[80] These dynamics often unfold in relation to established dynamics of privilege and power, but they also are performed through more insidious dynamics of who gets to be counted as "the adult in the room." The "good citizen," as Claudia Rankine has suggested, is typically someone who does not speak truth to power, does not expose inequality, but does maintain a polite demeanor so as not to disrupt established conventions of civil and political conduct.[81] Such practices of the good citizen tend to reproduce rather than remake existing power structures.

Customary ways of exercising the *right to*, moreover, can assume a universal, privileged, normative, masculine, white, and actively enabled form of citizenship. Such citizenship practices would in part require that people struggle and confront injustices and exclusions, often in public forums and settings that favor some voices over others. In attempting to exercise these rights, many struggling urbanites could be exhausted by the crushing indifference of political processes.

As Berlant writes about such political engagements and attachments, people are "worn out by the promises that they have attached to in this world."[82]

Citizen-sensing devices seemingly invoke rights to data, to environments, to participation, and to breathable worlds. They promise to enable data citizenships that could redress the failure of rights. But the reinvention of rights requires worlds in which to take hold and become relevant. Data citizenships and citizen data do not solve the problem of partial rights and "citizenship contradictions."[83] Rather, they cultivate other strategies for making and remaking breathable worlds where data could become relevant. Through this process, citizen data can contribute to forms of action that reinvent rights, less as the pronouncement of universal, static, or fixed claims received in a uniform register, and more as attempts to build more breathable worlds within contingent, differential, and unequal environments. These practices express the right to monitor, the right to data, the right to participation, the right to environment, the right to experience, and the right to be political. But they do not assemble here as a straightforward implementation of a claim. Instead, they involve complex struggles to make worlds in which more just social and environmental conditions might be possible.

Such struggles can be generative of renewed conditions of citizenship in the making—as well as in the unmaking. As much as citizens and worlds are made and remade, they are also unmade and bound to unworkable conditions. Technologies of citizenship might need to be formed, transformed, and unformed.[84] These conditions are equally constitutive of data citizens, but are often overlooked by techno-optimistic narratives that would characterize these practices as effortlessly achieved. Making and remaking rights, citizens, and worlds is not an inherently liberatory process. Yet democratic engagement requires taking action that carries risks of uncertainty, disappointment, and failure.[85] Rather than transcend struggles to contribute to democratic life, citizen sensing and citizen data practices become interlocked with and co-constituted by these ongoing social movements.

How to Make Urban Worlds with Citizen Data

The right to data would seem to promise that more democratic and livable conditions could be realized through data collection. But as this discussion has suggested, it is not data for data's sake that would activate these changes. The right to data is not a linear sequence that activates the right to transform environments. By collecting data and identifying pollution hot spots, citizens support and mobilize projects to intervene within and reshape environments, along with the sociopolitical relations that contribute to conditions of (un)breathability. Rather than collecting data for regulatory compliance, citizen-monitoring practices struggle with the right to data as the right to make breathable worlds.

Figure 3.17. Dustbox installation in the Deptford Park area where Deptford Folk is active in proposing and developing changes in the urban realm. Photograph by Citizen Sense.

Deptford is an area with multiple construction projects underway within the context of heavy traffic, an incinerator, and river vessel pollution. At the same time, this area has a shortage of green space, a lack of sustainable transport, a high rate of poverty, and social and environmental injustice sedimented into neighborhood fabric. Within this context, a second monitoring area, Deptford Park, became a key site where citizen data contributed to ongoing efforts to transform transportation use in the area.[86] Several members of Deptford Folk, a community group working to improve parks in the area, installed Dustboxes to understand the effect of road transport on pollution levels and generally compare levels across the Borough of Lewisham.[87] Deptford Folk was established in 2015

to "improve parks and the routes to them." In a short span of time they began projects to improve local park infrastructure, plant trees, and undertake transportation pilots by temporarily closing streets to automobile traffic. People were interested in monitoring air quality to support and expand these ongoing initiatives. In addition, the South East London Combined Heat and Power (SELCHP) incinerator is located within the Deptford Park neighborhood, and residents were interested to see whether emissions from this site and nearby waste-transfer yards would show up in the citizen data set.

When MP Vicky Foxcroft tweeted about her call for a debate in the House of Commons about findings from the citizen data, Deptford Folk replied: "Let's debate but also let's take action: we're planting more trees in #Deptford as part of #Evelyn200. We're redesigning streets to reduce traffic and we're supporting people to take up cycling." This focus on "action" formed a key part of how Deptford Folk mobilized citizen data along with a multifaceted set of initiatives underway in the area. With ten times more cars on the road in London in 2012 than in 1949,[88] the need to address congestion was keenly felt. In advance of establishing where specific pollution patterns were occurring, the group was already in the process of testing transportation pilots with Lewisham Council to undertake traffic calming. They were hosting bicycle-repair workshops and preparing a larger funding application with a walking and cycling charity, Sustrans, to apply for Liveable Neighbourhoods funding from Transport for London (TFL) so that concrete improvements to transportation could be implemented in the area. They used their preliminary citizen-sensing data from the area to support their bid and to document how alternative transportation arrangements could benefit the area.

Yet citizen data did not unfold in an Enlightenment-style trajectory, such that once people had evidence of pollution they took action. Instead, Deptford Folk were already in the process of undertaking multiple initiatives to improve the local environment. These actions drew on data from planning portals, council documents, online data sets, websites, historic campaign activity (including John Evelyn's 1661 proposal to plant trees to improve air quality), among many other resources. Citizen-sensing technologies and data did not deliver a simple pathway to action. Instead, they became enfolded in these multiple and accumulating forms of evidence that variously supported attempts to improve transport and streets. In this sense, citizen data also joined up in a pluralistic way with multiple observations and other data sets from community group members, partner organizations, planners, city hall, and more.

In late 2017, Deptford Folk learned that their collaborative Liveable Neighbourhoods bid was successful, providing them with £2.9 million to undertake

Figure 3.18. SELCHP incinerator in background, with new bikeway in foreground; Westminster garbage trucks transport rubbish from West London to South East London to be incinerated at SELCHP. Photographs by Citizen Sense.

a larger study to develop sustainable transport in the area.[89] From 2017 to 2019 they collaborated with Lewisham Council and other organizations, as well as local residents, to review streets and transport in the area. As they worked to join up fragmented bicycle and pedestrian routes, connect green spaces, and create traffic-free areas, they frequently referred to the problem of air pollution as a key impetus for addressing excessive traffic in the area. Citizen data were mobilized in a supporting way to inform proposals for which streets to make traffic-free based on detected pollution hot spots. These proposals included addressing ingrained inequalities, including the uneven exposure to vehicle-based pollution in an area where many people do not own cars and are constrained in their ability to move around in an area without accessible walking, cycling, or public transport. With these proposals now having gone through community consultation, further work is still to be done to turn plans into interventions that could make this a more breathable urban milieu.

While these multiple community actions took place, Lewisham Council developed a series of air-quality actions, seemingly in response to findings from the citizen data but never explicitly acknowledged as such. The council expanded its regulatory monitoring sites to include a fourth station in Deptford as well as a fifth station that included a new monitoring supersite in Honor Oak Park. It developed a green-infrastructure fund for community groups, and it undertook no-idling campaigns and supported traffic-reduction initiatives.[90] Yet these efforts to address air quality were somewhat disengaged from the citizens and research groups who had worked to document, analyze, and propose different approaches to addressing air pollution. They were also relatively short-lived, since the council announced in late 2018 that it would cut its Strategic Air Quality Programme due to lack of funds and would instead focus on regulatory and statutory air-quality requirements.[91]

The breathability of worlds shows up here as the need to transform urban milieus based on felt and lived conditions. Citizen data were not the singular impetus for these transformations (despite the claims of technology companies). Instead, they supported but did not precede ongoing projects. Data were not the precursor to action, but they did reinforce the need for action. Data contributed to open-air instrumentalisms, along with the co-constitution of rights, citizens, and worlds in the making.[92] This more processual and pluralistic set of data operations demonstrates how citizen data become enfolded into rights claims not as fixed discursive expressions of individuals, but instead as prospective conditions constituted through material practices in the urban environment. In this way, rights and data are reinvented as instruments and toolkits that attempt to make and remake breathable worlds.

Figure 3.19. Deptford Park; tree selection guide used by members of Deptford Folk for a tree-planting campaign. Photographs by Citizen Sense.

By building more breathable worlds, people also hoped to connect air pollution to the health of urban environments and reduce the negative effects of pollution. In this way, the Ella Roberta Family Foundation,[93] named for a nine-year-old Black girl, Ella Kissi-Debrah, who died from asthma in this broader area of South East London, has also made a point of linking air pollution to the need to improve environmental conditions.[94] Ella and her family lived twenty-five meters from the South Circular, one of the busiest roads in London. Despite her multiple trips to ICUs due to asthma attacks, medical workers did not address how air pollution from roadways could be a factor in her asthma. The Ella Roberta Family Foundation was granted a second inquest to attempt to establish air pollution as the cause of Ella's death. The inquest was successful, and her death certificate now records air pollution as a cause of death.[95] Such an action could more directly establish the consequences of unbreathable worlds, where pollution literally constricts and collapses the lungs of those most vulnerable and most exposed to emissions sources. Here, the right to creature data includes the ability to categorically state that air pollution does kill people—nearly nine million worldwide every year, including 40,000 in the UK, and 10,000 in London alone.[96]

Residents have continued to protest this inattention to and neglect of air quality, notably with a campaign for cleaner air, "Let Lewisham Breathe," with Extinction Rebellion Lewisham.[97] In June 2019, protestors undertook a morning rush-hour disruption on major roads in South East London, including the South Circular (where Ella Kissi-Debrah had lived) and the A2 (where citizen data had documented air-pollution levels at six times WHO guidelines for twenty-four-hour averages). Protestors held signs that read "This Air Is Killing Us," "Lewisham Is Choking," "Deptford Needs Trees to Breathe," "Toxic Air Zone," and "R.I.P. Ella Kissi Debra 9 years old! Killed by pollution and asthma." These same calls to breathability gained renewed traction in 2020, with Black Lives Matter protests taking place across London and in cities worldwide and air pollution and deprivation exacerbating the impact of Covid-19, especially for ethnic minorities.[98] Such events assembled into a perfect storm of unbreathability, where as one protestor's placard paraphrasing Frantz Fanon noted, "We revolt because we can no longer breathe."[99]

HOW TO REINVENT RIGHTS

The need to make more breathable worlds is, more than ever, pressing upon citizens in the making. Breathable worlds materialize through collective engagements, political relations, and possibilities for constituting citizenships, rights, and milieus of exchange. The making and remaking of worlds with and through

citizen data might work toward more breathable conditions. But this trajectory is not guaranteed. While writers such as Achille Mbembe call for a "universal right to breathe,"[100] the supposed condition of universality could work against the possibility of realizing—and reinventing—rights in highly differential conditions.[101] Instead, practices of combat breathing and situations that tune in to breath as an exchange and process that constitutes breathing entities, environments, and relations could generate sharper attention to the differential conditions that facilitate or impede the right to breathe. With these practices for making and remaking breathable worlds, it might also be possible to reinvent rights—to breath, data, participation, environments, and worlds—as a necessarily ongoing process of struggle.

From transportation experiments to the installation of a regulatory air-quality monitor in Deptford, the demolition of garden space, and the detection of pollution on the Thames, the effects and entanglements of citizen data developed in these collaborations between Citizen Sense and communities were complex and multiple. Sensors can format distinct modes of actionable data, yet they also mobilize forms of open-air instrumentalism that contribute to the making and remaking of urban worlds. As discussed in this chapter, citizens can generate data to support and create more just and livable cities. This is a particular way of understanding the right to make breathable worlds through the right of citizens to collect, analyze, and communicate data that dispute and question official accounts of problems such as air quality in relation to urban processes. The right to data then proliferates along with the right to clean air, the right to participate, the right to breathe, and the right to environment, as together they materialize as the right to make breathable worlds.

While data citizens form through multiple urban environmental data practices, they can also challenge and expand the usual ways of documenting and addressing environmental conditions. Indeed, one air-quality officer with whom I spoke about air-pollution levels in London stated that there was little that could be done about $PM_{2.5}$ levels in their borough, as the annual average of 19 μg/m³ varied by only +/–1 μg/m³ across their monitoring area. Particulate levels were seen to be attributable to pollution traveling from outside of the immediate area, or even from Europe or farther afield. From the expert's-eye view it might seem sensible to agree with the intractability of this problem, even though annual $PM_{2.5}$ levels of 19 μg/m³ are nearly twice the WHO's annual guideline of 10 μg/m³. Yet expert practices and infrastructures are here organizing the problem of air pollution in a particular way by assessing data sets according to annual averages as a measure of compliance (or not) with air-quality objectives. The numbers,

which apparently record the facts of air pollution in London, will not budge, and so it seems we are stuck with the air we've got.

But data citizens can offer a diverging picture of urban air pollution by documenting differently granulated patterns and distinct city processes. Inevitably, when citizens work with "indicative" air-quality sensors that produce "just good enough data," multiple questions arise as to the accuracy of devices, the actors who can put forward evidence with sensor data, and the procedures and protocols that might be in place to ensure the validity of citizen data.[102] At the same time, an approach to air-quality monitoring that focuses on regulatory compliance offers just one way of investigating urban air pollution. Citizen air-quality monitoring can demonstrate a very different set of attachments and concerns, as well as ways of working with data and evidence that become practices of computing otherwise. Here, citizen data do not attempt to replicate or become an organ of expertise. However, they do constitute the problem of air pollution differently, which points to the plural worlds that converge and diverge through environmental crises such as air pollution. Data and data practices form distinct sites of collective inquiry, making, and remaking. These practices are also generative of distinct data citizens.

As this chapter outlines, certain ways of establishing the facts of environmental problems are treated as more credible than others, with significant consequences for how data citizens can make contributions, as well as how urban life is experienced. Ruha Benjamin suggests that empiricism often only works for some, since no amount of evidence will be accepted if the "facts" challenge the status quo or are presented by marginal or unauthorized voices. As she writes, "The facts, alone, will not save us."[103] Citizens who collect or analyze data might register new and significant observations, but these forms of evidence might not make a dent in political or regulatory processes. Those who are most affected by environmental pollution could be the least likely to be able to take up monitoring and have their data count. In this sense, rights to data are not easily configured through clear codes of access and use, since data might be "open" but only certain groups can mobilize or make claims with such data, often in relation to other data sources and with access to particular trajectories of power. As expressed through citizen data collection, the right to breathable worlds can be a project undertaken through struggle, but that falls flat if political environments and relations do not exist to build on that struggle.

The data citizen, in this sense, is not an automatically enlightened or empowered political subject. Indeed, it could be an ambiguous position, since data also require environments of relevance to take hold and have effect. Whatever

accomplishments citizen data make in their observations, infrastructures, and collective experiencing, in order for them to realize less destructive environmental conditions these data also need to set in motion more just worlds that enable data to have an effect. Effectiveness, here, is less about the success or failure of data and more about the impasses that can arise when prevailing forms of political engagement break down or demonstrate hollow promises. The practices of data citizens can, in this way, work toward worlds where citizen data matter while also making more breathable worlds.

Citizen data practices attempt to support initiatives to make and remake worlds toward more breathable, just, and livable conditions. Data citizens and data citizenship materialize through these attempts to realize greater breathability by computing otherwise. But these practices are not just about the rights-based practices of preconstituted individual citizens. Instead, they involve searching out and making the conditions that would allow for collective exchanges across subjects and milieus. In order to realize the right to breathe, it might also be necessary to establish conditions to reinvent rights so that people can become citizens of worlds.

As noted in the introduction to this chapter, an increasing amount of legislation is being enacted to protect citizens' rights in relation to data, whether through tracking, the right to be forgotten, the right to open data, the right to transparency, and more. However, the generation of citizen data through citizen-sensing technologies raises the question of how data citizens and rights in the making are coextensive with worlds in the making. Rights to clean air might exist in some cities and countries, but these rights are frequently not observed. Citizen data practices have the potential to reinvent the terrain of rights—how they are formed, expressed, transformed, claimed, or abandoned. Such data practices form along with political subjects and collectives that are in search of more breathable urban worlds, but which rights do not fully support.

In this chapter I have examined data citizens and citizen data to consider on the one hand how data are produced in and connected to urban environments through sensors that monitor air quality, and on the other hand to study how citizens form environmental evidence that relates to their worlds of experience. While air-pollution monitoring instruments can be made to align, more or less, to detect a similar pollutant level in space and time, the actual uptake, use, deployment of sensors, and generation of data can veer into different directions when used by air-quality officials for regulation as opposed to residents observing and documenting changes in urban spaces. Not to attend to citizen data is to neglect urban dwellers' attachments to their cities, to the problems that matter in their lives, and to the practices whereby they document, analyze, and communicate

evidence that speaks to their concerns. To make expertise the only register for producing legitimate data is to forgo and forget the importance of the environments that sustain data and allow data to have effect. It is also to suggest that an annual average calculated to comply with a regulatory guideline is the only way to organize the problem of air pollution—as well as the only way of considering how to create possible preventative and mitigating actions. To adhere to one official version of collecting data and forming facts is also to miss the question of which problems these facts pertain to and which worlds they sustain.[104]

It is possible *both* for experts' data indicating that annual-mean levels of $PM_{2.5}$ are 19 µg/m³ *and* for citizens' data indicating specific patterns of elevated emissions when viewed as one-hour and twenty-four-hour data sets to be "accurate." Each of these forms of data takes hold and gains relevance within distinct worlds that can offer diverse responses to environmental problems. If a more pluralistic ontology of data and data practices were to be realized, then both—and more— of these creatures of data would need to be recognized as relevant to inundated urban habitats. Indeed, the very qualities of expertise could begin to shift and respond along with the environmental conditions that are meant to be governed toward more collective projects. Here is where data citizens materialize as figures constituted not just through digital technologies or observational practices but also through their concern for relations and communities on behalf of which evidence would be mobilized.

No singular figure of the data citizen concretizes here. These are, as Berlant has suggested, proliferating forms of citizenship, since they are tied to the worlds that are endured, narrated, created, and hoped for. Proliferating modes of citizenship are indications of different experiences that will inform how rights in the making are taken up, if at all, and the struggles they produce. Here, the right to data and the right to make breathable worlds are co-constitutive. The right to clean air is not simply about meeting a regulatory threshold for criteria pollutants; it is also about transforming the urban processes and milieus that are grinding away at conditions of breathability. These affective engagements are productive of different ways of being in, as well as making and remaking, worlds.

TOOLKIT 4

PHYTO·SENSOR TOOLKIT
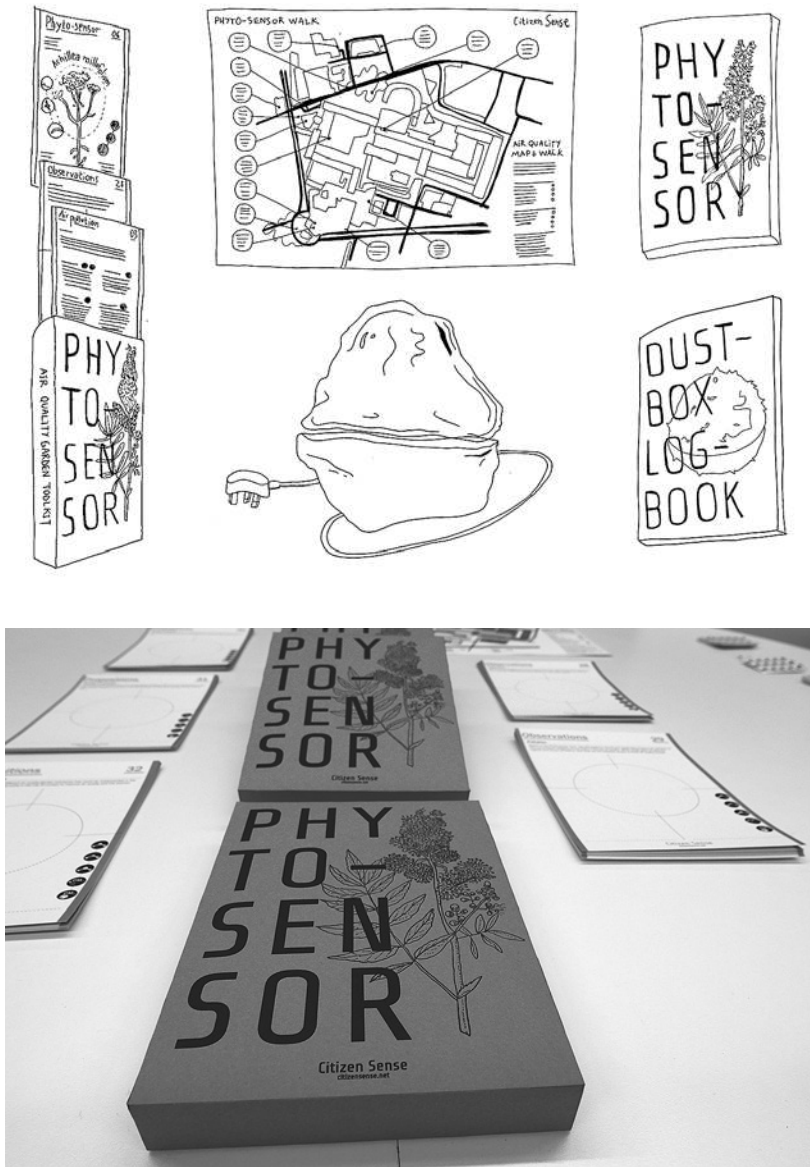
Phyto-Sensor Toolkit developed by Citizen Sense for developing air-quality gardens and monitoring air quality. Illustration by Sarah Garcin; photograph by Citizen Sense; courtesy of Citizen Sense. This toolkit can be found in a more extensive form online at https://manifold. umn.edu/projects/citizens-of-worlds/resource-collection/citizens-of-worlds-toolkits/resource/ phytosensor-logbook.