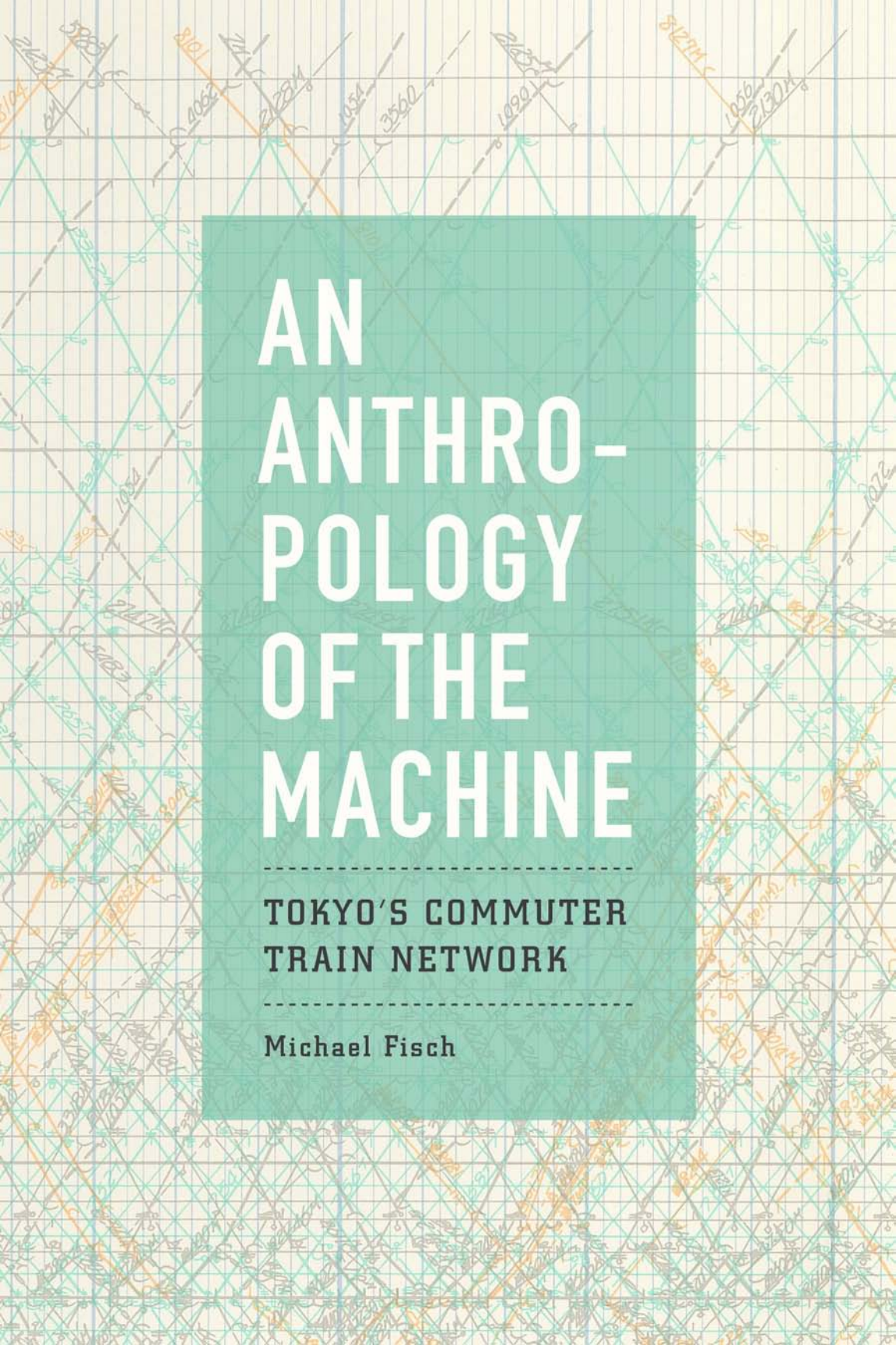
AN
ANTHRO-
POLOGY
OF THE
MACHINE
TOKYO'S COMMUTER
TRAIN NETWORK
Michael Fisch

An Anthropology of the Machine

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Tokyo's Commuter Train Network

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This book is dedicated to my partner Jun
and to our sons Kai and Mio.

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Preface

This book is a technography of collective life constituted at the interplay of the human and the nonhuman, of nature and machine. Its central scene is Tokyo's commuter train network, one of the most complex large-scale technical infrastructures on Earth, where trains regularly operate beyond capacity. This book treats this scene both as an articulation of specific sociohistorical relations between humans and machines and as a general expression of a current but also potential condition of collective life. The weight of analysis falls on the latter, the potential of collective life, for this book is an argument concerning not only what collective life *has* become but moreover *what it can become* under contemporary conditions of media and technology.

The events of March 2011, when a strong earthquake off the northeast coast of Japan sent a massive tsunami into the shore, killing thousands of people and causing several reactors at the Fukushima nuclear-power plant to melt down, have imparted urgency to the question of how we might inhabit and collectively survive within current and future socio-technical conditions. The tragedy of March 2011, or 3.11 as it is known in Japan, resists neat categorization as a human, technological, or natural disaster. It was all three simultaneously, demonstrating the absolute meaninglessness of a mode of thinking that remains confined to bounded sets of relations. This book takes up the challenge of rethinking technology by examining a large-scale transport infrastructure in Japan, where the issues provoked by 3.11 are inhabited in a daily

and regular manner, and where we can begin to develop an anthropological media theory of scale and ecology.

In taking this approach, this book advances the normative claim that we need to transform our understanding of technology if we hope for collective life to not only survive but thrive on this planet. Just as there can be no collective future without technology, there will certainly be no future collective without a significant transformation in how we think of technology and what we demand of ourselves in relationship with it. This is not a claim that technological development will save life (human and nonhuman) on this planet. Rather, this book is an argument for a different kind of ontological entanglement with technology, one that stresses a dynamic quality of ethical relationality and trust instead of rationalized interactions and profit. By *relationality*, I mean a system that is less rather than more determined, a system that has increasing leeway for interacting, thinking, and becoming with the human and nonhuman environment. The term I use to capture the notion of a relationality of quality and trust with technology is *technicity*. Coming out of a long history of machine theory, *technicity* denotes a machine's degree of dynamism and openness to current and future relational flourishing or becoming. The term emphasizes a technology's ontological and conceptual affordances, as well as its trustworthiness as a partner of collective life in the present and future. This is not an argument for human exceptionalism. It is, rather, an argument for a post-human humanism that recognizes the equal importance of technology, human, and nonhuman in the formation of a robust collective life while placing exceptional responsibility on human beings to maintain the dynamic and diverse integrity of collective emergence. Technography is the medium of post-human humanism. Embracing an experimental, speculative modality, technography seeks to open collective futures.

Among the many things that Fukushima revealed is the woeful inadequacy of the term *technology* for parsing the complexity of our contemporary collective life. The term *technology* does not allow us to make ethical distinctions between such vastly different kinds of machines as nuclear reactors, commuter trains, and more mundane personal devices like smartphones. It flattens all these machines into a single category. Even aside from their obvious but significant differences in scale, it seems like common sense that these are incommensurable kinds of machines that engender vastly different kinds of relationships—yet we have no real way to talk about the quality of ontological entanglement these technologies allow. *Technology* merely denotes a value-free instru-

ment, a means to an end, whose successful (read: "uneventful") operation is reduced to a matter of rational governance and technological management. This book rejects this reduction. It argues instead that we must begin to think about technology differentially, in terms of its trustworthiness.

Technological trustworthiness is not only about reliability, resilience, and fail-safe mechanisms. Although these are important attributes for any machine, they are not necessarily what makes for an ethically oriented ontological entanglement. Hence the argument, which one often hears from advocates of nuclear energy, that good nuclear power is just a matter of better reactor design and more-rational systems of management does not enter into how this book formulates trustworthy technology. Machines with which we can be in a relationship are machines that can be in a relationship with us. Trustworthy machines do not demand compliance; they are forgiving and ontologically capacious in their capacity to evolve with collective life.

Why develop such an argument through a train system, let alone Tokyo's commuter train network? Surely there are more timely techno-assemblages with which to think about current collective life, such as biotechnology, the internet, or even smartphones. Isn't a commuter train network merely an obvious instantiation of modern industrial technology and a bygone modality of value production through the capture of surplus human labor and attention? I contend that Tokyo's commuter train network is the ideal medium with which to rethink technology because the network operates beyond capacity and because generally we understand the train to be the originary machine ensemble in the evolution of modern industrial society and the advent of our current second-nature technological condition. In addressing questions concerning technology by thinking through Tokyo's commuter train network, this book develops a conceptual history of the train via technicity and opens up alternative ways for thinking about future collective life. This book posits that if we can tell the story of Tokyo's commuter train through its margin of indeterminacy and technicity while emphasizing questions of dialogue and relationality over tropes of conditioning and determination, then we can resist received technological narratives and identify novel limits and novel possibilities for trustworthy technologies of collective life.

Introduction: Toward a Theory of the Machine

Tokyo's commuter train network is a complex web of interconnecting commuter and subway lines that dominates the urban topography, providing the primary means of transportation for upward of forty million commuters a day from the city's twenty-three inner wards and three adjoining prefectures.[1] On a typical weekday morning, the system's ten-car commuter trains are packed at 175 percent to 230 percent beyond capacity. This means that a train car designed for no more than 162 people will carry between 300 to 400 commuters. With seven to ten people, rather than three, occupying each square meter of floor space, commuters are squeezed together so tightly that they can barely breathe.[2]

This operation beyond capacity defines Tokyo's commuter train network. Arms caught among the compressed bodies have been broken, and commuters sometimes lose consciousness for lack of oxygen. When they do, they remain standing, propped up by the collective pressure of the surrounding bodies. But operation beyond capacity is not just about train-car congestion. It concerns traffic density as well. During the morning rush hours, train operators must stream one train after another with the absolute minimum gap between them in order to accommodate the commuter demand. On main train lines, that gap is less than two minutes. Because of the relatively short distance between stations, the high-capacity and high-density traffic places enormous strain on the infrastructure, creating

highly precarious conditions whereby a delay of any kind catalyzes a vicious cycle, leading to platform crowding and more delay that can spread quickly to train lines throughout the network, causing a systemic collapse of order.

Nowhere is the precariousness of operation beyond capacity more clearly expressed than in Tokyo's Yamanote Line, which circles the center part of the city. The Yamanote Line has twenty-nine stations, only 1.5 kilometers apart on average, and is linked to every major train line.[3] During the morning rush, the typical ten-car train on the Yamanote Line carries between three and four thousand commuters (three hundred to four hundred people per train car), and traffic operates with just under 2.5 minutes headway between trains. If a train is delayed five seconds at each of the twenty-nine stations, the cumulative effect over the course of the twenty-nine stations is 2.5 minutes, which is equivalent to the minimal interval between trains. Consequently, a ten-car train must be cancelled to make space, leaving three to four thousand people with no choice but to try to cram themselves into the remaining trains. The effect is an inevitable delay that proliferates through the system. Operation beyond capacity, it would thus seem, demands an absolute and tightly coordinated schedule that does not allow for any divergence.

Paradoxically, during the Tokyo commuter train network's morning rush, not only are trains regularly delayed without the system collapsing into disarray, but also, more importantly, those delays allow for operation beyond capacity. Even at the line's most crowded stations (Shinjuku and Shibuya), the allotted dwell time (stopping time) for boarding and debarking is a mere fifty seconds. At other stations, the allotted dwell time is only thirty seconds. As platforms fill with long lines of commuters, it is simply impossible for commuters to exit onto the crowded platform and for waiting commuters to squeeze into the filled trains in that short time. Train drivers are thus forced to extend dwell time at stations, sometimes by as much as half a minute, in order to accommodate commuters. Lost time must subsequently be recovered or partially recovered. Ten seconds lost to extending dwell time at a station can be recovered in the interval before the next station by applying slightly more acceleration on departure and waiting until the last possible moment to brake when entering the next station. Recovery from an even greater temporal deficit, however, presents a more considerable and often impossible challenge. A thirty-second delay might be recovered entirely in the interval between a number of stations. Most likely, though, it will not, which forces operators to recalibrate and

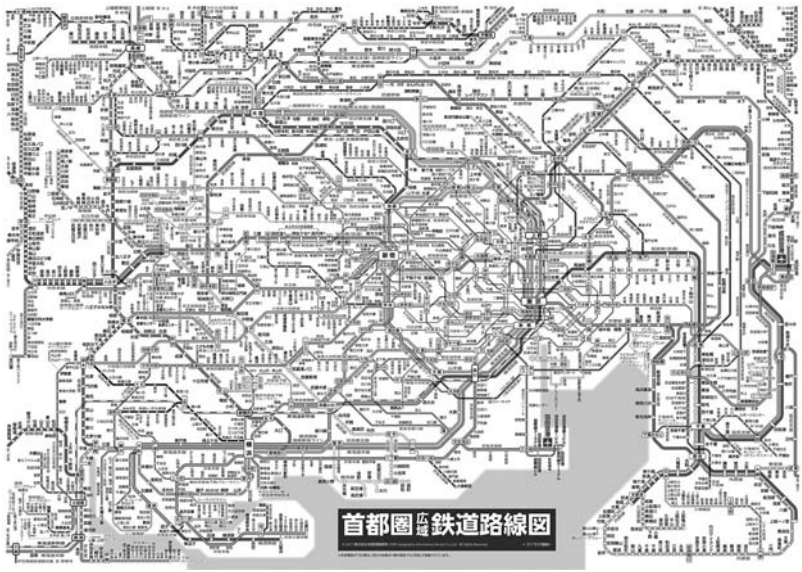

FIGURE 0.1. Tokyo Commuter Train Network Map
Source: CHIRI Geographic Information Service

tweak the gap on other train lines. Operation beyond capacity is thus realized through carefully managed divergence from the scripted order, not adherence to absolute punctuality.

For train drivers and system operators, managing divergence demands close attention to the gap between the specified order and the actual performance. Every second counts and every second is accounted for. For commuters, managing the gap is the technique of commuting, eliciting a constant, embodied, and active attention to the network's fluid order. Even during off-peak hours, it remains the guiding principle of train traffic management.

Crowded commuter trains are a facet of everyday life in urban centers throughout the world. In this book, I posit that the specificity of Tokyo's commuter train network lies in the significance of the gap for operation beyond capacity. The gap is schematized in the train-traffic diagram, or *ressha daiya* (hereafter just *daiya*). A traffic diagram is a universal technology for planning and managing a schedule within a restricted transportation system. Railroads and airports use traffic diagrams; expressways and highways do not. In a railroad-traffic diagram, the movement of trains is plotted on a horizontal axis of time and a vertical axis of stations.[4] Each train line has its own traffic diagram,

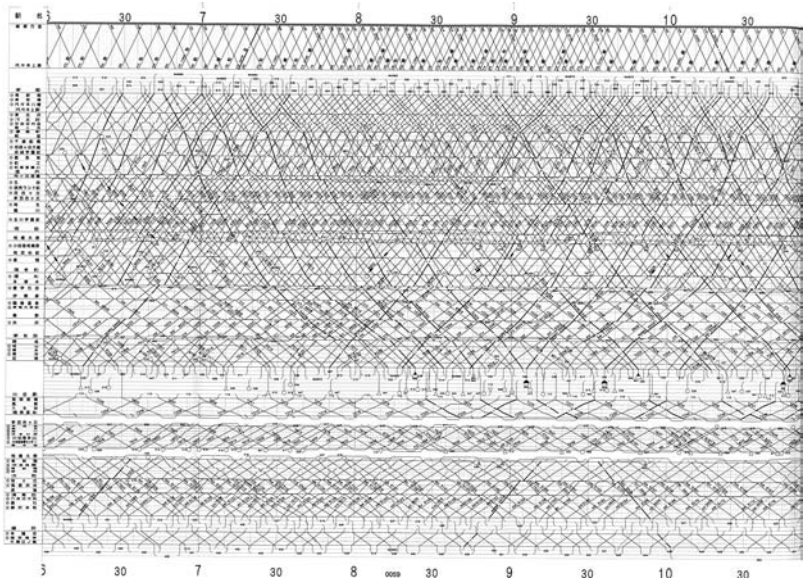

FIGURE 0.2. Principal *daiya* for train traffic between 6 a.m. and 11 a.m.

and each line of the diagram represents a single train, with the angle of the line indicating the specified speed of the train on sections of track: the more vertical the line, the faster the speed, and the more horizontal the line, the slower the speed. In addition to providing schematics of the actual track layout, environmental conditions such as slopes and curves, and signal locations, a train-traffic diagram specifies the different types of service (local, express, semi-express), different train technologies, and allotted stopping times at stations. In sum, the traffic diagram determines the spatiotemporal order of the commuter train network in addition to providing everything railroad operators need to know in order to operate the train.

The *daiya* is produced by expert technicians known as *sujiya*. For most of Japan's postwar period until the mid-1980s, the nation's main rail-transport company, Japanese National Railway, recalculated and redrew *daiya* annually during monthlong retreats for *sujiya* at secluded hot-spring resorts.[5] Today, much of that process has been eliminated, and the *daiya* can be redrawn several times a year with the assistance of computers and the compilation of commuter data constantly mined from electronic ticket gates in train stations. When *sujiya* and information scientists talk of recalibrating *daiya*, they speak in terms of optimizing traffic patterns in correspondence with shifting trends in

ridership discerned from this data. Their objective is to create a more "convenient *daiya*" (*benri na daiya*) that more accurately reflects the lived interaction of commuters and the commuter train network and also anticipates emergent commuter needs. Although *daiya* do not circulate among commuters, they command their constant attention. Everyone knows of commuter-train *daiya*, and everyone remains perpetually aware of the state of the *daiya* for their particular commuter line via posters in the trains that keep them informed of upcoming *daiya* revisions (*daiya kaisei*). Morning television and radio news programs also provide regular *daiya* updates.

While commuters in Tokyo tend to think of the *daiya* for each train line as a single, determined object not unlike a schedule, it is actually a combination of two components. There is a planned "principal" (*kihon*) *daiya*—a painstakingly calculated, idealized configuration of traffic flow—and an actual "operational" (*jisshi*) *daiya*, which emerges in accordance with the overall fluctuating circumstances of actual train operation.[6] Whereas the planned *daiya* refers to the temporality of clock time and delineates a schedule, the actual *daiya* reflects the lived tempo of the city and train network. This two-part composition lends the *daiya* a dynamic quality that leads technicians and system operators to call it "a living thing."[7]

Operation beyond capacity in Tokyo's commuter train network depends on maintaining the gap between the two *daiya*, making the gap a central focus of system operators. At the same time, operators must tend to more than just the gap between the *daiya* of a single train line. The dense and interconnected nature of the system demands a more global attention to the overall network condition, which is an expression of the correlate gaps of all of its train lines. In this book I borrow from the French philosopher and machine theorist Gilbert Simondon in identifying the field of interaction constituted by those correlate gaps as the Tokyo commuter train network's "margin of indeterminacy."[8] The network's margin of indeterminacy, this book posits, is its dimension of collective life. It is a domain of ontological entanglement where the processes of humans and machines intersect with the time and space of institutionalized regularities to produce a provisionally stable techno-social environment of the everyday. While operation beyond capacity in Tokyo's commuter train network is a mode of technological organization inseparable from the social and historical conditions of Japan in general and Tokyo in particular, it also makes legible the margin of indeterminacy as a principal quality of technical ensembles.

This book situates itself within the margin of indeterminacy of Tokyo's commuter train network. By thinking with the processes, practices, tensions, and contradictions articulated within the margin of indeterminacy, it develops a technography of the commuter train network. In so doing, it forges a *machine theory* adequate to the experiences, practices, and ethical questions that emerge within the immersive technological mediations that define contemporary collective life. Technography takes its cue from ethnography as the time-honored method of anthropology for generating analytical interventions into human society through detailed descriptions of specific human practices and modes of social organization.[9] But in replacing *ethno-* with *techno-*, technography works to accommodate a growing consideration within anthropology for cultures and practices of technological mediation that are irreducible to categories of identity, community, nation, agency, and subjectivity. Technography, I insist, must also move beyond anthropology's representational mode of knowledge production. Merely describing a technological condition or in situ processes whereby people adapt technologies to realize a specific outcome does not suffice. Not only does such a descriptive approach risk reifying a binary structural ontology of human versus machine, it is also burdened with a problematic, twentieth-century anthropological conceit for producing knowledge of an other. A technography must instead become performative by thinking *with*, not just *about*, technology. Such an approach is in concert with the call for empirically driven theoretical thought born of an encounter with material and immaterial conditions.[10]

The machine theory for thinking with technology that I develop in this book derives from the margin of indeterminacy of Tokyo's commuter train network. Its goal is to think with the processes of immersive technological mediation and conditions of human-machine interaction. Commuters emerge within these processes not as subjective positions constituted in opposition to the system's technology and the corporate enterprise behind it, but rather as iterations of a collective distributed across a technologically mediated milieu.

Not too long ago, a technography of a commuter train network would have been a profoundly difficult proposition.[11] Large technological infrastructures were simply not conventional sites of anthropological inquiry.[12] What is more, anthropology had yet to develop a robust theoretical orientation toward technology that could move beyond a concern with technology's relationship to modernity and its perceived mechanizing effects on the social mind and body.[13] Much has changed in recent decades, primarily as a result of scholarly work in the field of

science and technology studies (STS) making tremendous inroads into the study of infrastructure, media, and technology.[14] While I draw on this literature throughout this book, I take my main inspiration from neither STS nor anthropology; rather, I turn to a group of "machine thinkers" who emerged after World War II, at the height of cybernetics, whose work articulates the initial tenets of what I call *machine theory*.

Simondon is at the center of this group of thinkers. Writing mostly in the 1950s and 1960s, Simondon was concerned with the evolution of the collective formed in the interplay between humans and machines. He developed a unique approach to technology, one aimed at overcoming what he saw as an opposition between culture and technics that had led to a reductionist, utilitarian approach to machines.[15] In Simondon's thinking, machines are more than tools external to an ontologically stable human subject; rather, they are integral to the processes of human thinking and social becoming. Simondon's work had a deep impact on thinkers of the time, especially Gilles Deleuze. Nevertheless, only in recent years have his writings begun to receive close attention from scholars in philosophy, technology, and media. These scholars have extrapolated his ideas to think with today's increasingly sophisticated and ethically complex technologies and technical ensembles. I draw on this expanding body of work for my own thinking with Tokyo's commuter train network.

Like many machine thinkers in the early postwar period, Simondon developed his theories through an engagement with cybernetics. The impact of cybernetics in producing our present conceptual and material reality cannot be overstated. Although we typically associate cybernetics with the emergence of information theory, Cold War infrastructure, and research into artificial intelligence (which dissipated with the loss of funding in the early 1970s), a number of scholarly works in recent years have emphasized the profound impact of cybernetics, as an international and interdisciplinary project, in changing the direction of thought and practice in everything from architecture to philosophy, social theory to economic theory, financial systems to governmental rationality.[16] The media historian Orit Halpern does not exaggerate when she argues that cybernetics restructured how we encounter the world by reshaping our perception, rationale, and logic.[17]

Postwar machine theory embarks from the impulse in cybernetics to move beyond the dualistic presuppositions of technological determinism that have fueled either naive visions of techno-utopias or anxiety over the loss of human autonomy to a machine master. Such thinking dominated the discourse concerning the impact of machines on

human society throughout much of the twentieth century and can still be found in many popular mainstream forums today. Machine theory, by contrast, perceives the relationship between humans and machines in dialogic terms. Its idioms are coconstitution and interaction rather than dominance and control. At the same time, it rejects the fundamental proposition of cybernetics espoused by cybernetics' originator, the American scholar Norbert Wiener, that all life is reducible to information processing.[18] For scholars like Simondon, the reduction of life to information processing gives precedence to form over matter and is indicative of the dualistic and functionalist thinking that informs technological determinism. Machine theory, by contrast, treats information on an ontological level as an "intensity" and a material force.[19]

Similarly, machine theory rejects "cyborg" metaphors of human and machine symbiosis.[20] Its notion of technical becoming is not about the fusion of human and machine. It insists instead on a fundamental, ontological incommensurability between human and machine, and it insists on maintaining a space of difference as that which animates both. Maintaining this space of difference is critical for thinking about the relation between commuter bodies and the commuter train network in this book. Tokyo's commuter train network is not a platform for cyborg humanism; it is a scene of collective life constituted in the interplay of humans and machines that poses questions concerning the limits and potentials of our current technological condition.

Although I draw a distinction between machine theory and STS, in many respects STS cannot be separated from machine thinking. Indeed, many fundamental concepts in STS draw on the nondualist, nonsubstantialist approach to the interaction of things as co-constitutive processes (not identities) that was developed by postwar machine thinkers. This approach is explicit, for example, in Bruno Latour's attempt to move beyond the discursively constituted ontological boundaries separating human and machine in order to represent the active, agentive role of nonhuman things in the formation of a collective life.[21] While it has helped Latour transform what we think of as the social into a far more capacious, contingent, and processual collective of human and nonhuman actors (which includes everything from bacteria to objects, machines, and infrastructure), it has also guided feminist STS-related thinkers such as Donna Haraway in calling attention to the relational ethics of collective processes.[22] Emphasizing a commodious notion of collective, both STS and machine theory are invested in ontological questions, exploring how technology and technical things perform as material forces irreducible to symbols and representation.

Machine theory thus complements efforts among STS thinkers to shift ethnographic methods from a representational to a performative mode of engagement whereby the ethnographer is enfolded into the generative processes of contextualized practices and materialities.[23]

While much of STS is concerned with questions of knowledge production and technological practice, machine theory retains the speculative utopianism of cybernetics as it advocates the possibility for a different kind of relationship with technology. Machine theory asks not just what technology is and how it impacts or draws together social relations but also—and more importantly—how it works, what it does, and what it might become. Machine theory is invested in thinking *with* technological ensembles toward novel conceptual formulations while simultaneously maintaining a critical perspective on the kind of collective technology has enabled thus far.

With its focus on the ontogenetic affordances of technology, machine theory also departs from conventional forms of capitalist critique. Machine theory asserts that humanity's problem rests primarily in its relationship with machines, not in the logic of capital and its corollary discursive structures. Simondon parsed this as a matter of alienation. In contrast to Marx's theory of alienation as an effect of the structure of labor under capitalism's relations of production, Simondon understood the problem to be humanity's alienation from the machine and argued for an unconventional humanism in which human society would realize a collective potential through "technical becoming."[24] Simondon thus rejected the privileged status that social theory afforded to labor as the singular authentic site of social becoming, rather placing his hope on the notion of a novel collective becoming, one born of heightened "technical attitude."[25]

Guided by this approach, this book departs from historical analyses that have explored the development of the commuter train network in Japan as an exemplary instantiation of urban development under capitalism.[26] Situating itself within the margin of indeterminacy of Tokyo's commuter train network, this book asks how the tensions and contradictions that form under operation beyond capacity urge us to think, imagine, and practice toward novel forms of ethically bound collective becoming. In so doing, this book attends to the genesis of the schema of operation beyond capacity and its contemporary instantiation in Tokyo's commuter train network as a mode of techno-social organization. It also looks to re-mediations of the network's tensions and contradictions in films, advertisements, and web-based social media. Overall this book focuses on the processes of human and machine

interaction within conditions of immersive technological mediation that constitute the collective life of Tokyo's commuter train network.

The Modern Machine

Developing a technography of a train network requires dealing with theoretical baggage concerning the train as the historical mainspring of modern industrialism and the central driving force in the rationalization of human society. The historian Wolfgang Schivelbusch encapsulates this notion with the subtitle to his history of the railroad's development in Europe and the United States: "The Industrialization of Time and Space in the Nineteenth Century."[27] Schivelbusch's text has become a seminal work for scholars interested in technology and society, and it is typically read as a generalizable narrative of technological development in capitalist modernity. Its argument builds on an understanding, laid out in the initial chapters, of the train as the first "machine ensemble," by which Schivelbusch means the first expansive assemblage of technological components, systems, and subsystems whose seamless interaction was necessary for operation without disaster. In other words, the railroad was not just a machine: it was the first iteration of an emergent machinic ecology. Extending far beyond the basic tracks and stations, this machinic ensemble transformed the topography of the land while giving rise to a network of tightly coordinated auxiliary and affiliated industries ranging from the coal mine to the factory, the publishing house to the department store, the bed town to the resort town. Schivelbusch thus shows how the railroad was a driving force in the emergence of a technologically engineered environment that became the forerunner to the condition of immersive technological mediation of contemporary society.

In Schivelbusch's argument, the railroad effects the displacement of rhythms, views, and experiences of a premodern natural world with the tempos, pathologies, and sensations of a constructed, technological environment. Accordingly, this subjection of the natural world to the machine transpires in conjunction with the rationalization of the human sensorium and of human social relations. Veering at times toward technological determinism, Schivelbusch depicts the railroad as retooling human perception, thought, and social behavior in correspondence with the mechanical speed of the train, its schedules, and its operational imperative to engender a modern industrial experience of time and space. Nowhere is this clearer than in Schivelbusch's descrip-

tion (drawn from Georg Simmel) of passengers learning to manage the awkward intimacy imposed on them by the tight quarters of the train car and the development of a novel panoramic vision of the passing landscape perceived through mechanized speed.[28] Ultimately, Schivelbusch's account becomes a story of technological development as the loss of a premodern, nontechnological sensibility. This loss occurs in conjunction with intensified social rationalization, as the speed and complexity of the technological apparatus necessitates a heightened degree of technological efficiency and disciplined passenger behavior.

Whether situated in Europe, America, or Japan, stories about trains and histories of the advent of the railroad tend to follow in Schivelbusch's tracks, depicting the arrival of the train as fueling the rise of industrial society and the corollary struggle for authentic human relations against an oppressive rationality and automaticity of machinic life.[29] The train performs thus as the vanguard of capitalism's rationalizing, machinic logic, crushing the organic character of premodern social relations beneath its unforgiving steel wheels as it effects the mechanistic conditioning of minds and bodies toward the formation of a mass-mediated modernity. Similarly, the commuter train figures as a powerful vehicle of capitalist alienation that subjects time, space, and bodies to the merciless logic of capital as it transforms landscape into real estate and mediates transitions from home to work and school.

Through such theoretical expositions of the train, which anchor narratives of the historical shift from premodern to modern, trains and commuting have become bound up in the ideological mediations of modern technological infrastructure—mass transportation, mass production, and mass media. At the same time, these theoretical expositions insist on an intractable logic, perhaps best explicated in Georg Simmel's description of the clockwork relations of the early metropolis, whereby technological development that was initiated under the steam engines of the late nineteenth century leads to increasingly complex and tightly coordinated interaction between humans and machines.[30]

This story of the train becomes paradigmatic of the human relationship with machines in modernity. It has fueled dystopian prophecies warning of the automaton-ization of human society as well as cathartic visions of engaging in total war with machines in order to save the human race from machinic enslavement or extermination. A somewhat more optimistic but similarly invested approach underscores moments of machinic excess—points of shock, disruption, and instability—as potential sites of redemptive aesthetics and irrationality. Such points of excess are then celebrated as the condition of possibility for the

recovery of something human, generally in the form of stories of romance, crime, and intrigue against a technological background.

It is not difficult to align Tokyo's commuter train network with this narrative. Indeed, the network's famous precision and its infamous spectacle of fantastically packed commuter trains suggest a population of mechanistically conditioned commuters yielding to rationalizing technological forces—"trained," as it were, to the operational imperatives of the apparatus. Accordingly, the packed commuter train easily figures as a spectacular expression of capitalism's rationalizing logic whereby human beings are objectified as mere cargo, conveyed in accordance with the merciless dictates of mass production.

As compelling as this narrative may be, it represents a significant reduction of the historical and local complexity at work in the experiences of technological mediation that are part of the commuter train network. It also leaves us with nowhere to go theoretically but off the train, which becomes an especially problematic move for the way it constitutes a romanticized ideal of either a pre-technologically-mediated past somewhere outside the commuter train network or a digital, post-industrial, and postmodern future. Alternatively, we can try to stay on the train while resisting its subjugating force by insisting on recovering some persisting human essence that escapes technology's colonization, which is precisely the strategy of so many twentieth-century films and novels that employ the train as a mise-en-scène of human drama.

The initial challenge of this book can be summarized as the question, *How can we stay on the train and engage directly with its scene of technological mediation, in ways that attend to the historical and situated specificities of its human and machine relations, so as to open new possibilities for thinking about modes of collectivity and technological becoming?* This is the question of machine theory. In other words, how can we come back to the train through an understanding of its technological condition in ways that escape the teleological discourse of machinic modernity and its inevitable effects? How can we think with the train rather than simply invoking it again and again as an exemplification of technology's mechanistically rationalizing processes under capitalism?

Theory from the Gap

When the media studies and Japan scholar Thomas LaMarre revisits Schivelbusch's thesis in the introduction to his work on Japanese anime, he does so through a machine theory that draws on such thinkers

as Gilbert Simondon, Gilles Deleuze, Félix Guattari, and Martin Heidegger.[31] In so doing, LaMarre encourages us to reread Schivelbusch not as an allegory of modernity and mechanistic conditioning, but rather (in the vein of cybernetics) as an explication of a novel, immersive, mediated feedback environment that lends itself to different modes of thinking and becoming with the machine. Via Schivelbusch, the train in LaMarre's work becomes a technology that is good to think with. In contrast to Claude Lévi-Strauss's famous emphasis on thinking with animals toward the exposition of a structural model of symbolic associations, for LaMarre, thinking with the train emphasizes an ontological engagement in line with Simondon's approach to technology.[32] The train asks us to think with its material intensities in order to develop analogies for thinking about the conditions of immersive technological mediation.

Whereas the narrative of technological modernity posits the railroad as effecting increasingly hermetic and rationalized relations, LaMarre's thesis draws attention to points where Schivelbusch's argument asks us to understand the train as producing "gaps," or situations in which technologically-influenced perspective transpires as a material force, that elicit new forms of experience and thought. What is more, LaMarre emphasizes the emergence of a gap at the most totalizing moment of immersive technological mediation: when the train passenger's vision of the world outside the train becomes mediated by the novel experience of mechanized speed. If, for Schivelbusch, the passenger's experience of speed-blurred vision from the train window instantiates a split from a premodern panoramic vision, then, for LaMarre, perception at mechanized speed is important for the gap it generates. As LaMarre writes, "speed introduces a new kind of gap or interval into human perception of the world, and that specific interval, that manner of 'spacing,' does not serve to totalize the whole of perception or of experience related to train travel. Rather, the new interval or spacing folds humans into its operation and starts to rely on other machines such as printing presses, department stores, and carriages or cars."[33] In accordance with machine theory, the gap is a phenomenon of ontological significance. It is a space in which perspective transpires as a material force that elicits novel organizations of becoming with the machine. Such becomings incorporate the possibility of a new relationship with technology that unfolds from within the protean gaps, intervals, or spacings. In LaMarre's work gaps emerge as "zones of autonomy" that elicit new practices, new activities, and new ways of perception and cognition.

In identifying gaps, intervals, or spacings as sites of ontologically driven, conceptual individuation, LaMarre encourages us to approach the evolution of a technological ensemble such as the railroad from the perspective of its generative relations rather than its deterministic effects. This is not just about identifying a causal relation between the emergence of new machine ensembles and novel, technologically driven practices—for example, commuting gives rise to reading on the train, which gives rise to the corresponding publishing industry, and so on. Rather, it is about recognizing potential phenomena of co-constitution in the evolution of technical ensembles whereby the emergence of zones of indeterminacy elicit an interweaving of machinic and corporeal processes toward novel conceptual interventions. Under this approach, a technical ensemble potentially becomes a kind of "thinking machine," which LaMarre defines as a "heteropoietic process [involving human and machine] in which human thinking happens differently than it would otherwise, in another flow of material forms and immaterial fields."[34] Following LaMarre, throughout this book I will at times use such phrases as "thinking the train" or "thinking the train with the web" to gesture to this kind of heteropoietic process.

In Simondon's work, a technical ensemble's "margin of indeterminacy" is the scene of collective co-constitution and is ultimately, I argue, where it becomes a "thinking machine." In contrast to LaMarre's formulation of the gap, the margin of indeterminacy in Simondon's machine theory performs a more functional role. Nevertheless, I argue that it provides an underlying condition of possibility for the emergence of various forms of gaps, intervals, and spacings that I will identify throughout this book in relation to the co-constitutive processes of Tokyo's commuter train network. In the simplest sense, the margin of indeterminacy of a technical ensemble denotes the openness the ensemble maintains internally to external information and thus is what allows it to incorporate the changes and contingencies of its environment into its pattern of operation. As such, the margin performs as a structurally underdetermined zone of interaction between the ensemble and its environment, allowing for the resolution of conflicts between the internal organization of the technological ensemble and external forces. In a work that mobilizes Simondon toward a reassessment of technology, the media theorist Adrian Mackenzie aptly paraphrases the significance of this zone of indeterminacy when he writes, "A fully determined mechanism would no longer be technological; it would be an inert object, or junk."[35] As Mackenzie suggests, the margin of indeterminacy is what allows the technological ensemble to suspend

"final determination of its own form" and to remain continuously in formation and able to incorporate variation.[36] Junked technology, like a bricked iPhone, is a machine that is unresponsive to input.

But why does Simondon use the somewhat cumbersome phrase *margin of indeterminacy*? Why not just call it a technology's operational latitude, or its viable pattern of divergence from normal operation? The term *indeterminacy* traverses two fields of practice central to Simondon's thinking: quantum physics and philosophy. In both, it carries important ontological connotations that set it apart from terms like *latitude* or *uncertainty*, the latter of which has more to do with risk and unpredictability. *Indeterminacy* refers specifically to the incompleteness of an individual, by which Simondon means not the juridical or philosophical notion of personhood and subject, but a provisionally stable set of functional relations deriving from an environment. Individuals, in Simondon's thinking, can be physical things (rocks or simple tools), biological organisms (humans, animals, bugs, or trees), and/or machines (engines or commuter trains). Incompleteness is not about a lack. It emphasizes, rather, the irreducibility of an individual to an inherent identity, essence, or substance.[37] By remaining incomplete, an individual remains open to "information" and subsequently to further transformative interactions with a milieu.[38] Incompleteness is thus the condition of possibility for ontogenesis, or material foldings from which new functional associations that develop into sedimented patterns of interaction emerge. The margin of indeterminacy thus becomes the scene of the processual ontological entanglement of humans and machines—the scene of collective life.

The Margin of Indeterminacy and Large-Scale Infrastructure

As the scene of technical ensembles' collective life, the margin of indeterminacy provides an avenue for anthropological inquiry into a large-scale infrastructure such as Tokyo's commuter train network. What is more, it does so in a way that overcomes a number of theoretical and methodological challenges posed by the complex ontology of large-scale technical infrastructures.[39] Embodying contingent political histories, technological shifts, and expert knowledge, large-scale technical infrastructures make for fascinating but also unwieldy and unyielding sites of anthropological inquiry. They can be mediums of time and space that traverse borders, cities, and culturally distinct regions to allow for the movement of people and things; at the same time, they can

be a form of a place (or "non-place") with its own particular spatiotemporal character.[40] Designed to discourage dwelling and enable mobility, large-scale, technical transport infrastructures tend to be inhabited by indeterminate publics that are temporally manifest in various forms of communication and technologies.[41] Finally, large-scale technical infrastructures tend to be systems of systems formed in a fusion of mechanical, electrical, and informational technologies that ground our daily lives but often remain unseen and unacknowledged. The result is a messy techno-social topology that resists attempts to bring the pieces together in a nonreductive and coherent frame of analysis. The problem is not about finding an Archimedean point from which to constitute infrastructure as a proper, bounded object of inquiry: that would simply produce an ossified, lifeless structure. The problem, rather, is about developing an analytical orientation through which one can make legible the historically contingent material and immaterial processes of a large-scale infrastructure while simultaneously engaging the ethical problems raised within its particular articulation of collective life.[42] The margin of indeterminacy of a technical ensemble offers such an orientation.

The margin of indeterminacy of a large-scale technical infrastructure is not a place. It is a field of interaction and a medium for provisional resolutions of conflicts between the disparate processual orders of humans and machines. Such interactions make it a zone of perpetual tension marked by emergent processes that sediment via reiteration into temporary structures. While the margin of indeterminacy of a tool or machine can be fairly straightforward and easy to identify, Simondon contends that the margin of indeterminacy of a technical ensemble tends to be an extraordinarily complex aggregate of the correlate margins of indeterminacy of each of its parts.[43] For Simondon, this complexity makes the margin a particular kind of problem space. He writes that the margin of indeterminacy of a technical ensemble "cannot be calculated, nor be the result of calculation; it must be thought, posed as a problem by a living being and for a living being."[44] Simondon thus puts the human being at the center of the margin of indeterminacy, thinking with the constitutive tensions of its relations. But he also makes human beings accountable for the nature of the collective that is enabled in those relations. That is, posing the margin of indeterminacy as a problem becomes a matter of not only thinking with the margin of indeterminacy and its complex processes of human and machine interaction, but moreover calling attention to its "technicity"—its *quality* of relations. *Technicity* is a term that I will

unpack and develop throughout this book in regard to the constitutive and emergent relations of Tokyo's commuter train network. It is an important term that carries ethical connotations, in that it asks us to think in terms of the degree to which a margin of indeterminacy allows further ontogenesis beneficial to both humans and machines and thus affords the flourishing of collective. *Technicity* is a term through which I think about the ethical integrity and quality of the collective specific to Tokyo's commuter train network.

Gaps, Spaces, Intervals, and Margins

To live in Tokyo is to live on and by the commuter train network. Every morning of the week, commuters gather on crowded platforms in train stations to ride fantastically congested trains to work and to school. The majority are men dressed in blue, grey, or black suits. Their ranks are interspersed with women in business attire, uniformed high-school and junior-high-school students, and fashionably dressed university students. Forming queues at designated points behind the yellow line, they wait patiently and silently for the train. Some pass the moments before the train arrives by listening to music through headphones, composing emails, or surfing the web on smartphones. Others read pocket novels, magazines, manga, or newspapers carefully folded into fourths in order to negotiate the dense crowd. When the train arrives, it comes to a precise stop so its doors align with the queued commuters. As the doors open, a platform melody commences. Each platform and each station has a distinct melody whose tone, volume, and quickening cadence is calculated to expedite the exchange between embarking and disembarking passengers. Commuters waiting to board know that when the music stops, the doors will close, and they separate into two lines on either side of the train doors, forming a corridor for the arriving passengers to stream onto the platform and into the crowds that are inching down platform escalators and stairs. When the last commuter has alighted, those from the platform surge forward and into the train with those last in the queue entering backward, facing the platform and pushing with their backs into the mass of tightly compressed bodies. As a platform attendant announces through a wireless microphone that the doors will be closing, other platform attendants stand ready to rush forward and nudge a protruding arm, leg, or body inside the train. Finally, the doors are closed, and the repacked train pulls away. From start to finish, the entire operation takes less than thirty seconds.

No words are exchanged among commuters during the process, and no words will be exchanged for the entire ride, leaving the train car in an absolute silence punctuated only by regular service announcements and reminders from the conductor. As soon as one packed train leaves the station, the imminent arrival of the next packed train is announced for the replenished crowd of commuters already queued on the platform.

The first two chapters of this book engage this scene from within the commuter train network's margin of indeterminacy. These chapters prepare the ground for a critique of the ethical quality of the commuter-train collective that I develop in the subsequent chapters. My focus in the first two chapters is on the genesis of the commuter train network, by which I mean the emergence of its underlying schema of operation beyond capacity rather than the history of its technological development. Chapter 1 traces the emergence of operation beyond capacity through a series of phases of rapid urbanization over the course of a century in Japan. I show that in each phase the underlying imperative for train operators involved the question of how to accommodate the rising number of commuters. While the story of urbanization in Japan is a well-traveled history, it is typically told within the framework narrative of technological modernity as a process of progressive rationalization and the corollary mechanistic conditioning of commuter bodies. In contrast, I focus on the way operation beyond capacity evolves by expanding the commuter train network's margin of indeterminacy through a tactical dynamic that I call "finessing the interval." The term reflects the underlying technicity of the commuter collective. It underscores how, with each technological advance and each new tactic to increase operational efficiency that are developed during the phases of rapid urbanization, we see not the tightening of the technological noose around the figurative neck of commuter humanity, but rather a heightened level of openness—an expanded margin of indeterminacy—within the system that elicits increasingly higher degrees of skill and active attention from the commuter. In other words, the more the system suspends "final determination of its own form" under the pressure to operate beyond capacity, the more it relies on the delicate virtuosity of commuters as individuals and groups in order to maintain a collective coherence. The second chapter pursues the genesis of operation beyond capacity through the technicity articulated within the spatiotemporal confines of the commuter-train car. Asking how commuters inhabit the margin of indeterminacy, chapter 2 considers the forms of active attention and the techniques that com-

muters cultivate in conjunction with the paradoxical mediations of the system. At the same time, it looks at how various forms of media that have become essential features of the commute in recent years—from cell phones to screens to posters—become folded into the spatiotemporal contours of the system's margin of indeterminacy.

Once the genesis of a technical ensemble has been defined, writes Simondon, we can begin to explore the relations between it and other realities.[45] Chapter 3 takes up the question of the technicity of the commuter train network in conjunction with a critical reflection on the kind of intervention the term *technicity* provides into questions of techno-ethics. What I offer is not so much a criticism of the term but rather a critique of the way an agile corporate capitalism has been able to deftly maneuver in recent decades to colonize the conceptual interventions of machine thinking. Specifically, the chapter deals with the development in the late 1980s of a novel, decentralized computer technology inspired by organic systems that allows for administering the margin of indeterminacy as a self-organizing emergent order. I show that, by treating operational irregularities as part of the regular order, the new technology works to transform the underlying organizational schema of the commuter train network from operation beyond capacity to operation without capacity. In so doing, it produces a technological infrastructure that is both resilient to extreme operational events and generative of boundless consumption. The new technology, I argue, comes to embody what has become a general infrastructural paradox: while it realizes a form of infrastructure able to withstand increasingly extreme environmental conditions caused by rampant capitalism, it simultaneously provides a novel schema of operation for modes of extreme capitalism. By tracing the emergence of the new technology in a series of crises of capacity beginning in the late 1960s, my discussion demonstrates that extreme infrastructure has not materialized just in time to help us contend with the inescapable disasters of tomorrow; rather, it is a product of the manufactured crises of the past and the failures of the present.

Turning from matters of technicity to remediation, chapter 4 explores convergences between the internet and the commuter train. The underlying question of the chapter is how the internet thinks the space and time generated in the margin of indeterminacy. This question derives in part from a consideration of the ways in which twentieth-century cinema provided a medium through which to represent the commuter train and the commuter experience—often critically—as expressions of the structural imperatives and contingencies of mass-

mediated capitalist society. In asking how the internet thinks the train, I am interested in the ways the internet enables simulations of commuter space and time, and how, in so doing, the internet encourages a shift from knowing and deploying the train in a representational mode to experiencing the margin of indeterminacy differently through performative registers and strategies. Of particular importance in this regard is the way simulation takes its cue from computer gaming. Chapter 4 explores three examples of remediating the train through the internet; in each, computer gaming provides a model for the dynamic, interactive, and performative experience invoked through simulation. At the same time, by transforming commuter space into a kind of game space, the computer-game model produces an invitation to critically engage the experience constituted in the margin of indeterminacy as a place of potential social transformation that begins from the question, *Can the train teach us to care?*

Chapter 5 embarks from within a forty-four minute gap opened within the margin of indeterminacy as a result of a commuter suicide. A commuter suicide, as I show in the chapter, constitutes an extreme event that threatens the network's operational integrity. More importantly, the body on the tracks, I argue, generates a disorder that poses an ethical challenge to the nature of the commuter collective. My concern in the chapter is to understand how the collective attends to that ethical challenge. I show that, on the one hand, the ethical challenge is deferred through a logic of recognition that forecloses acknowledgment of the body on the tracks by reducing it to a mundane and meaningless repetition of salarymen death.[46] The result, I argue, is a collective that is functionally coherent but ethically impaired. On the other hand, the body on the tracks stages a return as a material force demanding acknowledgment. In this context, I turn to a former JR East employee who was tasked with cleaning up after commuter suicides. The chapter finishes, however, with a close reading of the film *Suicide Circle*, in which I argue that the representation of mass commuter suicide brings forward the issue of recognition versus acknowledgment within the context of a complex critique of mass-mediated connectivity.

In the final chapter, the location shifts from Tokyo to a JR West train line just outside Osaka, where a commuter train racing to recover from a ninety-second delay in late April 2005 derailed on a curve near Amagasaki Station, taking the lives of 106 commuters and the train driver. Insofar as the commuter networks of Tokyo and Osaka reflect the distinct character of their respective cities and thus are hardly in-

terchangeable, there are enough similarities between JR West and JR East (in Tokyo) to warrant the accident's inclusion in this book. In particular, JR West is related through its corporate structure and history to JR East. What is more, as the result of a ninety-second delay, the Amagasaki derailment brought forward questions concerning the gap and operation beyond capacity. Although the Amagasaki derailment occurred six years prior to the massive earthquake and tsunami that led to core meltdowns at a nuclear-power plant in Fukushima, it has since become impossible to talk about technological accidents in Japan without referring to this latter catastrophe. It is not difficult to identify a number of parallels between the Amagasaki derailment and the Fukushima nuclear accident in terms of the determinants and effects of massive technological failure in each case. Furthermore, in both cases a technological accident was deemed to be "unthinkable."

My argument in chapter 6 goes beyond such a mode of comparative inquiry to suggest that the Amagasaki derailment asks us to think about the problem of risk and about technological accident in general as a manifestation of a problematic relationship with machines. What we discover in the wake of the Amagasaki derailment is not a community of commuters longing for a return to a simple existence free of complex technological systems like train networks, power plants, and airplanes, but rather a community that takes it upon itself to engage seriously with the problems of complicated technological ensembles and to think about the possibility of a different kind of relationship with machines engendered through a remediated structure of institutional and social governance. In this context, chapter 6 draws attention to how, for the commuter community and the victims of the Amagasaki derailment, the possibility of developing a different kind of relationship with machines and technological risk involved a reexamination of the gap—the ninety-second delay behind the accident that was at the center of the subsequent investigation and controversy. Whereas the train company attempted to attribute the gap to human error on the part of the train driver, the community came to understand the gap as an effect of a *daiya* without a sustainable margin of indeterminacy. This is what I call "thinking with the gap." Consequently, while the train company endeavored to close the gap by relegating its significance to a matter of technical modification, in thinking with the gap the community sought to hold the gap open as a problem space in which to engage with and reflect on the values that had allowed for the emergence of a technological ensemble without a sustainable margin of indetermi-

nacy. As such, the gap becomes a space though which to reconceptualize not only the nature of institutional trust but also the capacity of technological ensembles to be trustworthy.

Privatization, the Bubble Economy, and Neoliberalism

Tokyo has had a thriving commuter train system since the early decades of the twentieth century, especially since the reconstruction of the city following the Great Kanto earthquake of 1923. While I explore some of the key developments in the early years of the system in chapters 1 and 2, the central time frame in this book is the postwar years to the present. Within this period, the privatization and breakup of Japanese National Railways (JNR) in 1987 and the collapse of the nation's bubble economy in the early 1990s figure as paramount events in terms of their impact on the technological and social organization of the commuter train networks in both Tokyo and Osaka. The privatization and breakup of JNR marked the end of an era. Formed just over eight decades earlier in the Railroad Nationalization Act, JNR was an institution of considerable economic and social significance whose iconic and material inseparability from the nation was captured in the idiom "JNR is the legs of the nation" (*kokutetsu wa kokumin no ashi*).[47] It was thus thought to be indissoluble without risking the national economy. Consequently, privatization of JNR in the spring of 1987 was the final act in a long and bitter struggle between the Ministry of Transportation, JNR management, and railroad labor unions that had begun in the 1960s and 1970s with the government's series of failed campaigns to rationalize railway labor.[48] Privatization broke JNR into six regionally based passenger railways that included JR East in Kanto around Tokyo and JR West in Kansai around Osaka, Japan's second-largest city.[49] Although these events occurred nearly two decades before I began the research for this book, the tensions generated around that major historical change remain palpable, especially around conflicts such as the Amagasaki train accident (chapter 6).

Similar to the privatization of JNR, the collapse of the nation's bubble economy in the early 1990s transformed the social and cultural landscape, especially in Japan's urban centers.[50] Japan's bubble economy was the result of complex financial finessing that spurred stock-market speculation and overlending from banks working with inflated land values. It extended roughly from the mid-1980s to early 1990, when

the nation's stock market began to collapse. The collapse sent Japanese society into a tailspin. The nation saw one prime minister after another unable to fulfill his tenure, while once-stable large companies rushed to restructure their workers, resulting in an unprecedented number of layoffs. The collapse was followed by years of economic recession that came to be known as "lost decades." During this time, the government moved to deregulate labor and slash social funding.

In more recent years, a number of scholarly publications have linked the above moments of historical transformation and unrest with the rise of neoliberalism in Japan. In particular, these scholarly works draw attention to the way neoliberal-style reforms of the political economy in Japan have led to increasingly precarious structures of employment,[51] the valorization of independence and self-responsibility,[52] shifts in education policy,[53] and the rise of the enterprise-society ideal.[54] The subject of neoliberalism also enters my argument in this book, particularly in my discussion of the development of new *daiya* technology (chapter 3) and the Amagasaki accident (chapter 6). However, I treat neoliberalism as a perversion of machine theory rather than as an effect of political economic theory and government policy. In this regard, my argument dovetails with Melinda Cooper's identification of a specific post-1970s iteration of neoliberalism that emerges with epistemological shifts at the intersection of theoretical physics, life sciences, and computer sciences.[55]

Post-1970s neoliberalism is economic theory under the influence of nonlinear complex-metastable-systems theory. Or, rather, it is the coopting of the principle of metastability from theories of emergence as a means of providing quasi-scientific rationale for the economic exploitation of the protean qualities of organic life—what Cooper calls capturing "life as surplus." Whereas Cooper focuses on the conversion of the principle of metastability in economic theory into socioeconomic precarity, I am interested in the materialization of emergence in extreme infrastructure and its appropriation toward realizing a new form of extreme capitalism that exploits the dynamic qualities of collective life. Neoliberalism, in my argument, is thus not just the expression of government or corporate economic policy: it is the result of subjugating to economic form the attempts in a number of related academic fields to overcome material limits by thinking with technology.

In the Shadow of Fukushima

No event in recent decades has raised more concern in Japan regarding technology than the reactor meltdown at the Tokyo Denryoku (TEPCO) Daiichi nuclear-power plant in Fukushima following the earthquake and tsunami of March 2011. In the initial years following the disaster, crowds of tens of thousands filled the streets and squares in front of the Japanese prime minister's residence and government buildings demanding that the government hold TEPCO accountable for the meltdown and scrap the nation's nuclear-energy program. Despite TEPCO's continuing struggle to clean up and contain the radioactive leakage from the event, the urgency behind those demands seems to have peaked. Antinuclear demonstrations in Tokyo continue, but they have become routinized events that draw a fraction of the participants they did in the past and are unable to produce enough energy to effect change.

The disasters in northeast Japan and the Fukushima reactor meltdown lend exigency to the argument in this book for a reconceptualization of our relationship with technology through the use of machine theory. Overwhelmingly, the reactor meltdown at Fukushima and the failure of disaster infrastructure in northeast Japan have been dealt with in terms of an ethical problem of a political and economic nature, with scholars pointing to multiple levels of collusion between the nuclear industry, construction companies, and government.[56] Machine theory generates a different kind of intervention. It asks us to conceptualize a relational ethics from within the margin of indeterminacy of a collective rather than as a rationally conceived formula meant to provide ethical order to a material world. Thus, machine theory elicits a techno-ethics that is highly particular in its formulation, demanding attention to the specific kinds of relationality enabled in a technology. Machine theory demands that we attend to technology in terms of its technicity—the quality of its collective. Following machine theory, a nuclear-power plant would not be thinkable as a solution for a collective's energy needs.

Although the ongoing nuclear crisis at Fukushima only enters this book explicitly in the last chapter, it is an implicit impetus behind the entirety of my argument. Since March 2011, the Fukushima meltdown has been a key part of the conceptual milieu in which the ideas and sense of urgency for this book were formed. In this context, this book is an effort to think with a technical ensemble from a novel direction, in order to mobilize critical intervention into the kind of thinking that

has given rise to such things as nuclear-power plants, and to reimagine the possibilities of collective life.

NOTES

1. See page 35 of www.mlit.go.jp/common/001179760.pdf.
2. http://kikakurui.com/e/E7106–2011–01.html.

   Commuter train car capacity is determined by the Japanese Industrial Standards Committee. Based on the determination that the average commuter weighs between 55 to 60 kilograms, the committee stipulates that each commuter requires 430 millimeters of seat space and 0.3 meters of floor space, meaning three commuters to every square meter of space. According to Ramon Brasser, a researcher at the Tokyo Institute of Technology's Department of Earth-Life Science, if we begin from a calculation that the typical person (55 to 60 kg) is 0.4 meters in width and 0.24 meters in depth, then the absolute minimum space required for one body is 0.096 square meters (0.4 × 0.24 = 0.096). Accordingly, ten people can fit into one square meter of space only if they are stacked liked sardines in a can (www.elsi.jp/en/blog/2015/11/blog1126.html, accessed March 26, 2017). Certain points in Tokyo's commuter train network, such as between Nakano and Shinjuku Stations on the Chūō Line, realize such intense sardine-like congestion conditions during the morning rush hours.
3. I borrow this example from Mito, *Teikoku hassha*.
4. Tomii, *Resshya daiya no himitsu*.
5. Mito, *Teikoku Hassha*; Tomii, *Resshya daiya no himitsu*. The setting was chosen more out of concern over the logistics of gathering hundreds of railroad employees for an extended time rather than because of any potential for indulgence. The process involved a number of phases, including at one point coordinating lengthy negotiations over rights-of-passage among managers from different train lines in each area of the country.
6. Tomii, *Resshya daiya*.
7. Eguchi, "Ressha daiya wa ikimono," 103. My translation. (Throughout this book, unless otherwise noted, all translations are my own.)
8. Simondon, *On the Mode of Existence of Technical Objects*.
9. Jansen and Vellema, "What Is Technography?"; Vannini, Hodson, and Vannini, "Toward a Technography of Everyday Life."
10. I am referring specifically here to approaches for the exploration of technology. See for example the notion of "ontological experiment" in Jensen and Morita, "Infrastructures as Ontological Experiments," as well as the notion of "practical ontology" in Gad, Jensen, and Winthereik, "Practical Ontology: Worlds in STS and Anthropology." In both of these works, Andrew Pickering's call for a "performative idiom of knowledge" is an explicit inspiration; see Pickering, *The Mangle of Practice*.

11. Even as recently as the early 1990s, the sociocultural anthropologist Bryan Pfaffenberger argued in his review of anthropological approaches to technology that anthropology had yet to take technology seriously as a legitimate topic of inquiry. Pfaffenberger, "Social Anthropology of Technology."
12. Marc Augé's work on the non-places of technological mediation and the Paris Métro stands out as an exception; see Augé, *In the Metro*, and Augé, *Non-Places: Introduction to an Anthropology of Supermodernity*. Despite working to bring the subject of large technical ensembles into the terrain of anthropological inquiry, Augé did not develop a corresponding theory of technology. Although innovative in many respects, his work stays within the confines of ethnographic theory.
13. Such concerns were most forcefully and famously articulated by key thinkers associated with the Frankfurt School, whose work on technology veered toward technological determinism. The Frankfurt School is the term given to an intellectually diverse group of scholars associated, sometimes somewhat tangentially, with the Frankfurt Institute for Social Research, founded in Germany in the interwar period. Among its central figures, the most outspoken in their concern with technology were Theodor W. Adorno and Max Horkheimer. Although Walter Benjamin and Georg Simmel (who are also associated with the Frankfurt School) diverged from Adorno and Horkheimer's position, they tended to treat questions of technology mainly within their larger preoccupation with developing a theory of modernity.
14. The work of Bruno Latour, particularly his development of Actor Network Theory (ANT), was especially responsible for opening anthropology up to large technical ensembles.
15. Simondon, *On the Mode of Existence of Technical Objects*, 157.
16. Hayles, *How We Became Posthuman*; Johnston, *The Allure of Machinic Life*; Martin, "The Organizational Complex"; Mindell, *Between Human and Machine*; Pickering, *The Cybernetic Brain*.
17. Halpern, *Beautiful Data*.
18. Wiener, *The Human Use of Human Beings*. Wiener's reductive approach posits technological systems and social systems as comparable expressions of a logical, informational patterning. His theory has been widely criticized for leading cybernetics into its failed attempts at building artificial intelligence in the 1960s; see Brooks, "Intelligence without Representation"; Brooks, "Intelligence without Reason"; Johnston, *The Allure of Machinic Life*.
19. Parikka, *Insect Media*, 141.
20. See Thomas LaMarre's critique of the cyborg notion in LaMarre, "Afterword: Humans and Machines," in *Gilbert Simondon and the Philosophy of the Transindividual*.
21. Latour, *We Have Never Been Modern*; Latour, *Reassembling the Social*.

22. Haraway, *When Species Meet*.
23. Gad, Jensen, and Winthereik, "Practical Ontology"; Morita, "The Ethnographic Machine."
24. Combes, *Gilbert Simondon and the Philosophy of the Transindividual*, 71.
25. Simondon, *On the Mode of Existence of Technical Objects*.
26. Fujii, "Intimate Alienation"; Hashimoto and Kuriyama, *Kindai nihon ni okeru tetsudō to jikan ishiki*; Kuriyama and Hashimoto, *Chikoku no tanjō*; Tanaka, *New Times in Modern Japan*; Noda, Katsumasa, and Eichi, *Nihon no tetsudō*; Sawa, "Nihon no tetsudō koto hajime."
27. Schivelbusch, *The Railway Journey*.
28. Ibid., 74–75. Schivelbusch cites Simmel in the following manner: Georg Simmel, *Soziologie* (Leipzig, 1908), pp. 650–1.
29. For literature on the train in Japanese, see Nakamura, *Ressha seigyo*; Nihon kokuyū tetsudō sōsaishitsu shūshika, *Nihon kokuyū tetsudō hyakunenshi*; Noda, Katsumasa, Eichi, *Nihon no tetsudō*; Sawa, "Nihon no tetsudō koto hajime"; Watanabe and Tamura, *Ryojō 100-nen*; Kuriyama and Hashimoto, *Chikoku no tanjō*.
30. Simmel, "The Metropolis and Mental Life."
31. LaMarre, *The Anime Machine*, xvii.
32. Lévi-Strauss, *Totemism*.
33. LaMarre, *The Anime Machine*, xxvii.
34. Ibid., 301.
35. Mackenzie, *Transductions*, 53.
36. Ibid.
37. Sarti, Montanari, and Galofaro, *Morphogenesis and Individuation*.
38. Simondon's formulation of the term *information* departs considerably from his understanding of the term *cybernetics* in terms of a quantifiable signal, probability, and entropy. As Thomas LaMarre points out in the introduction to Muriel Combes's work on Simondon, if cybernetics gives us information theory, Simondon produces a theory of information (Combes, *Gilbert Simondon and the Philosophy of the Transindividual*, xv). In the latter, information is a nonquantifiable material force, or what Jussi Parikka parses as "the intensive process of change at the border of different magnitudes" (Parikka, *Insect Media*, 142).
39. For an excellent distillation of the challenges posed by the anthropology of infrastructure, see Larkin, "Politics and Poetics of Infrastructure."
40. The term "non-places" is from Marc Augé's work of the same name, *Non-Places*.
41. My use of the term "indeterminate publics" is in reference to Mimi Sheller's methodological problematization of the "mobile public" of transport and communications infrastructure; Sheller, "Mobile Publics."
42. Anthropologists have handled this methodological dilemma in creative ways. Most notably, Bruno Latour's Actor Network Theory (ANT) endeavors to capture the complexity of the collective by mapping its constitutive

human and nonhuman relations; Latour, *Reassembling the Social*. While Latour's approach has proven generative, it has been criticized for its failure to engage the ethical quandaries of these relations; see Fortun, "From Latour to Late Industrialism." By contrast, others have brought forward ethical considerations by foregrounding the political, legal, and economic tensions manifest in infrastructural processes; see Chu, "When Infrastructures Attack"; Harvey and Knox, *Roads*; Anand, "Pressure"; Appel, "Walls and White Elephants."

43. Simondon, *On the Mode of Existence of Technical Objects*, 157.
44. Ibid.
45. Simondon, *On the Mode of Existence of Technical Objects*, 20.
46. *Salaryman* is a broad term incorporating normative notions of gender, class, and race that appears early in Japan's history of modernization but has seen significant fluctuations in its currency in recent decades. Basically, it refers to a salaried, full-time, white-collar, male Japanese worker.
47. JNR was initially designated the Japanese Government Railways. It was renamed JNR after World War II.
48. Weathers, "Reconstruction of Labor-Management Relations in Japan's National Railways"; Kasai, *Japanese National Railways*.
49. The Japan Railways (JR) Group is an organization comprising six passenger-rail companies, each operating within a designated geographical region (JR Hokkaido, JR Central, JR East, JR West, JR Shikoku, JR Kyushu), a freight company (JR Freight), a research organization (RTRI), and an information-systems company (JR System). The group includes a number of subsidiary companies as well, such as the East Japan Marketing and Communications Company (JEKI), which handles advertising within the JR East Kanto Network.
50. I conducted the initial fieldwork for this book between spring 2004 and winter 2006. During that time, I lived on the western side of the Greater Tokyo Metropolitan Area in the city suburb of Higashi-Koganei, which is served by the Chūō Line. I then returned to Tokyo, where I remained from late 2006 until the summer of 2008, accompanied by my wife, who was engaged in her own anthropological fieldwork. Since 2010 I have had the opportunity to return to Tokyo almost every summer in order to conduct follow-up research and interviews.
51. Allison, *Precarious Japan*.
52. Alexy, "Intimate Dependence and Its Risks in Neoliberal Japan"; Lukacs, "Dreamwork."
53. Arai, *The Strange Child*.
54. Yoda, "A Roadmap to Millennial Japan."
55. Cooper, *Life as Surplus*.
56. Kainuma, *Fukushima ron*.