

INFORMATION IN FORMATION:
POWER AND AGENCY IN CONTEMPORARY INFORMATIC
ASSEMBLAGES

Bryan G. Behrenshausen

A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Communication in the College of Arts and Sciences.

Chapel Hill
2016

Approved by:

Lawrence Grossberg

Jennifer Daryl Slack

John Pickles

Sarah Sharma

Neal Thomas

© 2016
Bryan G. Behrenshausen
ALL RIGHTS RESERVED

ABSTRACT

Bryan G. Behrenshausen: Information in Formation: Power and Agency in
Contemporary Informatic Assemblages
(Under the direction of Lawrence Grossberg)

This dissertation critically examines the concept of "information" in an effort to understand the ways it participates in contemporary relations of power. Chapter 1 surveys the contemporary social, political, and economic conditions under which information operates today, and elaborates four "grammars" of information prominent in popular discourse. It also unpacks various assumptions implicit in these discourses, and explains the limitations of such popular accounts for theorizing information's role in various social formations. Chapter 2 performs an historical genealogy of information, tracing the concept's articulation in the American context, especially during the postwar period. This chapter discusses the work of Claude Shannon and Norbert Wiener, who formalized and mathematized the notion of information during this time, their reasons for and aims in doing so, and these theories' implications for conceptualizing information today. Chapter 3 builds on this analysis in order to pinpoint the particular problematic an historical account of information discloses: namely, that of "agency." This chapter traces this problematic's motivating influence through writing in first- and second-wave cybernetics. It demonstrates that critical social theory's current preoccupation with nonhumanistic theories of agency has conceptual roots in this writing, and

offers a schematic for assessing accounts of agency that problematize accounts of the phenomenon inherited from the Enlightenment. Chapter 4 offers a "cartography" of contemporary theories of nonhumanistic agency in order to concretely connect these accounts with their forebearers in cybernetics and information theory; it then re-situates Shannonian and Wienerian theories of information in relation to this cartography. Chapter 5 concludes the dissertation by returning to information's popular articulations. It explains how a "mixed semiotic" approach to information and information technologies might enhance critical discussions of information politics, and attends specifically to the ways in which various figures of agency shape accounts of these politics.

ACKNOWLEDGEMENTS

I am forever indebted to my inimitable advisor, mentor, and friend, Dr. Lawrence Grossberg, who taught me how to ask questions. Larry's boundless generosity of spirit and infectious passion for intellectual work both catalyzed and motorized this project. Conversations with him helped me make and break the necessary articulations.

Committee members Drs. Jennifer Daryl Slack, John Pickles, Sarah Sharma, and Neal Thomas all offered insight, wisdom, and guidance on this dissertation during various stages of its development. Classes with them inspired my very best work. Seeds of this project germinated in an independent study Dr. Thomas graciously agreed to facilitate during his first semester on the faculty.

My fellow PhD students in the Department of Communication at the University of North Carolina, Chapel Hill—particularly Kiely Flanigan, Julia O'Grady, and Jessica Rich—were a constant reminder that dialogue and community are essential to scholarly activity. I thank them all for helping me learn. I also owe specific thanks to Carey Hardin, who patiently guided me through Claude Shannon's equations.

The Department of Communication, where I worked as a teaching assistant to Drs. Christian Lundberg, Michael Palm, and Lawrence Grossberg, provided five years of funding. The university's Davis Library enabled access

not only to specific archival materials integral to my research, but also to a place I could read and write about those materials: study carrel #6301.

Institutions in the Triangle Research Libraries Network supplied necessary archival pieces in rare cases where Davis Library could not.

Dr. Gregory J. Seigworth of Millersville University introduced me to cultural studies as an undergraduate student in the spring of 2002. More than a decade later (and across many long-distance telephone calls) he continues to teach me.

The Global Awareness team at Red Hat in Raleigh offered much-needed camaraderie during summer breaks. In 2010, Jeff Mackanic took a chance on a doe-eyed humanities postgrad. I think Ruth Suehle talked him into it. Jason Baker, Rikki Endsley, Ginny Hamilton, Jen Wike Huger, Carla Rudder, Alex Sanchez, and Nano Serwich made me a better writer. So did Jason Hibbets, who prepared the salsa.

Numerous open source software applications facilitated my writing, and I am grateful to the communities of programmers who continue to make them available. Special thanks to the teams behind gedit, pandoc, RedNotebook, Firefox, LibreOffice, Xfce, Debian, and Linux Mint.

Finally, I owe many thanks to both my immediate and extended families—source of love, encouragement, and support—who never failed to ask how the writing was going, and who listened when I inevitably told them. And I owe so much more than gratitude to Kate Behrenshausen, forever my partner. I needed 69,000 words to complete this project, but describing what she means to me would require more still.

PREFACE

*The information is ravenous
The ticker tape feeds the mind ...
When the information comes
We'll know what we're made from
—Beck, "The Information"*

This dissertation's title, *Information in Formation*, encapsulates twin impulses that guide the project's approach to something that (for the last half-century and especially in the global West) many have called "information."

The first of these impulses is an effort to locate information *in* formation, amidst the field of multiple, overlapping processes, discourses, and practices, which grant information some definition or effectivity. This "field" is information's *context*, and, apart from this context (this loosely-coordinated *formation* of determinations), information has no definition, no self-evident identity. The current project asserts that (as Stuart Hall might say) information *as such* doesn't exist, that one can apprehend only "a diversity of practices and historical situations" through which some-*thing* called "information" is "produced, circulated, and deployed" (cited in Grossberg, 1986, p. 65). In other words, this dissertation assumes what Lawrence Grossberg (2010) calls a "radically contextualist" posture with respect to information (p. 20); wherever and whenever possible, it refuses to disembod or disassociate information from the very social, historical, cultural, economic, and political relations that in fact

constitute it. This project traces the links or the connections—the *articulations*—between these relations, in order to specify the manner(s) in which they shape certain conditions for thought and action.

These connections are never stable, never final. Indeed, this is the second impulse guiding the present work: an appreciation for information in *formation*, in the ongoing and dynamic (de- and re-) articulations that continually modify, shift, or reify the particular *ways* information is *always taking shape*, even today. Such a focus reveals something additional: to say (cheekily) that information *doesn't exist* is actually to insist that it doesn't exist *necessarily*—that its particular taking-shape at a given moment (and nothing more) is precisely what defines its capacity to influence the field in which it's embedded. In this way, information "exists" only as a distribution of pressures and discontinuities, a heterogeneous collection of relations between material technologies, embodied conducts, popular and technical discourses, and certain knowledges—in Foucault's (1972) terms, a *system of dispersion*. For Foucault, such systems function according to particular rules, the "*rules of formation*" (p. 38, emphasis in original), which an analyst can track to better understand the role something like information, "a blank, indifferent space, lacking in both interiority and promise," (p. 39) plays in organizing everyday practices. Crucial here is not so much what information *is* (for as we've already seen, it isn't anything apart from its various and varied articulations), but what it *does*: the way it *participates* in the field of relations that constitute it, reinforcing some, deflecting others, and modifying still more. For information is always in *formation*—always in motion, always coming-to-form in different and

noteworthy ways. This dissertation assumes that information traffics in certain *regimes of power*, and that a focus on the *conditions* of information's *emergence*, on the never-settled *field* of which it is indelibly a part, might reveal something about the way such power operates today. Yes, information is both the product of and a motor for various relations—but the nature, valence, scope, and effect of the particular relations it mobilizes are never predetermined, and the shape of their (temporary) settlement(s) are important.

They are especially important with regard to one thorny and ambiguous concept in contemporary critical social and cultural theory: *agency*. Construed as some ability to act *genuinely* or *authentically*—or perhaps more modestly (though just as problematically) as simply some ability to *have an effect* —"agency" is intimately bound to the problem of information, and has been since information's postwar American theorizers first grappled with the implications of a "new science" that seemed to challenge tenets of liberal humanism. Though they never used the term, "agency" preoccupied these thinkers; it both vexed and fascinated them, and their responses to it had repercussions in multiple fields (include continental philosophy) for years to come. Today, those responses have something to teach us about the ways popular *struggles* over "information" get articulated and framed.

The impulses guiding this dissertation, then, express something critical about the present search for knowledge about information. Its goal is not sheerly taxonomic or documentational; it does not necessarily seek to "clarify" some singular, objective *thing* that decades of research and writing across multiple discourses and domains have labeled "information." It approaches

information as something that belies a milieu the complexity of which is beyond the static frame of any single term: a certain *formation* always and already *in* formation. Generating knowledge about such a thing is not only an effort to better comprehend it—but also an attempt to *intervene* in its constant reconfiguration. For "knowledge is not made for understanding; it is made for cutting" (Foucault, 2010, p. 88).

TABLE OF CONTENTS

List of Figures.....	xv
Chapter 1: The Informational Resource.....	1
The Grammars of Information.....	1
The 'Resource Doctrine' of Information.....	9
The Problem(-Space) of Information.....	14
On the Agency of the Informatic.....	17
Approaching Information.....	21
Toward a Cultural Studies of Information.....	26
Chapter 2: The Formation of Information.....	30
Articulating Information.....	30
A Mathematical Theory of Communication.....	33
A New Theory of Entropy, Again.....	37
A Model 'Suitably Idealized'.....	39
Inform-ative Events.....	41
Signal and Noise.....	44
The Meaning of/in Weaver's Shannon.....	46
A New Science of Communication and Control.....	55
Another Theory of Entropy.....	60
Control and/is Communication.....	63
'Control by Informative Feedback'.....	66

A Contingent Universe.....	72
The Minus Sign.....	74
The Problem of Information.....	77
Information is Non-Substantial.....	77
Information is Non-Semantic and Non-Representational.....	79
Information is a Matter of Organization.....	86
Toward a New Problematic.....	88
Chapter 3: How to Think About Machines.....	91
The Cybernetic Problematic.....	91
The Purpose of Purpose.....	93
A Cybernetics of Cybernetics.....	97
Autopoiesis and Machinic Autonomy.....	103
Machinic Desire and Ecological Subjectivity.....	111
Toward a Machinic Ontology.....	120
Agency Without Reductionism.....	126
Chapter 4: Mapping Information (Theory).....	137
Plotting a Course.....	137
Problem-Spaces of Control.....	140
The Governance of Power, the Power of Governance.....	146
From Epoch to Conjuncture.....	153
From Model to Meta-Model.....	165
Actor-Network Theory.....	166
Vital Materialism.....	170
Agential Realism.....	175

Charting Ontologies (Three Agential Territories).....	181
Actor-Network Theory.....	181
Vital Materialism.....	183
Agential Realism.....	185
Relationality, or Power's Cardinal Directions.....	187
An Orientation Toward Power.....	188
Two Mathematicians, Two Maps.....	193
Wiener's Abstract Machine.....	194
Shannon's Expressive Ensemble.....	196
Conclusion: A Cartographic Theory of Communication.....	199
Chapter 5: On Information Politics.....	207
Grammars and Modalities (or, Some Redundancy).....	207
Semiotization Without Signification.....	214
Information—.....	224
—About Reality.....	225
—For Reality.....	228
—As Reality.....	232
On the Agency of the Informatic (Once More).....	236
On the Agency of the Signifying.....	236
On the Agency of the A-signifying.....	239
Interlude: Against the Resource Doctrine of Information.....	240
On the Agency of the A-semiotic.....	246
Agency Beyond Subjectivity (or, Some Entropy).....	248
References.....	252

LIST OF FIGURES

Illustration 1: Shannon's equation for information.....	36
Illustration 2: Shannon's communication model.....	40
Illustration 3: Guattari's mixed semiotics, as conceived in 1973.....	217
Illustration 4: Guattari's mixed semiotics revised.....	223

CHAPTER 1: THE INFORMATIONAL RESOURCE

The Grammars of Information

Much writing on information begins in frustration over the difficulty of definition. The task appears simple. "After all," Terranova (2004a) writes, "information has become such a common word and is used so freely and with such ease that we should have no problem at all defining it" (p. 6). Today, fewer words are as familiar as "information." But fewer words are also as elusive. Perhaps this is because information appears in so many discourses—what Day (2001) calls information's multiple "grammars"—and, he adds, "today the grammars of this term are extremely diverse" (p. 84). What follows is another attempt at definition, albeit one that does not seek to arrive at information's singular meaning. For what Raymond Williams (1983) writes of another complicated word, "culture," is also true of information: it "is a record of a number of important and continuing reactions to [...] changes in our social, economic, and political life, and may be seen, in itself, as a special kind of map by means of which the nature of the changes can be explored" (p. xvii). Tracking information's multiple, heterogeneous grammars is key to understanding what's at stake in the various social and political scenes in which information appears today, scenes disclosing struggles that populate the current historical moment. Consider the following.

Scene 1: To quell an uprising of users concerned by recent changes to Facebook's terms of service—changes specifically to the language regarding the company's right to users' "information" after those users have terminated their accounts—public relations representative Kathy Chan takes to the blogosphere. "Our philosophy," she writes (2009), "is that people own their information and control who they share it with" (n.p.). The company's pseudo-apology, "On Facebook, People Own and Control Their Information," continues:

People want full ownership and control of their information so they can turn off access to it at any time. At the same time, people also want to be able to bring the information others have shared with them—like email addresses, phone numbers, photos and so on—to other services and grant those services access to those people's information. These two positions are at odds with each other. (Chan, 2009)

Call this information's *political economic* grammar, one in which information is a commodity of post-Fordist social formations. Here, information is a bounded and discrete object, something that can be bought, sold, and traded on a market. And it is quite valuable. As Verizon Wireless executive Bill Diggins notes when reports indicate that the mobile phone provider routinely gathers "information" (McCullagh, 2012) about its customers' usage habits and sells those details to marketers: "Data is [sic] the new oil" (n.p.). "Information" becomes "data" to the extent that it can be packaged, controlled, and manipulated to *reveal* some-thing about some-one. But it does not do this easily, for information-as-commodity is a tricky kind of thing that often refuses to obey traditional laws of physics and complicates taken-for-granted market logics. It

can occupy two locations at once; it can transfer between parties without any essential loss. But it nevertheless "bears the stamp of society and history in its very core" (Schiller, 2007, p. 8), for it is, after all, an expression of certain configurations of capital, labor, and the state (Beniger, 1986). It is the principal stuff of "information societies" (Lash, 2002; Webster, 2006), where it appears as both input and output for a particular mode of production.

Scene 2: John Perry Barlow (2008), co-founder of the Electronic Frontier Foundation and author of the provocative treatise "A Declaration of the Independence of Cyberspace," agrees to pen the foreword to science fiction writer and activist Cory Doctorow's essay collection, *Content*. He disagrees with the book's title: "Ha! Where's the container?" (p. xv). So-called "content," Barlow writes, is a term that "only arose when the institutions that had fattened on their ability to bottle and distribute the genius of human expression began to realize that their containers were melting away" (p. xvii). It's a conspiracy, a "plot to make you think that meaning is a thing" (p. xvii). But Barlow isn't fooled: "Information isn't a thing. It isn't an object. It isn't something that, when you sell it or have it stolen, ceases to remain in your possession. It doesn't have a market value that can be determined" (p. xvi). "Information is simultaneously a relationship, an action, and an area of shared mind," says Barlow. "What it isn't is a noun" (p. xvi).

Call this information's *cultural* grammar, in which information enjoys a distinct relationship with "meaning." Indeed, here the terms frequently slide into one another (as Barlow so easily demonstrates). Information is *formless meaning*, the result of human creative practices. It is the intangible and amorphous stuff that might be made to inhere in various "containers" but is never completely controlled or determined by them. Information-as-meaning becomes information-as-commodity through the incorporeal transformations of intellectual property law. But it exists then only as an impure, bastardized version of itself—something not quite in harmony with its essence as the free-floating semantic. Popular writing in this grammar (like Barlow's) often celebrates information's uncontainability, its power to supersede constraints. More critical writing tackles the relationship of *information* and *meaning* head-on. It might construe information as progenitor of particular cultural logics—say, increasing skepticism of authoritative narratives and "expert" accounts (Andrejevic, 2013), the decline of representation as a singular locus of power relations (Terranova, 2004a, 2004b), or the fetishization of dematerialization (Hayles, 1999).

Scene 3: On his first day as President of the United States, Barack Obama issues a memorandum to all federal agencies: *Subject: Freedom of Information Act*. "The Government should not keep information confidential merely because public officials might be embarrassed by disclosure, because errors and failures might be revealed, or because of speculative or abstract fears," he writes

(Obama, 2009, p. 1). President Obama hopes to "usher in a new era of open Government" (p. 1) characterized by transparency and accountability. The formula is simple: "A democracy requires accountability, and accountability requires transparency" (p. 1). And both of these require information. Obama instructs the Director of the Office of Management and Budget to "improve information dissemination to the public, including through the use of new technologies" (p. 1). A year later, Julian Assange disseminates information—leaked military documents—to the public using new technologies. Obama calls the act "deplorable" ("Obama lashes out"). Assange claims he's simply carrying out the government's quest for total information awareness, conceptualizing the government the same way the government conceptualizes terrorist organizations: as a set of networked nodes. "We extend this understanding of terrorist organizations and turn it on the likes of its creators where it becomes a knife to dissect the power conspiracies used to maintain authoritarian government," he writes (n.p.). Information is key to targetting those conspiracies, which Assange imagines as homeostatic systems capable of sustaining themselves through themselves. "Conspiracies take information about the world in which they operate (the conspiratorial environment), pass it around the conspirators and then act on the result," he says. "We can see conspiracies as a type of device that has inputs (information about the environment) and outputs (actions intending to change or maintain the environment)" (n.p.). Hacker and activist Aaron Swartz (2008) is more succinct:

"Information is power. But like all power, there are those who want to keep it for themselves" (n.p.). The best way to fight an authoritarian conspiracy? *Disrupt its information flows.*

Call this information's *documentational* grammar, wherein information is *the stuff of record*, both a thing and a process of recording and retrieval (Buckland, 1991). While in the political economic grammar *data* emerge from *information*, the documentational grammar positions information *between* data (sensory stimuli) and knowledge (propositions that orient one in the world) (see Tweedale et al., 2014, pp. 2-4). Information bridges sensing and believing (Buckland, 1991). It operates on and reconfigures user's "knowledge structures" (Day, 2011; see also Day 2001). Information is what *reveals*; like a light, it shines on ignorance and dispels uncertainty. In theory, it brings one closer to the truth. Indeed, in civil societies, it is what free subjects require in order to be most free. Information is the mechanism of liberation.

Scene 4: Cryptologist Kristin Lauter of Microsoft Research wonders about the potential of the human genome. Using sample data, she computes a patient's risk of heart attack in two tenths of a second. She and her colleagues are working on a practical method for securing, through encryption, the "genetic information" (Sumner, 2014, n.p.) that will unlock the secrets of human composition. Costs associated with sequencing the human genome are apparently plummeting, leading some to worry about the future security of "personal health information" (Sumner, 2014, n.p.). John Wilbanks, privacy

expert at Sage Bionetworks in Seattle, is one of those people. He imagines a world in which even the slightest physical interaction might disclose a person's deepest biological secrets:

In 50 years the cost of genome sequencing is expected to be very low. If there's a copy of your genome out there that's heavily encrypted, it would just be better for me to shake hands with you and take some of your genetic material. The more we increase the penalty for getting an existing copy of a genome, the more the incentive is to just make a new copy. (cited in Sumner, 2014, n.p.)

Call this information's *metaphysical* grammar, where information is a universal substrate, the raw material for the universe's potentially infinite (re)configurations. Learning to manipulate this information gives humans control of the shape of the cosmos itself. This grammar leans heavily on a distinction (one Wilbanks' account activates) between two realms: the informatic, where patterns (and copies of patterns) proliferate endlessly, and the material, where those patterns get instantiated (even stolen). Black (2014) characterizes it as a relationship of "the perfect, eternal, and transcendent originators and determinants of messy, flawed, contingent matter" (p. 109)—an odd kind of neo-Platonism. It is an idea "already well established in the discourse of genetics" for example, where molecules like DNA and RNA serve as "the archetypal manifestations of molecules' power to mediate between pure information and physical materiality" (p. 105). As part of this grammar, Black writes,

The concept of information, as an abstract means of describing material phenomena, is credited with an objective reality independent of material phenomena and so, because all material phenomena can be described in terms of information, information is reasoned to be a universal animating principle behind all material phenomena. (p. 115)

It is a tendency pronounced not only in genetic discourses but also those of quantum computing. For example, Davies (2014) elaborates "a view in which *information* is regarded as the primary entity from which physical reality is built" (p. 95, emphasis in original). Indeed, for scientists like Lloyd (2014), the universe is "a machine that processes information [...] a giant quantum computer" (p. 131). This is indisputable. "This is simply a mathematical fact" (p. 131); "the universe computes" (p. 123). Information is the expression of an infinite generativity. "It is the ongoing computation of the universe itself that gave rise naturally to subsequent information-processing revolutions such as life, sex, brains, language, and electronic computers" (p. 123). To discover information's natural dynamics is therefore to unlock not only the secrets of life itself but also the keys to the organization of the entire cosmos—why things are the way they are and not some other way, or what Emeritus Regius Professor of Divinity at Oxford University, Keith Ward (2014), calls "the supreme informational principle for constructing universes" (p. 370):

[...] the ultimate ontological reality is indeed information, but that information is ultimately held in the mind of God, and such a hypothesis expresses one of the most coherent and plausible accounts of the nature of ultimate reality that is available to us in the modern scientific age. (p. 378)

Information is a window to the divine.

Four grammars of information. Four figures of information present in contemporary discourses. Four ways this *thing* called "information" gets invoked, policed, and mobilized. Each is not as tightly bounded as these descriptions might make it seem; boundaries bleed and overlap. Yet each is more than a definition. Each is a *site*: a site of contestation, a site of *struggle*. These struggles—over objects, over meanings, over truths, over a universal substrate—not only *depend* on certain notions of information, but also *perpetuate* them. These notions are neither fixed nor eternal; they are *contextual*, pieced together from contingent resources available in specific social and historical contexts. But this does not make them any less real, or their study any less pressing. *Defining* information may be difficult, but *mapping* its activities is even more so.

The 'Resource Doctrine' of Information

The point of elaborating information's grammars is not to reconcile them, to somehow synthesize them into a single definition that elides the particular nuances of each. Indeed, retaining information's very multiplicity—its ambiguity and polysemy—is important for any analysis of the multiple ways the concept of "information" is able to productively *function*. Today, however, information has been effectively naturalized. So ostensibly ubiquitous is this thing called "information" that it seems propelled by its own internal and essential dynamics. According to many popular accounts, information shows little regard for the persons and institutions attempting to arrest, control, store, release,

secure, or monetize it. Byfield (2008) suggests contemporary discourses of information herald it as both a "cudgel," a "relentless, inevitable almost malevolent historical force that threatens institutions and forces adaptation," and a "carrot," "an enticing, endless, immaterial garden of delights in which instantaneous access to timeless knowledge promises the opportunity of transformation for individuals and for the globe as a whole" (p. 129). But information's apparent *naturalness* is of course part and parcel of its very historical construction. Information, as Day (2001) notes, continues to be rather effective at eliding its own history, one that "*must be forgotten* within any 'metaphysics' or ideology of information, because information in modernity connotes a factuality and pragmatic presence [...] that erases or radically reduces ambiguity and the problems of reading, interpreting, and constructing history" (p. 3, emphasis in original). Tensions exist not only *between* divergent notions of information—how can information be both amorphous and a commodity?—but also *within* seemingly coherent colloquial and institutional definitions of it. Such tensions invite exploration of the ways in which those definitions hang together, how they efface their own fissures and fractures while performing important work in the world.

Many popular definitions of information do, however, share one commonality: they treat information as a *resource*. This is to say that they interlock to form a particular epistemic formation, a way of *knowing* information Balnaves and Willson (2011) call the "resource doctrine of information" (p. 44). According to this view, information is a *thing* with some *utility*; it can be *used*, *mis-used*, or *used up*. Moreover, the resource doctrine of

information "carries with it explicit assumptions about rationality" (p. 43)—that is, it presupposes a certain mode of subjectivity that *engages with* informational resources. As a resource that pre-exists certain engagements with it, information becomes disembodied from the relations that in fact constitute it. Popular discourses tend to treat it as either a *motor* of social and cultural change or some *outcome* or *symptom* of personal, cultural, juridical, scientific, or economic processes. Additionally, struggles *over* information are often likewise contests over *resources*, the informational *objects* or *contents* so central in contemporary debates concerning often disparate or divergent issues: privacy, creativity, ownership, communication, control, truth-telling, and/or liberation. Despite apparent disagreements between forces or factions struggling to define information's utility or limits, information's status as a resource remains unchanged, and it serves a powerful framing function. And because struggles over information often fail to displace this frame, it continues to orient even the most seemingly radical interventions *into* these struggles. If we are to understand what is at stake when powerful forces deploy "information" as part of their discursive and material strategies or tactics, we must understand the ways in which a resource doctrine of information enables and constrains those repertoires.

Materials for doing this are already at our disposal. Interestingly, a "resource" view of information diverges considerably from those of information's mid-twentieth century theorizers—the mathematicians and engineers who, in the postwar United States, firmly rejected many notions that are today part and parcel of informational common sense. For them,

information was not an *object*—not something to be bartered, shared, disclosed, or revealed—but a *measure of relations*, a particular manner of *addressing contingency*. Postwar theories of information responded to growing concerns about reality's ability to hold itself together, and suggested a desire to predict and control a world whose stability and coherence could no longer be taken for granted. "The beginning of the twentieth century marked more than the end of one hundred-year period and the start of another," writes polymath Norbert Wiener (1954) in the introduction to *The Human Use of Human Beings*, his bestselling book on "cybernetics," the science of self-regulating systems (p. 7). Indeed, Wiener's book expresses the anxiety of the age quite forcefully. It opens on the image of a chaotic cosmos, a universe that persistently tends toward disorganization. Newtonianism—with its assurances that every element of the universe operates with wholly predictable and incontrovertible behaviors (see Hacking, 1990, 2006)—is under attack, both in the sciences and in mathematics. For Wiener, it is the dawn of a new epoch, one inaugurated by the waning influence of strictly deterministic scientific imaginaries. The ascendancy of probabilistic theory is part of an unavoidable "recognition of [...] an irrationality in the world," a "fundamental element of chance in the texture of the universe itself" (p. 11). The title of his book's preface names the source of so much trepidation: "The Idea of a Contingent Universe."

For Wiener and his fellow cyberneticists, the universe's absolute contingency is its only certainty. No longer can one assume that the universe holds together of its own accord. It offers no guarantees about its shape, its movements, or its temporary and local configurations. "It is a world of Process

[sic]" Wiener later writes in his memoirs, "not one of a final dead equilibrium to which Process leads nor one determined in advance of all happenings, by a pre-established harmony" (Wiener, 1956, p. 328). And so, drawing on available resources from physics, calculus, and engineering, Wiener names that process. He develops a concept meant to assist in measuring the probabilities of the world's various arrangements, and calls it "information":

The needs and the complexity of modern life make greater demands on this process of information than ever before, and our press, our museums, our scientific laboratories, our universities, our libraries and textbooks, are obliged to meet the needs of this process or fail in their purpose. (Wiener, 1954, p. 18)

Articulated more than half a century ago, this definition of information diverges sharply from those circulating in contemporary discourses. But as this dissertation will argue, it is integral to understanding something about the way power operates today. To be sure, Wiener's writings (as well as those of Claude Shannon and others whose work this dissertation will examine) disclose dimensions of information occluded in information's popular accounts. But even more importantly, they gesture toward a profound sense of shifting ground, the dissolution of relations that secured some (albeit loose and fissured) consensus about the way the world worked. By revisiting these writings, this dissertation seeks to understand how information might be more than some *thing*—some *resource*—over which people struggle today. In doing so, it does not seek to return to some "original" and therefore more "correct" definition of information,

but rather suggests that renewed attention to the *concerns* motivating postwar information theories might disclose additional key dimensions of the contemporary political terrain.

The Problem(-Space) of Information

More appropriately, then, one might refer to the *problem* of information as the *problem-space* of information. As Scott (2004) argues, problem-spaces are historical conjunctures, conceptual-ideological thickets that pose genuinely new questions to cultural analysts. Problem-spaces are those material and discursive regimes in which the "meaning" of a particular object of inquiry might be disclosed through what Grossberg (2010) calls a "conversation between analyst and context" (p. 48), a conversation that both generates the problem-space and orients the critical inquiry going on in and around it. The idea of information as problem-space underscores the *contested* nature of the term (its status as multivalenced and overdetermined). It also highlights the fact that it points not to a single referent, but to an *entire constellation* of ideas, practices, discourses, effects, signs, and knowledges. This is to say that information is a problem-space insofar as *what* it discloses is not a singular object but rather a *configuration* of elements aligned to organize the activities that *can* and *should* take place *in* that space. This dissertation argues that the central problematic disclosed through investigations of information's effectivity today is that of *agency*.

Though the term does not often appear explicitly in them, agency becomes central to information theories and informatic discourses—for empirical, theoretical, and political reasons. It is visible in the work of the American

scientists, mathematicians, and engineers who theorized the nature and function of both information and informatic technologies. Cyberneticists in particular grappled with agential concerns, especially when confronted with the radically antihumanist implications of their work, which seemed to posit a certain symmetry between human and nonhuman actors, both of which, cybernetics claimed, embody the same behavioral propensities (see Hayles, 1999). Indeed, in a world that constantly tended toward chaotic dissolution, "agency" was for the cyberneticists a matter of *maintenance* or *stability*, a capacity to *remain coherent* in light of this thoroughly contingent cosmos. Furthermore, many popularizations of Shannonian information theories (such as that of well-known collaborator Warren Weaver, for example) stressed information's indispensability for asserting influence over the actions of others; they rendered information a matter of exerting influence through the deliberate, rational selection and transmission of messages. While information theorists might not have *claimed* to be developing theories of agency, their work is rife with concepts and themes—choice, will, efficacy, possession, determination, change—that have traditionally clustered around this notoriously thorny problem.

An interest in nonhuman actors' agential capacities links cybernetics (and the information theories it mobilized) with some trends in critical social, cultural, and political theory, where nonhumanistic theories of agency have proliferated in recent years (see, for example, Barad, 2007; Bennett, 2010; Coole, 2005; Coole & Frost, 2010; Latour, 2005; Passoth et al., 2012; Whatmore, 2002). Such theories attempt "to undo the conceit that humanity is

the sole or ultimate wellspring of agency" (Bennett, 2010, p. 30), and they attempt to account for the dynamic effectivity of *myriad* entities (human and nonhuman, organic and inorganic) not only *producing* particular social formations but also *maintaining, subverting, or recomposing* them in ways that determine the activities those formations might afford. This work also embodies key cybernetic impulses, like an emphasis on the relational complexity between heterogeneous actors and a tendency to think "machinically" about systems' behaviors. In fact, this dissertation demonstrates the historical, discursive linkages between ongoing work in cybernetics and a growing body of work that, while intellectually indebted to it, nevertheless (and occasionally vociferously) rebukes it. For instance, the "machinic ontology" of Deleuze and Guattari owes much to the thinking of second-order cyberneticists, even as these two thinkers are at pains to distance themselves from any association with what they consider "information theory" (see Chapter 3). Cybernetics helped set the stage for decades of social, cultural, and political theorizing by clearing a discursive space in which the solitary, autonomous, efficacious subject—icon of Enlightenment political imaginaries—might undergo rigorous critique.

Exploring the problem-space of information has both theoretical and political consequences. For if information is today construed primarily as a resource, then one must ask *for what or whom* is it a resource? The resource doctrine of information often smuggles into contemporary discussions about information, information technologies, and information politics a view of agency as some-thing located "in" a human subject, which struggles against social structures the principal aim of which is *denying, restricting, or otherwise*

delimiting this agency. Interestingly, while this Enlightenment notion of agency has recently undergone rigorous critique in the academy, it continues to exert powerful pressures in popular politics. The resource doctrine of information elides the *question* of agency, and the Enlightenment subject (reappearing now in its neoliberal re-figuration) remains the taken-for-granted locus of agency in discussions regarding struggles over information-things. Information's reification into a resource one might possess or use—with which one might truck, barter, and trade—involves the concomitant naturalization of this subject as agent in constant tension with the structures of a given social formation.

On the Agency of the Informatic

This view of agency tends to promote linear and reductionist models of the otherwise complex relationship between information *technologies* and social *formations*. As Slack and Wise (2005) note, popular narratives regarding ways in which technology and society "interact" invoke specific notions of determinism often expressed through arguments about causality (see also Slack, 1984); these determinisms are themselves predicated on a dualistic model that separates humans activities and material technologies. As Williams (1974) suggests, in popular accounts of "technological change," two predominant forms of determinism prevail. The first is *technological determinism*, whereby a new technology enters into a given social arrangement and, as a consequence of its own essential and internal dynamics, alters that arrangement, or "sets the conditions for social change and progress" (p. 13). The second is *social determinism*, whereby broader social processes *produce* a new technology as a *symptom* of cultural values, a mere "by-product of a social

process that is otherwise determined" (p. 13). In these accounts, then, either technologies or human actors impinge on the other from a place somehow *outside* their interrelationship(s); implicit in them is an agent/structure dualism that imagines technology either as a useful resource *for* or an unfortunate impediment *to* human activities. The result is a zero-sum, linear relation of influence between people and things, "a stand-off between a person and a machine" from which critics must "determine on which side lies the central point of agency, the fulcrum of power on which the social rocks" (Wise, 1998, p. 424). Posing questions about the nature and function of technology (including *information* technology) becomes a simple matter of choosing which of these "sides" to consider and analyze, which to narrate as the active subject that impinges on an otherwise passive object. Moreover, such linear thinking frequently rests upon a humanist bias that frames research projects in advance of actual investigation, encouraging researchers to either bemoan the "detrimental" effects of technology on already-existing social arrangements or celebrate ways in which technology augments some essential human capability. More useful instead are descriptions of relations among information, information technologies, and social formations that do not easily collapse into linear narratives featuring diametrically opposed forces whose nature and valence are prefigured in advance of research.

The resource doctrine of information both depends on and reinforces linear and dualistic models of technological causality. This is one effect of the doctrine's facility as a particular epistemic formation. Another is the tendency to *posit certain qualities* of information, namely:

- *Information is meaningful content*; that is, information is the "stuff" of creative activity, the *substance* of some exchange between entities that *makes sense* to those entities because it can be "read" against some experiential horizon. Information is *what is transferred* as part of social interactions. But it is an odd kind of content, one that often refuses to obey certain physical laws. It replicates easily (for some, *too* easily), and needn't remain a single entity's exclusive property. What is more, information-content typically takes a specific form: *amorphousness*. As the content of transfer, this formless and ephemeral yet meaningful substance might inhere temporarily in or on various media, those *storage devices* that attempt to contain it (books, hard drives, the brain). And yet one must never confuse the "meaning" of information with any *specific* material instantiation of information, as information's "natural" ephemerality *complicates* these attempts to contain it. Information operates primarily in *semantic* registers as both precondition for and outcome of some meaningful exchange. Indeed, struggles over information-as-content are typically struggles over *enclosure*. They comprise a political project aimed at either access (availability of information) or control (restriction of information).
- *Information is representational*; that is, information *discloses something* about the actions, proclivities, dispositions, and traits of a target or source. Information functions according to the logic of the semiological sign: it *stands in for* something that is less ephemeral and therefore *more real*. And if information is *representational*, it often is so in the most

"transparent" way. Information is a vehicle of objectivity, providing some knowledge (unsullied by ideology) of a state of affairs. Information can disclose truths. Indeed, information cannot be "false," for then it would be "misinformation." Information represents to a conscious mind something essential or enduring. Struggles over information-as-representational are therefore struggles *over* these representations or misrepresentations. They comprise a political project aimed at either demystification (dispelling "misinformation") or resignification (circulating "different information"), and spark never-ending debates regarding information's (in)ability to (in)adequately account for the traits or conditions it supposedly represents (debates over identity and verisimilitude). Indeed, information's "facticity" makes it a public resource, the lifeblood of democracy. Information that accurately portrays a given state of affairs is exactly what "free" citizens require to make rational decisions and, consequently, to remain free.

Each of information's many grammars registers the effects of these qualities to varying extents, but all seem to converge on them—and with important consequences, as we will see. What motivates this dissertation is the sense that popular struggles over what is commonly known as "information" are often misdirected, for they do not adequately apprehend the complexity of the object they claim to contest. Certain philosophical commitments (commitments bound up in and presupposed by commonsense notions of information) constrain their understanding of what is at stake in these struggles, and might actually undermine their success in securing the political victories they seek.

This work attempts not only to gain insight into the cultural, political, and economic dynamics that animate struggles over information today, but also to develop methods and conceptual tools better suited for intervening effectively in these struggles.

Approaching Information

This dissertation returns to a specific body of writing on information: that which emerged in American scientific, engineering, and mathematical literatures during and after the Second World War, a time of intensifying interest in the emerging field of information science and the communication and control technologies that might embody and demonstrate its important contributions. As Wiener indicates in the quotations above, this is also a moment that presents itself as the beginning of a new *conjuncture*, a novel, if temporary, settlement in the social forces aligned to produce and secure the conditions of everyday life. Undoing Newtonianism's assurances—dissolving the certainty with which one could speak about the determinacy of events, of effects and their causes, of movements and their trajectories—gave rise to the *problem* of radical contingency. This is the problem information's postwar architects *designed* the concept to address and, ultimately, resolve. For the *question* of agency, the question of an entity's ability to *make* or *be* otherwise, became salient precisely in that historical moment when faith in the past's ability to precisely and irrevocably determine the future wavered (Hacking, 1990). One way to glimpse the tensions present in this conjuncture—one way

into the problem-space of agency it disclosed—is through the question of the politics of information, which the scientific and engineering literatures under investigation here inaugurate.

This is, admittedly, not a popular brand of theory today. Many groups of communication scholars have for decades lodged their critiques of these models, rejecting them as unduly simplistic, tired, even politically and ethically dubious. Many critics paint the models with a broadly negative brush, insisting they imagine communication scenarios as largely disembodied, decontextualized, and dematerialized affairs (in other words, everything against which contemporary theory rails). This dissertation does not dismiss these criticisms, but it does embrace their critical spirit in order to refute them. It reads American information theory closely—historically and critically—and it argues for recuperating what this body of work has to offer contemporary interventions into informatic politics. For the American information theorists thought and spoke about information in ways that frequently run counter to what we take for granted about information today; the figure of information they articulated during and after World War II in some respects differs quite dramatically from those that animate our everyday understanding of the concept. In particular, this dissertation argues that they understood information as *nonsubstantial, non-semantic, and non-representational*. For them, information was not a *resource* to be *used*; it was not a matter of some object-thing to be protected, hidden, deployed, or disclosed, but rather a matter of *organizing possibilities for action*.

We tend to forget this definition's purchase when we fail to question the resource doctrine of information, and consequently our conceptualization of the cultural politics of information suffers a kind of myopia. Framing information as a resource entrenches the view that what's *at stake* in struggles over information is only something like *ownership* or *access*—in other words, something a sovereign subject either *has* or *doesn't have*, something an *agent* can or can't *do* in the face of the social institutions or structures that restrict it. The result is a cultural politics of information aimed solely at assessing an individual's ability to act in the world, to "own" or "protect" the information that represents it, to "disclose," "circulate," or "tap into" the information that tells it something about the world. These are not unimportant political considerations, but they do not exhaust the scope or significance of informatic politics today (see Chapter 5). A return to the mid-twentieth century American literature on information helps make this point.

For the American information theorists were adamant: information is no substantial content-thing. Against contemporary images of information as a stable, unified, and self-evident object, these mathematicians and engineers posited something more *processual*. For Shannon, "information" names something about the certainty with which one can apprehend the arrangement of bodies in a given field, the precision with which those arrangements might guarantee accurate replication of signals. Shannon's information is intimately bound to a notion of *measurement*, and therefore speaks directly to *relations* between entities in a fluctuating field of forces. The same is true for Wiener and other cyberneticists who spoke of information as something determined in and

through relations of bodies more or less organized. For them, information functions as a force of stability in a rapidly changing world; it ensures survival, salvation from a universe moving inexorably toward annihilation. In fact, Wiener (1961) thought information occupies its own ontological category. "Information is information" he writes, "not matter or energy" (p. 132). In the postwar American context, information functions not as discrete and bounded object-resource, but as a matter of relationality; it resists reification and retains a significant degree of processuality.

Nevertheless, for American theorists information was not ephemeral, not some rarefied stuff that floats free of otherwise weighty and worldly concerns. As both a tool for measuring the relative organization of a given field and a process of taking shape against forces of disarray, information is for these thinkers *incorporeal*—while it might lack a *physical* body, it "is certainly not immaterial; it takes effect, becomes effect, always on the level of materiality" (Foucault, 1972, p. 231). Real as the forces that shape it, information participates in the very formations that give rise to it and is capable of affecting those formations to a significant degree. Indeed, for the American engineers, therein lied its very utility. Conceived otherwise, it simply could not have addressed the problem its postwar progenitors wanted it to: the radical contingency of material relations.

If information inheres only in relations, then it tracks relations of a particular type. Certain as they were about information's non-substantiality, American theorists held equally that information is not a representational phenomenon. That is, information does not "stand for" anything in the

semiological sense; it does not traffic in economies of signification as a signifier of something outside or beyond itself. Upon committing his now-famous mathematical theory of information to writing, Shannon (1948) was quick to note that while popular discourses of communication tend to conceive informational messages as things that "refer to or are correlated according to some system with certain physical or conceptual entities," the "semantic aspects of communication are irrelevant to the engineering problem" (p. 379) his work addressed. The relationship of information to its referent is not one of re-presentation (see Chapter 2).

Posing the question of information in a decidedly non-representational register therefore complicates discussions of informatic "accuracy" or fidelity, as information that does not re-present anything to consciousness cannot be deemed true or false. Put another way, one might say that information in its American formulation operates *outside an economy of verisimilitude*; its ability to transparently reflect or transmit "facts," then, is in this sense questionable. For the American theorists, information was instead a matter of *configuration*, of arranging bodies in such a way as to modulate their potentials to function in specific ways (see Chapter 2). Precisely how it does so, of course, differs depending on the particular information theory in question.

This emphasis on ongoing configuration meant that American information theories embraced a specific *nonlinear* understanding of causality. Early cyberneticists, for example, introduced the concept of feedback into both engineering discourses and the philosophical lexicon (see Chapter 3). Indeed, cyberneticists like Ashby (1956) used this very concept to distance cybernetics

from traditional scientific and engineering pursuits. Feedback relations are those in which a process' output becomes its input, those in which the distinction between "cause" and "effect" is blurry indeed. In this way, then, feedback complicates linear understandings of the relationship between singular actors and/in social formations, and poses rather dramatically the question of action and efficacy in complex constellations of human and nonhuman entities. Moreover, feedback relations' particular temporal orientation toward a future that might be otherwise puts the cyberneticists in conversation with continental philosophers and social theorists who framed the question of power as something *machinic*, as something that inheres in a *field of forces* to control current and future actions. Somewhat curiously, however, these thinkers (such as Deleuze, Guattari, and Foucault) tended to uncritically adopt *received* notions of information—information as a resource, as the content-stuff of a unidirectional transmission from one mind to another—and for this reason often failed to glimpse all they held in common with their American forebearers (see Chapter 4).

Toward a Cultural Studies of Information

Pieced together from disparate resources in statistical mechanics, electrical engineering, calculus, and neuroscience (among other fields), theories of information are themselves contingent entities specifically designed to address the problems of *contingency* and *agency* at a particular moment. A critical approach to information must therefore embrace contingency not only as an object of inquiry but also as a methodological imperative.

This dissertation is a work of cultural studies, a politically-motivated intellectual project concerned with providing useful analyses of ways in which social and historical contexts are produced and maintained as unequal relations of power. This project seeks a better understanding of the specific ways theories of information—those both historical and contemporary, scientific and popular—couple with particular technological apparatuses to naturalize and/or transform specific contexts.

To do this, it addresses the way these contingent resources get *articulated*. Articulation involves forging non-necessary (but nevertheless real and effective) connections that define the capacities of the elements thus connected (see Grossberg, 1992, 2010; Hall, 1986; Slack, 1996), and articulations are the contingent linkages between activities, signs, experiences, affects, subjectivities, and discourses that produce and determine the elements in a given social formation. As Slack and Wise (2005) suggest, complex collections of articulations are *assemblages*, dynamic constellations of connections that organize capacities for action, movement, connection, and investment. Indeed, assemblages must be defined by the very articulations they manage to achieve, sustain, and decompose, for articulations define an assemblage's capacities, what it *can do* (what it draws together, what it makes possible through the relations it establishes). Theories of information (as well as those technological apparatuses and practices one might call "informational") are articulations inasmuch as they produce, facilitate, or foreclose certain modes of relation.

Moreover, *information itself* consists of nothing but articulations, and conceptualizing informatic theories, practices, techniques, and technologies as articulations means grappling with their irreducible contingency.

To say that cultural studies is concerned with (re)constituting context(s) is to say that it seeks to map those relations (or *articulations*) that define the contours of possibility in a given social formation. Cultural studies treats a context as "a structured field, a configuration of practices" that map conditions of existence (Grossberg, 1992, p. 60). As Grossberg (2010) explains, "context" is the object of cultural studies in a dual sense. First, it is the *object of inquiry* for cultural studies. A context is a field of forces out of which elements are produced through various (and changing) articulations, and these elements cannot be thought apart from the relations that constitute and reconstitute them. Cultural studies is in this way *radically contextualist*; it considers context not as the *background for* but rather the *complex actuality of* any social formation. For Grossberg (2010), "the identity, significance, and effects of any practice or event (...) are defined only by the complex set of relations that surround, interpenetrate, and shape it" (p. 20). Cultural studies thus sets itself the task of *mapping these relations* in an attempt to generate some insight into their effects. In this second way, then, context is also the goal of cultural studies, it's *object-ive*. In sum, cultural studies aims to *reconstitute* the contexts that make any given element or formation what it is, if only so that it can offer strategies for addressing that formation and assessing its consequences for the ways in which power is distributed in, through, and by it (and, if possible, for dis- and re-articulating the connections that shape it).

In light of this relationship between contexts and their articulation(s), Slack (1996) argues that articulation is indeed the *method* of cultural studies, a way of addressing and intervening in the complex and contradictory relations researchers encounter when confronted with a particular problem-space. Articulation, she suggests provides not only a way of avoiding "the twin traps of reductionism and essentialism" (p. 113) that often plague studies of culture and technology, but also an ethos of engagement with a context, one that stresses the importance of *intervening* in contexts in order to reshape them. This dissertation embraces thinking and working with articulation as a way of maintaining cultural studies' ongoing commitment to foregrounding *relations* and *connections* in thought and in practice, and as a way of producing the kind of politically useful knowledge characteristic of cultural studies. It attempts to do what Grossberg (2010) insists is the aim of any cultural studies project: to tell stories that permit the possibility of transformation and change.

To begin, then, this dissertation reconstitutes the postwar American context in which scientists, engineers, and mathematicians articulated information for the purpose of confronting contingency. It aims to partially and provisionally reconstruct the field of forces in which "information" (and information *theories*) took shape. It seeks to track the multiple, overlapping, and frequently contradictory articulations of information, and understand their deployments in certain fields of power. That is to say, it seeks to understand how information accumulates a certain capacity for authorizing and accomplishing particular goals.

CHAPTER 2: THE FORMATION OF INFORMATION

Articulating Information

This chapter historicizes "information" by tracing its articulation in an American context. More specifically, it unpacks the scientific, mathematical, and engineering literature that circulated through and across multiple, overlapping spaces and institutions—universities, think tanks, governmental organizations, and popular culture—during and immediately after the Second World War, a time of intensifying interest in potential applications of electronic computing technologies for both military and civilian ends.

Forged from curiously disparate intellectual, social, and historical resources gathered amid a rapidly shifting social, political, cultural, and economic wartime landscape, information is never easily or cleanly dissociated from the context of its production (on this, see Beniger, 1986; Edwards, 1996; Mindell, 2002; Schiller, 2007). And yet many popular and academic attempts to address "information"—its characteristics, say, or its uses—tend to ignore critical aspects of this context. They instead speak unproblematically of "information" as a coherent, stable, and bounded object of study. But like other terms that comprise a vocabulary for thinking and speaking about contemporary social and cultural dynamics, "information" refers to no such object. Instead it opens, as Raymond Williams (1976) suggests in the

introduction to his *Keywords*, onto an *entire formation*, a complex and overdetermined series of practices, discourses, artifacts, and moods: "ways not only of discussing but of seeing many of our central experiences" (p. 13). Words like "information," Williams stresses, are important not for the singular meanings they clarify, but rather for the *problems they disclose*; they cannot "really be thought through [...], cannot even be focused until we are conscious of the words as elements of problems" (p. 14) that prompt their construction, takeup, and circulation.

For this reason, Williams (1976) says, studies of word-problems must be in some way historical, aimed at recognizing what Grossberg (2010) calls the *problematics* that seem to define the particular field of forces in which they act. This chapter concerns what Geoghegan (2008a) calls "official histories" (p. 68) of information, those technical accounts of information the work of which constituted information and rendered it intelligible in the wartime and postwar conjuncture. These accounts, along with their attendant narrations (see Ashby, 1956; Aspray, 1985; Cherry, 1951; Pierce, 1973, 1980), depict information as an object awaiting scientific and mathematical discovery, particularly by Claude Shannon and Norbert Wiener, two figures widely considered the intellectual fathers of information. Their accounts of information—published in technical journals, scientific monographs, and popular books alike—have become "benchmark documents of information and communication theory" (Edwards, 1996, p. 180), undeniably responsible for constituting modern information and positioning its uptake in the mid-20th century. Popular narratives to the contrary, these theories of information did not spring forth "full grown" (Gleick,

2001, n.p.) in "complete form" (Waldrop, 2001, n.p.), but were instead the result of painstaking and rigorous articulatory work that instantiated information as a natural phenomenon available for scientific inquiry and mathematical explication.

The information theories of Shannon and Wiener are in fact especially illustrative of the fractures and inconsistencies that characterize the concept of information; indeed, exploring the patchy and frequently tenuous connections these theories marshal and sustain makes "the flat, two-dimensional information 'birthed' in 1948 [become] promiscuous, lively—even schizophrenic" (Geoghegan, 2008a, p. 75). This chapter does not offer something like a definitive or comprehensive account of information in the postwar period. Rather, it concerns the *present*, explicates those particularities of information that have been elided or misconstrued in many accounts of both Shannon's and Wiener's work, and reconstitutes where necessary and appropriate the contexts surrounding them in order to expose their motivating questions and concerns. These concerns indicate ways in which information might be *more* than some *thing* over which people struggle today, and they suggest that a renewed focus on these literatures might disclose additional dimensions of the contemporary political terrain in which information seems to be playing an increasingly significant role.

So this chapter does not advocate a return to some "original" and therefore more "correct" or "pure" definition of information as a tool for quickly or easily diagnosing contemporary formations of power (as if, like Williams notes, simply clarifying a term does anything to address or even resolve the

problems its various uses disclose). But it does suggest that mathematical and technical literatures offer valuable resources for potentially assessing and intervening in these formations—resources those who readily dismiss these histories risk ignoring. The following reading of early American information theory does run against the grain of popular interpretations of this literature in certain strands of contemporary communication studies, which tend to brush off informatic and cybernetic models of communication as ostensibly too linear, too reductive, too mechanistic, or too decontextual. Instead, this chapter joins Genosko (2012) in "refusing to rehearse well-known criticisms that would leave [these texts] behind for the sake of a critical communication and cultural studies, whether it is explained in terms of signification, media, political ecology, or poetics" (p. 31). It offers an unabashedly materialist reading of information that attempts to dissociate information from various connotations it has accrued in recent decades—and recuperates a means of conceptualizing information that in fact gestures toward theoretico-political problem-spaces (Grossberg, 2010) occluded by its more popular narrations. In short, these literatures express a profound concern with the ways in which seemingly unpredictable, heterogeneous collections of elements might be organized and their capacities for current and future action productively modulated—a problem one might call *agency*.

A Mathematical Theory of Communication

Nearly all historical accounts of modern information, both popular (Gleick, 2011) and academic (Pierce, 1980), begin with the figure of Claude Shannon. As an undergraduate at the University of Michigan, Shannon straddled

mathematics and electrical engineering (he earned a bachelor's in each), twin interests that would occupy him for practically his entire life. In 1936, Shannon began a master's program at MIT, where he assisted Vannevar Bush with work on the differential analyzer—an analog computer that was, at the time, the world's most powerful (Nahin, 2013). During WWII, Bush served as chairman of the National Defense Research Committee (NDRC) under President Roosevelt, and his work with the analyzer was directly related to anti-ballistics research. Shannon's advisor indelibly linked him to the war effort.

Shannon's master's thesis, "A Symbolic Analysis of Relay and Switching Circuits," married Boolean algebra with the science of electrical switching circuits (Nahin, 2013). In a 1939 letter to Bush, Shannon concedes that he had "made some progress in various outskirts of the problem" of performing mathematical operations with machines, but was "still pretty much in the woods" (Shannon, 1993e, p. 456). While he toiled away on that effort, however, Shannon idly experimented with another interest—one sparked by an undergraduate encounter with engineer Ralph Hartley's work on signal transmission (e.g., Hartley, 1928): "an analysis of some of the fundamental properties of general systems for the transmission of intelligence," something he felt had "not been rigorously proved" nor "thoroughly investigated" (Shannon, 1993e, pp. 455-456). His letter to Bush contains rudimentary equations representing the process by which various messages (rendered mathematically as discrete functions of time) might be transformed into signals for eventual transmission and replication.

After a brief fellowship at the Institute for Advanced Study in Princeton, Shannon began his career at Bell Labs, where he would produce the theory that made him a household name. But Shannon's initial work at Bell in 1940 did not concern the theory of signal transmission for which he became famous. Shannon published that work only after eight years in the lab. Cryptography was for Shannon the more immediate pursuit, and his efforts here placed him in productive conversation with British mathematician Alan Turing (Gleick, 2011). In this arena, Shannon composed a paper that would eventually bear the title "Communication Theory of Secrecy Systems" when published in *The Bell Systems Technical Journal* in 1949. But the title Shannon initially gave to the piece—classified upon completion and released only in 1945—resonates with Shannon's later contributions: "A Mathematical Theory of Cryptography."

In 1948, Shannon published (in two installments) the document that brought him widespread acclaim: "A Mathematical Theory of Communication." The essay addresses the seemingly straightforward problem of efficiently encoding a message into a signal for transmission through a channel with minimal interference from noise and therefore maximal chance of reproduction by a receiving entity. The problem was not "new" to Shannon; the first pages of his essay explain Shannon's debt to fellow Bell Labs researchers Hartley and Harry Nyquist, whose work on information predated Shannon's by decades (see Sterne, 2012, for an explanation of the extent of these contributions, particularly in telegraphy and telephony). But Shannon's approach specified the problem in a way his predecessors' had not: it assessed signals as probability

functions. With resources from statistical mechanics (resources that had also assisted his cryptographic analyses), Shannon explained information with the following equation:

$$H = -K \sum_{i=1}^n p_i \log p_i$$

Illustration 1: Shannon's equation for information

Here, H is the "amount of information," which is equal to the sum of the logarithms of the probabilities of the occurrence of a particular message from a set of possible messages. Shannon writes " $p_i \log p_i$ " to indicate the relative likelihood of one event over others (as we will see presently, information is intimately related to the certainty with which one might assess this likelihood). Summing the logarithms of these probabilities (the role of big sigma in this equation) produces a negative value between 0 and 1. K is for Shannon simply "a choice of a unit of measure" (Shannon & Weaver, 1963, p. 50)—and the minus sign that precedes it is significant indeed (as we will soon see). Quantities that take this form, Shannon writes, "play a central role in information theory as measures of information, choice and uncertainty" (p. 50). Shannon preferred a single word to describe the relationship between choice and uncertainty that "information" was to measure: "entropy."

A New Theory of Entropy, Again

Shannon's mathematical theory of communication articulates information in *physical* terms. For Shannon (1993b), information "can be treated very much like a physical quantity such as mass or energy" (p. 190). This is to say "information" describes some property of an ensemble, situation, or state; like "mass" or "energy," it names an abstract characteristic available for measurement. Just as "mass" refers to the degree of gravitational pull on a body and "energy" to the relation between force and distance, "information" measures the relative amount of *entropy* in a closed system.

By designating "entropy" his operative term, Shannon reinforces links between information, physical science, statistical mechanics, and probabilistic logic. As Wicken (1987) explains, the concept of entropy "has had a long and interesting history" (p. 177), one that spans more than a century and traverses disparate disciplines. In particular, Shannon's mathematical formula for calculating an amount of information strikingly resembles those of Austrian physicist Ludwig Boltzmann (see Wicken, 1987; Johnston, 2008), whose work attempted to describe the relative distribution of particles in a closed system by calculating the probabilities of various arrangements of those particles (with results that correspond to one's degree of certainty about those distributions). Yet while Shannon recognizes his debt to Boltzmann (Shannon, 1993a, 1993b), his eventual adoption of the term may owe more to a conversation with mathematician John von Neumann, who suggested Shannon use the term "for two reasons: first, the function is already in use in thermodynamics under the same name; second, and more importantly, most people don't know what

entropy really is, and if you use the word *entropy* in an argument, you will win every time" (cited in Floridi, 2010, p. 46, emphasis in original). Shannon would later dispute this alleged conversation (in Price, 1985).

Nevertheless, as Wicken (1987) notes, Shannon's use of the term ushers his work into the "enormously broad connotative field" in which entropy traffics, for while Shannon's equation is "symbolically isomorphic" with Boltzmann's equation from statistical mechanics, "the meanings of the symbols in the respective equations bear little in common" (p. 179-180). Exploiting this ambiguity was, however, critical in the eventual uptake of Shannon's work—and the popularization of the concept of information itself.

Physical scientists will describe entropy as *disorder* (the relative level of dispersion among elements in a closed system); Shannon will instead speak of *uncertainty*. For Shannon, information is "closely associated with uncertainty" (Shannon, 1993a, p. 173) insofar as an increase in the former indicates an increase of the latter. In other words, information is *directly proportional* to uncertainty and therefore *synonymous* with entropy. The concept is therefore useful for predictively calculating the probability that a certain event—and not others—will occur. The greater the likelihood of this occurrence (the greater the certainty that it will occur), the less information present in that situation.

Shannon (1993a) offers the following explanatory example:

The information I obtain when you say something to me corresponds to the amount of uncertainty I had, previous to your speaking, of what you were going to say. If I was certain of what you were going to say, I obtain no information by your saying it. (p. 173)

Information is a matter of novelty and unpredictability—both of which are closely associated with uncertainty.

Placing Shannon's theory of information into an engineering context better illuminates its particularities. Doing so is especially important as Shannon conceived his theory here, and often noted its limited applicability elsewhere (Shannon, 1993c). The principal task motivating Shannon's articulation of a theory of information was the construction of technical apparatuses capable of reliably (that is to say, predictably) transmitting signals across channels in ways that protected them from forces threatening to render them unintelligible—or replicating "at one point either exactly or approximately a message selected at another point" (Shannon & Weaver, 1963, p. 31). Closer examination of Shannon's model for these apparatuses indicates critical subtleties popular glosses of the schema frequently elide.

A Model 'Suitably Idealized'

Shannon's schematic for modeling a communication system is by now quite familiar, and has become undeniably entrenched in Western popular imaginaries of communication. Despite Shannon's (1993c) skepticism concerning over-extensions and universalizations of his work (as if, he wrote, "a few exciting words like *information*, *entropy*, *redundancy* [could] solve all our problems" [p. 462]), his model continues to inform contemporary conceptualizations of communication in multiple contexts. Shannon makes clear his goal: to abstract the functions of elements in a communicative situation from the specificity of their concrete conditions. In considering "certain general problems involving communication systems," Shannon (Shannon & Weaver,

1963) thought it "first necessary to represent the various elements involved as mathematical entities, suitably idealized from their physical counterparts" (p. 34). He illustrates his model this way:

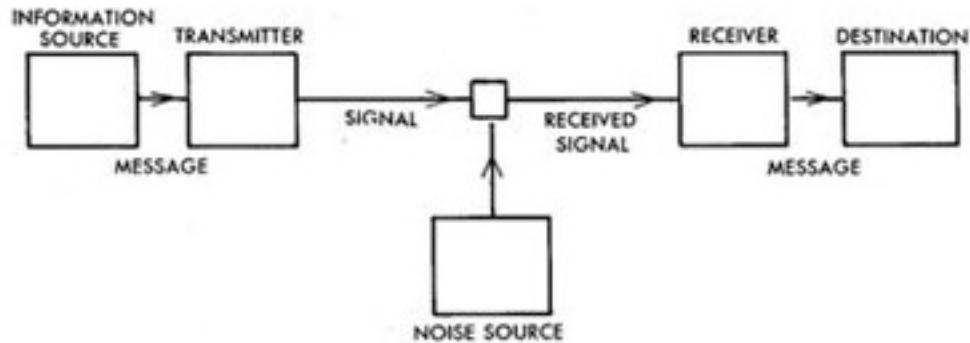


Illustration 2: Shannon's communication model

Famously, Shannon's (Shannon & Weaver, 1963) model "consists of essentially five parts" (p. 33): an *information source* which selects a message to be encoded via a *transmitter*, or that which transforms the message into a signal for its distribution through a *channel* and its eventual reception by a *receiver*, which operates on the signal to produce a message for a *destination*. Information figures prominently in Shannon's elaborations of the model but not in the way most popular accounts assume.

Proponents and critics alike often refer to Shannon's schema as a model of "message transmission." But doing so is wholly incorrect. In Shannon's account, no message is ever transmitted; only signals are. For Shannon, the problem of the message is therefore not a problem of transmission but rather one of *selection*. Recall Shannon's (Shannon & Weaver, 1963) definition of "the fundamental problem of communication": "that of reproducing at one point

either exactly or approximately a message selected at another point" (p. 31). Note, too, the location of the "message" in Shannon's diagram. It appears only *before* and *after* a transmission (tellingly, the "message" is *not* one of Shannon's five "essential" parts of a communication system). Calling Shannon's model one of "message transmission," wherein messages are "loaded" with content (content some will call "information") and sent to a receiver that assesses it with varying degrees of accuracy, drastically misconstrues the nature and function of messages in Shannon's work. Messages are for Shannon not vessels or vehicles for information-content. Messages are the very *events* that *generate* or *ameliorate* information.

Inform-ative Events

"Message" is simply Shannon's name for an event. The moment of message selection is one in which a source activates one likelihood from an array of possibles. Message-events are either more or less likely to occur, and information is an index of the probability of this occurrence: that a source will select one message (i.e., that one event will occur), and not another. In Shannon's (1993f) terms, "we consider information to be produced by a suitable stochastic process" (p. 180). This *process* is the *unfolding* of the message-event as an information source's selective operations activate that message (or sequence of messages) from a system of discrete symbols. Information is therefore dynamic; it modulates in accordance with the varying levels of predictability or unpredictability that inhere in the situation as a event unfolds. Shannon (1949, 1993f, 1993g) models message-events as specific *spatio-temporalities*; events of selection involve successive modifications to a *time*

series that spatialize certain arrangements (as, e.g., in an early paper that depicts "messages and the corresponding signals [as] points in two 'function spaces,' and the modulation process [as] a mapping of one space into the other" [Shannon, 1949, p. 10]; for more on this, see Chapter 4). Shannon's concern is the *probability of activation*, and information is crucial for addressing this concern.

One can calculate the amount of information in a given situation, Shannon suggests, by summing the logarithms of the probabilities of all messages in a given set of possible messages. High-information systems are those in which a larger number of potential message-events might occur (i.e., be selected for eventual transformation); low-information systems are those in which relatively few selections are likely (in which the probability of the occurrence of a particular message-event is high). Information fluctuates as a communicative event unfolds; selecting one element from a field of possibilities enables or constraints possibilities for future activations. A telegraph operator producing a message in English by selecting from a finite set (e.g., the English alphabet) the symbol "q" will see the field of possible subsequent selections narrow significantly, as convention stipulates a narrow field of characters that could potentially follow "q." (Mobile telephone users sending SMS messages via predictive T-9 word completion will be familiar with this phenomenon, as T-9 uses probability-based mechanisms for predicting precisely what users wish to compose.) Selecting "q" is an act that generates little information, as those

arrangements to which it leads are rather certain. The result is unsurprising; it is not very informative, and the communicative situation is therefore not remarkably entropic.

As a physical quantity, information is available for *measurement*. If information is *only* a concern *when selection is possible*, assessing, then calculating, or gauging the amount of information present in a situation is *only necessary in the presence of indeterminacy*. Systems demonstrating no degree of potentiality—no uncertainty—are without information. But even the most fundamental choice, that between one possible message-event and another, affords measurement. Indeed, a choice between two possibilities is at the conceptual center of Shannon's mathematics (the reason calculations for amount of information involve logarithms with a base of 2). Adopting a term from mathematician J. W. Tukey, Shannon gives a name to the unit for measuring the number of selections a source can (or must) make: the *bit* (short for "binary digit"). As the gram is to mass, so the bit is to information; the greater the number of choices between binary pairs necessary for determining the message, the greater the number of bits, and the greater the amount of information inherent to a particular situation. For Shannon, an information source does not *send a message*; it activates a series of probabilities by selecting some elements and not others, and in this way *generates* information as a degree of undecidability.

Signal and Noise

But for Shannon communication is not simply a matter of message selection. Subsequent to the event of selection, a transmitter performs work on messages "to produce a signal suitable for transmission over the channel" (Shannon & Weaver, 1963, p. 33). Shannon's mathematical theory of communication addresses the possibility of constructing devices for the encoding of messages into signals and transmitting those signals through channels in ways that resist forces threatening to divert, dissolve, or confuse them—forces Shannon called "noise." Shannon's preoccupation with calculating the probability of a message-event's occurrence is directly related to this goal insofar as the success of a communication system—its effectively reproducing at one point the message selected at another—depends on that system's ability to anticipate the generative actions of an information source. Regarding message selection and encoding, Shannon's principle concern is a channel's capacity to *modulate* and *transmit* that which an information source produces—the adequate production of a signal. Shannon's demonstration of various methods for efficiently encoding a signal for effective transmission through a channel is one of his most influential contributions to communication engineering, as it "suggested unexpected ways to encode the message to take advantage of the statistical properties of a particular channel" (Johnston, 2008, p. 139). Shannon's theorems indicate methods for ensuring predictability and replicability, not simply by increasing the strength of a transmitter, but via means that are rather more nuanced: establishing reciprocal, predictable, and context-specific patternings, or redundancies, from an array of uncertainties.

If information is for Shannon synonymous with novelty and unpredictability, then information's foil is redundancy. Redundancy is inversely related to information inasmuch as a communication system's relative degree of redundancy determines its potential for variability—its openness to fluctuation. For Shannon, no information is present in a completely redundant system, where systems exhibiting *no* redundancy are *maximally* informative (completely unpredictable). In this sense, information measures the precise relationship between signal and noise (that is, between predictability and unpredictability, redundancy and entropy, certainty and surprise). In part, then, Shannon framed the problem of information as a design problem: one of creating technical apparatuses capable of generating clear signals—uninterrupted connections, prolonged and sustained contact (Terranova, 2004a)—that pierce through noisy environments and facilitate the replication of a message-event. Put another way, for Shannon the problem of information is one of ensuring the effective propagation of a probabilistic sequence, the ongoing activation of certain elements from a field of possible ones.

Yet Shannon's identification of information with uncertainty seems to introduce an odd conflation: if information is directly proportional to entropic unpredictability (and therefore inversely proportional to redundancy), and noise is by definition something that threatens the stability of redundancies, then information and noise would appear synonymous. Indeed, according to Shannon, signals subject to noisy distortions can actually produce *more* information for a receiver than that generated by a source, for they *acquire* a degree of uncertainty through their propagation. In systems designed

specifically for increasing the probability of an event, information would thus act as a threat to be eliminated. Warren Weaver, author of what is perhaps the most influential interpretation of Shannon's work, grappled with (and attempted to resolve) this ambiguity in a way that demonstrates several consequences of extrapolating Shannon's work into domains for which it was never intended.

The Meaning of/in Weaver's Shannon

In what is perhaps his most famous definitional maneuver, Shannon dissociates the mathematical study of information from any concern with meaning. In the second paragraph of his *Mathematical Theory*, he acknowledges that messages often "refer to or are correlated according to some system with certain physical or conceptual entities," but asserts that "these semantic aspects of communication are irrelevant to the engineering problem" with which he is concerned (Shannon & Weaver, 1963, p. 31). Clearly Shannon (1993a) was aware of potentially confusing differences between his definition of information and "everyday usage," which "usually implies something about the semantic content of a message" (p. 173). But he never equivocated on this issue. For Shannon, information is simply not a semantic matter.

And yet Warren Weaver tried to make it one. Weaver's commentary, "Recent Contributions to the Mathematical Theory of Communication," first published as a popular essay in *Scientific American* magazine, appeared alongside Shannon's essays in 1949, when they first saw publication as a book-length monograph. Weaver also worked with Bush as head of fire control research for the National Defense Research Committee (Conway & Siegelman,

2005). For a time, he was director of the Rockefeller Institute in New York, in which capacity he circulated copies of the *Mathematical Theory* among early structuralists, including Levi-Strauss and Jakobson (Geoghegan, 2011). In that book's initial printings, Weaver's essay follows Shannon's work, functioning as a kind of summary comment and speculative rumination on additional implications of the work readers have just encountered. Later printings saw Weaver's essay *precede* Shannon's, where it could act more like a preface or primer suitable for laymen. An increase in the book's popularity with non-technical audiences—such as students in the blossoming interdisciplinary field of communication studies, who, as Ritchie (1986) notes, were "being advised to 'read Weaver first'" (p. 279)—may have motivated the reorganization (Rogers & Valente, 1993). Weaver offers struggling readers an account of Shannon's work nearly devoid of the mathematics that might make it appear impenetrable. Those interested in learning about not only the technical but also the social import of Shannon's work could presumably read Weaver instead, and with much less difficulty. But "it is questionable," Ritchie writes, "whether they should read Weaver at all" (p. 279). For Weaver (Shannon & Weaver, 1963) attempts to turn Shannon's non-semantic theory of information into a template for the study of meaning—indeed, into an entire theory of human communication in general, as "the relationships it reveals indiscriminately apply to all [...] forms of communication" (p. 25)—and, in the process, inflects Shannon's work with a liberal humanism that persists in many of its contemporary renditions.

Weaver acknowledges the seemingly limited applicability of Shannon's work. The mathematical theory of communication, he notes, chiefly addresses *technical* problems (e.g., problems of organizing redundancies for the purpose of successfully transmitting a signal). Weaver (Shannon & Weaver, 1963) calls these "Level A" problems (p. 4). But one might also bring Shannon's work to bear on additional problems, Weaver suggests: *semantic* problems ("Level B" problems, or those "concerned with the identity, or satisfactorily close approximation, in the interpretation of meaning by the receiver, as compared with the meaning of the sender" [p. 4]) and *effectiveness* problems ("Level C" problems, or those "concerned with the success with which the meaning conveyed to the receiver leads to the desired conduct on his part" [p. 5]). Weaver believes all messages are constrained in the first instance by considerations at Level A (e.g., technical limitations determine a message's ability to "convey" meanings and "affect conduct" in desired ways), but insists that an analysis of Level A "discloses that this level overlaps the other levels more than one could possibly [sic] naively suspect," and that "the theory of Level A is, at least to a significant degree, also a theory of levels B and C" (p. 6). For Weaver, the mathematical theory of communication is a skeleton key that unlocks the mysteries of human communication in ways Shannon never foresaw.

The first sentence of Weaver's treatment advances a particularly revealing definition of communication as "all of the procedures by which one mind may affect another" (p. 1). From the start, then, Weaver's conception of communication is decidedly cognitive. It is also brazenly personological. Weaver's definition of communication in fact "shifts us from the discourse of

engineering to that of social theory and philosophy" (Balnaves & Willson, 2011, p. 22), domains in which Shannon had little, if any, interest. Though he does not elaborate any theory of "mind," Weaver makes clear throughout his text that mind is an exclusively human faculty, and that the study of communication is therefore the study of "in fact all human behavior" (p. 1). Less clear is whether Shannon viewed persons as essential for the process of communication. Shannon (Shannon & Weaver, 1963), for example, will define one of his "essential" components of a communication system, the *destination*, as "the person (or thing) for whom the message is intended" (p. 34). For Shannon, communication needn't necessarily entail any faculty called a "mind."

Weaver's emphasis on the mind's role in communication systems is especially significant because it facilitates a rationalistic interpretation of Shannon, one that strategically re-reads Shannon's definition of information humanistically. Weaver (Shannon & Weaver, 1963) understands that in Shannon the term "information" is "used in a special sense" and "must not be confused with meaning" (p. 8). Weaver additionally acknowledges that for Shannon information is a measure of signal to noise—of certainty to uncertainty—and not something easily reduced to some "content" of a signal or message. The study of information is thus (as it was for Shannon) a concern with *selection*. But Weaver reads "selection" humanistically, as a synonym for rational choice, and therefore arrives at a shorthand definition of information imbued with volitional overtones: "Information is a measure of one's freedom of choice when one selects a message" (p. 9).

To be clear, Shannon occasionally described information-generating events as choices. To ask the question of information, he writes, is in some sense to ask, "Can we find a measure of how much 'choice' is involved in the selection of the event [...]?" (Shannon & Weaver, 1963, p. 49), for "information exists only when there is a choice of possible messages" (Shannon, 1993a, p. 173). But Shannon rarely speaks of *making a choice* (note his cautionary scare quotes in the preceding statement); instead, he uses the term "choice" in its *cryptographic* sense to refer to the relative variability of a field of potential messages (the greater the number of potential messages available for selection, the greater the degree of "choice" associated with that field). Weaver humanizes choice, suggesting that "human choice and uncertainty are constrained in the same way that source choice and receiver uncertainty are constrained in cryptography" (Balnaves & Willson, 2011, p. 24). Unsurprisingly, then, he will describe information's opposite, redundancy, as that "fraction of the structure of the message which is determined not by the free choice of the sender, but rather by the accepted statistical rules governing the use of the symbols in question" (Shannon & Weaver, 1963, p. 13). Weaver transforms information from a matter of predicting and encouraging the occurrence of particular message-events to one of an agent's conscious and willful intention in opposition to constraints.

This is perhaps nowhere more apparent than in Weaver's proposed correction to Shannon's conflation of information and noise. Recall Shannon's description of "noise" as that which can scramble a signal and hinder a message's accurate reproduction. Introducing noise into a communication

system enhances the degree of uncertainty inherent to that system and therefore increases the amount of information present in that system. So Shannon might be read as suggesting symmetry between information (the desirable) and noise (the undesirable), and therefore introducing a kind of paradox.

Weaver (Shannon & Weaver, 1963) proposes a solution to this paradox by suggesting that information can be either "good" or "bad":

Uncertainty which arises by virtue of freedom of choice on the part of the sender is desirable uncertainty. Uncertainty which arises because of errors or because of the influence of noise is undesirable uncertainty. (p. 19)

For Weaver, "good" (desirable) uncertainty is that which permits a sender the greatest degree of latitude in selecting a message, because in this case a receiver can be less certain about his intentions, allowing the sender to remain relatively unpredictable in (read: undetermined by) his relationship with the receiver. But "bad" (undesirable) uncertainty is that which grants too much of this latitude to the *receiver*, who might incorrectly reconstruct the message from a signal, and prevent the sender from achieving some desired goal. A sender strives for maximum freedom while wishing for her receiver only the degree of freedom necessary for replicating the message. Weaver makes information a psychological matter.

Shannon disliked this tendency. During a 1950 presentation on the redundancy of the English language, he clearly explained how his definition of information avoids the ambiguity Weaver and other attribute to him. "I never have any trouble distinguishing signals from noise because I say, as a mathematician, that this is signal and that is noise," Shannon says:

But there are, it seems to me, ambiguities that come in at the psychological level. If a person receives something over a telephone, part of which is useful to him and part of which is not, and you want to call the useful part the signal, that is hardly a mathematical problem. It involves too many psychological elements. (p. 155)

Weaver's understanding of the communication process, however, is undeniably speaker-centered, and, as Rasch (2000) notes, "hinges on the notion of authorial intention" (p. 60). A sender attempts to replicate conscious intentions and meanings in the mind of another, and communication is successful if the receiver can reproduce these meanings or re-enact these intentions. Weaver must posit "good" and "bad" information to distinguish between those situations in which a sender is capable of achieving some desirable correspondence between one mental state and another and those in which this correspondence fails.

In his analysis of Weaver's Shannon, Genosko (2012) suggests that this desire for correspondence is endemic to communication theory as a whole:

[T]he production of an identity between encoded and decoded messages remains the fundamental problem in communication, no matter if we are considering signal accuracies or the asymmetry (non-identity) between meaning structures at either end of the model. (p. 32)

Genosko emphasizes the necessity of restoring those socially, historically, and technologically specific models implicit in both Shannon's and Weaver's respective theories of communication in order to better apprehend "the techno-cultural scene of information 'handling' embedded in their groundbreaking efforts" (p. 31). He proceeds to demonstrate the telegraphic imaginary underpinning Weaver's conceptualization of the communication process, one that also undergirds his description of information.

A similar recontextualization of Shannon might be similarly beneficial (a recontextualization Genosko does not pursue). Indeed, Shannon's postwar work on information is heavily indebted to his earlier work in cryptography—so much so that his now-famous model of communication distinctly resembles one he developed to depict the process of transporting encrypted messages (Shannon, 1993g; see also Gleick, 2011). Cryptography is one "techno-cultural scene" in which one *cannot necessarily presume* a desire for correspondence between sender and receiver. As Geoghegan (2008b) has already convincingly argued, cryptographic work articulated and circulated a communicative imaginary (borne of a broader epistemic formation Geoghegan calls "crypto-intelligence") predicated not on symmetry and harmony, but rather on agonism and duplicity. From a cryptographic standpoint, then, Shannon's paradox is no paradox at all: a signal that accrues additional uncertainty en route to a source is *welcome*, as the message encoded in that signal therefore becomes more difficult to decode (i.e., decrypt). In this context, noise (entropy) is *desirable* to one seeking to encourage aberrant decodings.

Shannon himself recognized the reciprocal relationship between his work on cryptography and his efforts in communication theory. While he began experimenting with applications of stochastic modeling to signal transmission at Princeton in 1940, Shannon applied his early findings to cryptography "as a way of legitimatizing the work" (in Price, 1985, p. 169). Wartime political pressures certainly motivated his turn to cryptography (though Shannon, who enjoyed playing with cryptograms, insists he would have tackled the problem anyway), as "I was not yet ready to write up information theory. For cryptography you could write up anything in any shape, which I did" [in Price, 1985, p. 169]). A more general mechanic—entropy—provided insight into both secrecy systems and signal transmission, which Shannon viewed as simply two dimensions of the same problem:

There is this close connection; they are very similar things, in one case trying to conceal information, and in the other case trying to transmit it. (in Price, 1985, p. 170)

Recontextualizing Shannon's model demonstrates the futility of *a priori* assumptions regarding information's positive or negative valence (as if one could say that mass was categorically either "good" or "bad," desirable or undesirable). In the context of secrecy systems, information is precisely that which introduces a significant degree of uncertainty into a communication system, enough to keep unwanted receivers sufficiently confused (see Shannon, 1993d). Shannon's cryptographic background underscores the inadequacy of speaker-centered interpretations of his work as well as charges of its penchant

for correspondence or symmetry. Any characterization of "good" and "bad" information is, as the mathematical theory of communication itself, entirely contextual.

A New Science of Communication and Control

While at Bell Labs, Shannon would frequent MIT's campus for visits with another of Vannevar Bush's close collaborators: Norbert Wiener. Wiener, a polymath trained in philosophy, zoology, and mathematics, welcomed Shannon into confidential conversations regarding antiaircraft ballistics research (which occupied them both at their respective institutions), and insider accounts of their meetings at MIT recall the two men filling blackboards with early expressions of communication problems (Conway & Siegelman, 2005). The pair also corresponded (Gleick, 2011). While Wiener tended to lament the degree to which the younger mathematician would "pluck my brains" (cited in Conway & Siegelman, 2005, p. 126), the two scientists related surprisingly well. Shannon (Shannon & Weaver, 1963) would later readily admit that conversations with Wiener "considerably influenced" his contributions to information theory (p. 115).

Like Shannon, Wiener owed his deepening relationship with Bush to war efforts. In September of 1940, as German attacks on Britain intensified, Wiener (1985c) wrote to Bush expressing his sincere desire that the head of the NDRC might "find some corner of activity in which I may be of use during the emergency" (p. 124). Bush had been soliciting from his scientifically- and technically-minded peers some advice for setting the nation's wartime technical agenda (Conway & Siegelman, 2005). Obviously aware of Bush's expertise with

early computing machines (like the differential analyzer), Wiener wrote to suggest that the NDRC prioritize experiments with a relatively new type of computing apparatus: one that functioned numerically rather than through analogical measurement, via electronics instead of gears, with a base-two logic and not a base-ten one, by way of programmed software stored in the machine itself (not fed to it by human operators), and with some internal storage device for maintaining these instructions (Wiener, 1961, p. 4). In short, Wiener proposed exploring what are today the principal features of digital computing devices.

Bush was uninterested. In his response to Wiener, he regretted that Wiener's ideas seemed to be "of the long-range type"; more pressing, he wrote, were those "matters of more immediate promise" (cited in Conway & Siegelman, 2005, p. 106). Of "more immediate" concern to Bush was anti-ballistics research, perhaps because British military officials had just visited Washington seeking assistance on this very problem (Conway & Siegelman, 2005). More specifically, the British sought methods and devices for tracking warplanes' flight patterns, predicting their future positions, adjusting artillery accordingly, and firing with precision. And all this should be done with as little human intervention as possible—preferably none at all.

Bush recruited Wiener to the cause, recognizing in the mathematician's early contributions to the study of Brownian motion (the seemingly random movement of gas particles as a result of their collisions with other particles traveling with myriad velocities and trajectories; on this, see Wiener, 1938) an effectively stochastic approach to a science of prediction, and within months

Wiener had developed a prototype for a device he called the "antiaircraft predictor" (Galison, 1994). In early 1941, Wiener hired Julian Bigelow to assist with the device's construction. An MIT-trained engineer and former IBM employee who came highly recommended by Warren Weaver (then still head of NDRC fire control operations), Bigelow would become one of Wiener's most prominent and trusted collaborators. Wiener (1956) called Bigelow "a quiet, thorough New Englander, whose only scientific vice is an excess of scientific virtue" (p. 242). Together the two set about implementing Wiener's designs.

By the middle of the year, Wiener and Bigelow were prepared to offer a "Summary Report for Demonstration," a preliminary statement regarding their progress with the antiaircraft predictor. In it, they bemoaned a lack of usable data concerning actual pilot activity with which they could test the machine:

We realized that the "randomness" or irregularity of an airplane's path is introduced by the pilot; that in attempting to force his dynamic craft to execute a useful manoeuver, such as straight-line flight or 180 degree turn, the pilot behaves like a servo-mechanism, attempting to overcome the intrinsic lag due to the dynamics of his plane as a physical system, in response to a stimulus which increases in intensity with the degree to which he failed to accomplish his task. (cited in Galison, 1994, p. 236)

Here Wiener and Bigelow liken the activity of a human pilot to that of a electro-mechanical servomechanism, suggesting that the two behavior similarly in response to ongoing stimuli that feed back into their operations and cause them to adjust their activities. It is, as Galison (1994) notes, the germ of an ever-multiplying series of conflationary analogies that in Wiener's hands will blossom into a unified theory of human, animal, and machine behavior.

This vision took root in another report Wiener filed in 1942. He titled the 120-page technical document, which offered in dense detail the results of his work on predictive fire control, *The Interpolation, Extrapolation of Linear Time Series and Communication Engineering* (see Masani & Phillips, 1985). Weaver immediately had it classified; the MIT press published it in 1949 as *Extrapolation, Interpolation, and Smoothing of Stationary Time Series: With Engineering Applications*. Only a handful of cleared scientists and engineers had access to it, and even among these privileged few the paper became notorious. Its unforgiving impenetrability and brightly-colored cover earned it an unflattering nickname: the "Yellow Peril" (Masani & Phillips, 1985; Conway and Siegelman, 2005). The work, however, was profound. To those with the gumption to tackle it, Wiener's perilous treatise offered more than an exposition of automated anti-ballistics. It portended a new scientific endeavor: the study of communication and control.

Shannon (Shannon & Weaver, 1963) called *The Yellow Peril* "the first clear-cut formulation of communication theory as a statistical problem, the study of operations on time series" (p. 85). Tukey (1952) described it as "a book which can reward long and careful study, and which requires it" (p. 321). The book articulates Wiener's (1949b) concern with "the study of messages and their transmission" and defines messages as "an array of measurable quantities distributed in time"—something that could be "corrupted by a noise" (p.2). Communication, moreover, was not merely the "conscious human effort for

transmission of ideas" but rather that which is principally "carried out by electrical or mechanical or other such means" (p. 2) by entities partaking of the same resource: information.

By now, Wiener's theories had their adherents, who decided that the newfound science needed a unifying moniker. Adopting the Greek word for "steersman," Wiener gave it one: cybernetics. The term reflected his science's particular emphasis on ongoing adjustment, and Wiener appreciated its historical resonances with notions of *government*. He called "cybernetics" a "neo-Greek expression" (Wiener, 1961, p. 11), recalling Plato's use of the term to name a form of *self-governance*. And in the early 1800s, French physicist André-Marie Ampère had similarly used the term as an umbrella label for all sciences of government. "Cybernetics" helped Wiener (1961) and colleagues stress "the fact that the steering engines of a ship are indeed one of the earliest and best-developed forms of feedback mechanisms" (p. 12). The name stuck.

Wiener viewed cybernetics as a universal project, applicable to any number of diverse scientific domains. It would "cover those aspects in which the theory of communication in instruments, the theory of control apparatus, and the theory of the nervous system and other modes of communication and control within the body, and the theory of social control[,] resemble one another and justify the use of parallel methods" (Wiener, 1985d, p. 203). Wiener was determined to convince other scientists of cybernetics' value, and in 1948, the same year Shannon published his mathematical theory of communication, Wiener's proselytism took shape in *Cybernetics, or Control and Communication in the Animal and the Machine*, a book aimed at technical audiences. A popular

book, *The Human Use of Human Beings*, followed in 1950. Both works heralded cybernetics as the science of a new epoch: "If the seventeenth and early eighteenth centuries are the age of clocks, and the later eighteenth and the nineteenth centuries constitute the age of steam engines, the present time is the age of communication and control"—its principal concern, "the accurate reproduction of a signal" (Wiener, 1961, p. 39). "Fundamental" to any investigation of the selfsame processes by which systems of humans, animals, and machines utilize signals to adjust their behavior and organize themselves, Wiener (1985d) writes, is "information" (p. 203). And central to *that* problem was a matter with which Shannon was equally concerned: entropy.

Another Theory of Entropy

While Shannon acknowledged his theoretical inheritance from Boltzmann and Gibbs, he did not necessarily elaborate the philosophical ramifications of these connections, concerned as he was with the practical matter of constructing technical apparatuses for signal transmission. Wiener not only explored (and therefore constituted—see Geoghegan, 2008a) this lineage but also leveraged it as part of his effort to legitimize cybernetics as a universal science, and to stress the importance of information on a cosmic scale.

Once again, entropy played a key role in these endeavors. Before Wiener began writing his cybernetic treatises, Boltzmann and Gibbs had already disarticulated the concept from its traditional location in thermodynamics and given it "a much more general formulation by defining it as a probability function" not limited to heat engines (Hayles, 1999, p. 101). As previously noted, the work of Boltzmann and Gibbs addressed the relative distribution

(e.g., the relative organization) of particles in a closed system and the certainty with which one might know the location of those particles at a given moment. Because of its cryptographic legacy, Shannon's formulation of information utilized the language of *uncertainty* inherent to a statistical mechanic view of the universe. To construct his "cosmological drama of chaos and order" (Hayles, 1999, p. 100), Wiener preferred tropes of *disorganization*.

For him, entropy is an incontrovertible tendency of the universe "to move from the least to the most probable state, from a state of organization and differentiation in which distinctions and forms exist, to a state of chaos and sameness" (Wiener, 1954, p. 12). Wiener was completely resigned to the inevitability of entropic dissipation, and he does not spare readers of his popular work from a rather disheartening portrait of a moribund universe:

Sooner or later we shall die, and it is highly probable that the whole universe around us will die the heat death, in which the world shall be reduced to one vast temperature equilibrium in which nothing really new ever happens. There will be nothing left but a drab uniformity out of which we can expect only minor and insignificant fluctuations. (p. 31)

But Wiener finds solace in seemingly improbable moments in which entropy's effects might be staved off, those "local enclaves whose direction seems opposed to that of the universe at large and in which there is a limited and temporary tendency for organization to increase" (p. 12). He uses a single word to denote "all phenomena which locally swim upstream against the current of increasing entropy": "life" (p. 32). Clearly aware that this designation might meet with resistance, Wiener presses for a definition of life as anything that "can exemplify locally anti-entropic processes" (p. 32). His goal was not to

demonstrate how nonorganic and mechanical systems were somehow more like the biological than previously thought—"I do not for a moment mean that the specific physical, chemical, and spiritual processes of life as we ordinarily know it are the same as those of life-imitating machines" (p. 32), he says—but rather a complete reworking of the category of life itself. Life is simply "pockets of decreasing entropy in a framework in which the large entropy tends to increase" (p. 32). Humans, animals, and machines are alike in that they are all "but whirlpools in a river of ever-flowing water": "not stuff that abides, but patterns that perpetuate themselves" (p. 96).

"Information" is the name Wiener gives to these organizing patterns. Consequently, Wiener defines information in a manner directly *opposite* that of Shannon: as the inverse of entropy, not its synonym. Information is for Wiener a principally *negentropic* force, a *foil* to the workings of a universe driving toward maximum disorder. "Just as the amount of information in a system is a measure of its degree of organization," Wiener (1961) says, "so the entropy of a system is a measure of its degree of disorganization; and the one is simply the negative of the other" (p. 11; see also pp. 62-64). But like Shannon, Wiener stressed that information was not a *thing* but a *process*, a taking-form in coordination with ever-changing environmental conditions. Information could of course be "built up" (p. 31)—not stockpiled like an object, but accumulated through the accretive process of becoming-organized. In this way, information was paramount to any effort at resisting entropy—essential to life itself.

Control and/is Communication

As it was for Shannon, the fundamental problem of communication is for Wiener the replication of patterns or redundancies. Yet Wiener's communication schema does not involve a transformational moment of encoding; the message is *that which is transmitted*. Recall that for Shannon messages are selected (activated) from a field of possibilities and subsequently transformed through the operations of a transmitter such that they might be recomposed at another site. For Wiener, messages *are* form, and the very process of their transmission is an exercise in control. Wiener suggests that messages themselves replicate form as they propagate through systems of heterogeneous elements. As the study of messages' function in systems of communication and control, cybernetics is thus an entire social theory, for "society can only be understood through a study of the messages and the communication facilities which belong to it" (p. 16).

When human and nonhuman bodies engage in what Wiener (1954) calls "communication," they participate in a process of mutual in-formation that is *synonymous* with control. "When I control the actions of another person," Wiener writes, "I communicate a message to him" (p. 16). Moreover, information is that which maintains relations between bodies and environments, as "the commands through which we exercise our control over our environment are a kind of information we impart to it" (p. 17). Because for Wiener an organism is *nothing but* its particular pattern, communication is the very process by which life negotiates its relationship to the entropic environments threatening to scramble it. Communication is *fundamentally* a matter of

regulation for Wiener, as messages themselves are *not representational* as much as they are *operational*. They exist, Wiener states, "in the imperative mood," and "the technique of communication does not differ from that of a message of fact" (p. 16). Statements *about* things are statements that *do* things. Successful communication is that which effects desired behaviors by successfully inculcating form: "if my control is to be effective I must take cognizance of any messages from [another] which may indicate that the order is understood and has been obeyed" (p. 16). To use messages is to in-form through organizational imperative: "When I give an *order* to a machine, the situation is not essentially different from that which arises when I give an *order* to a person" (p. 16, emphasis added). Every message is (quite literally for Wiener) a *form* of control that organizes an entity's present and future behaviors: an order that orders.

Though his descriptions of communicative processes tend to depict communication as the rational and deliberate exchange of idea-objects between discrete individuals, Wiener (1954) stresses repeatedly that the "stuff" of communicative encounters is not a thing, but a form. He suggests that "messages themselves are a form of pattern and organization" and that "it is possible to treat sets of messages as having an entropy like sets of states of the external world" (p. 21). Nowhere is Wiener's emphasis on this materiality of the message-form stronger than in "Thermodynamics of the Message," a brief piece Wiener published in a 1955 issue of the journal *Neurochemistry*. In typical fashion, Wiener claims to demonstrate the applicability of cybernetic discoveries to ongoing work in another field—in this case, biochemistry. He

aims to "emphasize the need for a mode of thought which will take account of resonance phenomena in all those phenomena which seem to have to do specifically with life," but does not "wish to saddle any of my colleagues with more than a suggestive discussion of the matter" (Wiener, 1985b, p. 211). Yet Wiener's evocative, "suggestive" intervention spans the topics of statistical mechanics, thermodynamics, electro-mechanical engineering, quantum physics, biology, and chemistry in the course of five pages. Wiener suggests that the message-form, as a fundamentally negentropic force, is "subject to the various possible transformations which may be performed on it" and therefore tends "to lose order and not gain it" (p. 206). In other words, Wiener says, "a message may be garbled, but never ungarbled" (p. 206); to do so would be "to unscramble an egg" (p. 207). Forms are for Wiener as material as the realities they organize, subject as they are to the same incontrovertible laws of thermodynamics. Messages are not *re-formed* as much as they are *re-constituted*; Wiener says he considers "the ungarbling of a message as simply the replacement of the message" under conditions appropriate to the receiving entity (p. 206). Here Wiener echoes Shannon's emphasis on the *work of reproduction* involved in communication, as when (in Shannon's model) a signal is subject to the work of a decoding entity that replicates a particular series of selections for a receiving element. Communication is not the passive transmission of a message; it is that active organizational work of reproducing (in)form(ation).

If life is enduring form, and communication is fundamentally the replication of form, then communication technologies might some day transmit life itself. Indeed, Wiener (1954) grappled with the prospect of this "phantasy" (p. 95) in a chapter of *The Human Use of Human Beings* entitled "Organization as the Message." Here Wiener speculates about the viability of "travel by telegraph," which he considered "not intrinsically absurd, far as it may be from realization" (p. 103). Indeed, Wiener was entirely comfortable with the idea of decomposing, transmitting, and recomposing body-patterns, an inevitability he portends through a string of metaphoric associations between bodies and messages (on the role of metaphor in Wiener's writing, see Hayles, 1990a, 1999). Wiener stresses that bodies do not possess intrinsic properties that might dictate their functions and distinguish them from other bodies; instead, an individual is "a certain continuity of process" (p. 101)—more like "a flame rather than [...] a stone, [...] a form rather than a bit of substance" (p. 102). Organisms are chiefly patterns, and the same is true of messages. Both resist entropy: "Organism is opposed to chaos, to disintegration, to death, as message is to noise" (p. 95). Messages are bodies and bodies are messages, delicate and contingent associations struggling against entropic forces. Communicative control assists them both.

'Control by Informative Feedback'

For Wiener, communication involves not the linear transfer of discrete information-objects, but a reciprocal patterning that may enhance or attenuate an entity's coherence or trajectory—what Wiener calls *feedback*. "Feedback" names a kind of mutual in-formation in which body-patterns loop back on

themselves via processes whose twin aim is boundary negotiation and performance calibration. The concept allows Wiener to pinpoint methods by which human and nonhuman bodies organize themselves—adjust conduct and behavior—through the transmission of and response to informational message-patterns. Recall that for Wiener informative messages are not those that successfully transfer some *content*, but rather those whose organizational "imperatives" take hold; feedback is the ongoing process by which messages inform.

Feedback was crucial to Wiener's early wartime efforts to produce anti-ballistic apparatuses capable of predicting enemy aircraft flight paths (Conway & Siegelman, 2005; Edwards, 1996; Galison, 1994). But his later writing extrapolates the concept into one that defines a capacity of life itself. As Wiener (1954) writes, feedback is the function that permits an entity some degree of control over "the mechanical tendency toward disorganization" and allows it "to produce a temporary and local reversal of the normal direction of entropy" (pp. 24-25). Wiener (1961) considered feedback the hallmark of a cybernetic theory of society, for "it is certainly true that the social system is an organization like the individual, that it is bound together by a system of communication, and that it has a dynamics in which circular processes of a feedback nature play an important part" (p. 24). Wiener makes clear that "the social system" is not an exclusively *human* system, but a collectivity of humans, animals, and machines that relate through feedback systems: "it is my thesis that the physical functioning of the living individual and the operation of some of the newer communications machines are precisely parallel in their analogous attempts to

control entropy through feedback" (p. 26). Wiener offers a theory of sociality predicated on an ability to share information—to both impel and respond to message-forms.

The problem of information is thus for Wiener a problem of making-redundant, of establishing replicable patterns that permit little deviance, of understanding how stability is not only possible but probable in a world characterized by constant fluctuation. In "Feedback and Oscillation," one of the most densely mathematical chapters of his *Cybernetics*, Wiener (1961) explains the pertinence of feedback to human and nonhuman bodies alike—and explores the possibility of constructing technical apparatuses for maintaining beneficial homeostatic states. Of concern to Wiener are those systems that fail to effectively (re)calibrate behavior through some communicative malfunction (some breakdown in a system of control via transmission of message-forms). Such systems are prone to "violent oscillations" (p. 97) that inhibit coordination—the becoming-out-of-sync of a system's various patternings. Wiener admits that what he calls "*control by informative feedback*" (p. 113, emphasis in original) is a complicated affair precisely because no single entity is capable of independently or completely determining the overall functioning of a system. He sketches an example involving a railroad signal tower, a complex human-machine apparatus that regulates railway track switching. Via a series of levers, a human signalman operating in this system might issue a command to change the position of the tracks; however, he can never be sure that this operation has succeeded without some report from the switches themselves "in what we shall from now on call the chain of feedback" (p. 96). Signalman, switches, levers,

tracks, and signals exist in a tightly-bound series of connections that together maintain the operation of the elements thus connected. For Wiener "it is true that the signalman is not altogether a free agent" in this system, "that his switches and signals are interlocked, either mechanically or electrically, and that he is not free to choose some of the more disastrous combinations" (p. 96).

But the signalman *does* act on the various parts of the ensemble, just as the other components of the switching apparatus act on the signalman to regulate his behavior in some way. Cyberneticists like Wiener were in fact *only interested* in relationships like these, in which elements reciprocally act on one another in attempts to bring their collective function into some kind of loose coordination. Relationships without such reciprocity are simply uninteresting from a cybernetic perspective, as Ashby (1956) writes in his *Introduction to Cybernetics*. "Feedback," he says, "exists between two parts when each affects the other" (p. 53). Unidirectional relationships, in which, for example, element *P* affects element *R* but *R* does not affect *P*, are not feedback relations. In this case, says Ashby, "*P* is said to *dominate R*" (p. 53, emphasis in original), affording *R* no recourse for mutual affection. Such relationships of domination actually *preclude* the possibility of control-through-feedback, which is predicated on "a circularity of action [...] between parts of a dynamic system" (p. 53). Resisting the dissipative effects of entropy through feedback is an enterprise involving the coordination of actions among "freely" operating elements—a multidirectional affair in which components of a cybernetic system

mutually inform one another by modifying their actions. In a 1949 essay for *Electronics*, Wiener flatly states that the concept of information itself is irrelevant to situations that do not involve this type of relation:

What, then, is information? One important feature of information is that it cannot be described or measured merely by specifying any single message. Obviously information is significant only if there are several courses of action open to the recipient and if the information might have been something else. (Wiener, 1985a, p. 197)

Information addresses the mutuality of processes aimed at controlling a pattern-entity's being-otherwise; as for Shannon, information indexes the field of possibilities that actions and events open or foreclose.

Feedback is of course most effective when the elements whose actions it coordinates can embody and recall a history of adjustments as part of self-regulation; entities might begin to embody those modifications to their behavior effected by feedback in order to avoid behaviors destructive to the system. In this way, feedback is for Wiener (1954) also "the property of being able to adjust future conduct by past performance" (p. 33). Wiener (1954) called this process *learning*. Humans, animals, and machines might be said to learn when "information which proceeds backward from [a] performance is able to change the general method and pattern of performance" (p. 61). In his final popular book, *God & Golem, Inc.*, Wiener (1966) offers an extended comment on the ways a nonhumanistic theory of learning challenges some (principally religious) biases around the term. He writes:

[...] An organized system may be said to be one which transforms a certain incoming message into an outgoing message, according to some principle of transformation. If this principle of transformation is subject to a certain criterion of merit of performance, and if the method of transformation is adjusted so as to tend to improve the performance of the system according to this criterion, the system is said to *learn*. (p. 14, emphasis in original)

Wiener here depicts learning as a kind of feedback process: an ongoing process of coordinating, translating, and managing multiple, overlapping forms—a *trans-formation*. Learning is a process whereby organized systems accrue information that influences their relative abilities to reduce entropy through an ongoing series of adjustments. Again, recall that for Wiener information is not something *representational*; its role in learning is therefore not the adequate *reflection* of prior knowledge but instead the inculcation of forms. Halpern (2005) offers a compelling account of the ways in which Wiener's writing expresses a desire to rework traditional notions of representation as part of a broader shift away from modernist formulations of temporality, perception, and memory. She suggests that cybernetic discourses like Wiener's were "invested in developing a universal language temporally uninterested in referentiality through description, producing instead a statistical grammar of prediction" (p. 293). "Learning" serves a pivotal role in the articulation of such a discourse insofar as it names a cybernetic capacity for regulating behavior according to criteria for "proper" conduct (conduct that adheres to acceptable levels of deviation). As that which establishes and maintains order in systems of heterogeneous elements, information plays a critical role in the regulation of conduct. A human, animal, or machine may "learn" information, but because

information is for Wiener not simply *representative* of some prior state of affairs, information does not *mediate* in the representationalist sense. Instead, it functions probabilistically to *coordinate*. Halpern writes:

Mediation, which has long been the foundation of the idea of "representation," was therefore [for cyberneticists] no longer a site of problematization or obfuscation. Rather, it became the site of potential and probability. We are no longer focused on the "meaning" or origin of the signal, but rather on its transmission. (p. 293)

Cybernetic learning involves the recollection of information only insofar as those re-collections might be useful for feeding-back into present and future behavior for the purpose of (dis)allowing certain possibilities. "I repeat," Wiener (1954) stresses, "feedback is a method of controlling a system by reinserting into it the results of its past performance" (p. 61). Information mediates not by representing the past, but by coordinating action in the future tense.

A Contingent Universe

Both *Cybernetics* and *The Human Use of Human Beings* begin not with mathematical demonstrations but with philosophy. In them, Wiener traces the intellectual developments that have made cybernetics desperately necessary in the postwar era. Most critical among these is the gradually waning influence of Newtonianism—a trend, according to Wiener, whose consequences are nothing short of revolutionary.

For Wiener (1954), Newtonianism's comforting assurances—"a universe in which everything happened precisely according to law, a compact, tightly organized universe in which the whole future depends strictly upon the whole

past" (p. 7)—are no longer tenable. A Newtonian worldview, Wiener claims, presupposes both a determinism and a precision that are simply impossible. "No physical measurements are ever precise," he writes, "and what we have to say about a machine or other dynamic system really concerns not what we must expect when the initial positions and momenta are given with perfect accuracy (which never occurs), but what we are to expect when they are given with attainable accuracy" (p. 8). Because the universe is never entirely predictable, because the behavior of any body is never completely determinable, science must settle for knowing "not the complete initial conditions, but something about their distribution" (p. 8). In other words, Wiener says, we "cannot escape considering uncertainty and the contingency of events" (p. 8).

Naturally, Wiener (1954) attributes to Boltzmann and Gibbs the application of probabilistic logic and statistical mathematics to physical systems that throws Newtonian certainties into crisis. The stochastic "revolution" means that "physics now no longer claims to deal with what will always happen, but rather with what will happen with an overwhelming probability" (p. 10). Thus, for Wiener, science can no longer be merely a matter of *mapping* the world; it must engage in projects that attempt to *anticipate* and *control* its contingent manifestations, to *bring about* those desirable distributions of elements. Cybernetics, of course, would become the master science of such control.

Centuries of scientific, mathematic, and philosophical work had already cleared the terrain cybernetics would eventually claim to occupy. Indeed, cybernetics can be seen as a twentieth century effort in what Hacking (1990) calls "the taming of chance" (see also Halpern, 2005). A fundamentally

stochastic universe is conceivable only in a world where *chance* ceases to be the province of misguided superstition. Loss of faith in deterministic models of the universe was "the most decisive conceptual event of twentieth century physics" (Hacking, 1990, p. 1), and fostered the worldview Wiener's books expressed so anxiously. As Hacking suggests, a probabilistic world also became a *calculable* one, and calculation served as a means of controlling a world that ceased to make itself perfectly known. "This fact is instructive," Hacking notes, for "it is now common to speak of information and control as a neutral term embracing decision theory, operations research, risk analysis and the broader but less well specified domains of statistical inference" (p. 3). Cyberneticists spoke this language as it brought stochastic, probabilistic reasoning to bear on problems of communications engineering (Halpern, 2005). As Hayles (1999) notes, theorizing information "was an active extension of a probabilistic worldview in the new and powerfully synthetic realm of communication theory" (p. 90). Wiener was concerned with "a fundamental element of chance in the texture of the universe itself" (p. 11), an "incomplete determinism, almost an irrationality in the world" (p. 11). The conception of a fundamentally uncoordinated universe prompted the development of theoretical tools for coping with an entropic and ultimately contingent reality. Information was one of those tools.

The Minus Sign

Reading both Shannon's and Wiener's respective accounts of information through a rather mundane operator illustrates their seemingly radical divergence. That operator is a minus sign. Despite commentators' attempts to

downplay its significance, this single horizontal stroke belies a crucial difference between Shannon and Wiener, one closely related to certain presuppositions inherent in their individual accounts of information.

Both Shannon and Wiener calculate the amount of information by computing the logarithm of a set of probabilities—an act that results in a negative number. Shannon prepends his formula with a minus sign so that its result might be read positively. Wiener does not. The effect is two seemingly different accounts of information, each of which acts as the inverse of the other. This did not go unnoticed. Ashby (1956) notes that

A little confusion has sometimes arisen because Shannon's measure of "entropy," given over a set of probabilities [is] multiplied by -1 whereas the definition given by Wiener in his *Cybernetics* for "amount of information" is the same sum [...] unchanged (i.e., multiplied by +1). (p. 177)

And in a footnote to his explanation of Shannon's *Mathematical Theory*, Weaver (1949), too, remarks on the minus:

Any probability is a number less than or equal to one, and the logarithms of numbers less than one are themselves negative. Thus the minus sign is necessary in order that H be in fact positive. (p. 15)

Both men are rather nonplussed by what they perceive as a mathematical triviality. "There need however be no confusion," Ashby (1956) writes, "for the basic ideas are the same" (p. 177); "there is obviously no real discrepancy between the two methods" (p. 179). Weaver is even more dismissive: "Do not

worry about the minus sign" (p. 15). Yet Shannon did. In an October 13, 1948 letter to Wiener, he explained the fundamentally different approaches their respective equations embodied:

I consider how much information is *produced* when a choice is made from a set—the larger the set the *more* information. You consider the larger uncertainty in the case of a larger set to mean less knowledge of the situation and hence *less* information" (cited in Gleick, 2011, p. 281; emphasis in original).

Taylor (2001) likewise characterizes the difference as one of emphasis: "Whereas Shannon focuses more on the *information one lacks*, Wiener focuses on the *information one gains* upon receiving a message" (p. 121, emphasis in original). Hayles (1990b) makes a similar point: Shannon's theory of information emphasizes the uncertainty generated at its *source*; others begin from the vantage of the *destination* (p. 58). Shannon's account of information begins with a state of pristine clarity, absolute redundancy, in which an information source and its destination are in perfect agreement—"the special case in which the received message is known with certainty" (Ashby, 1956, p. 178)—unlikely as this state may be in a given arrangement, preceding as it does an act of selection that establishes relationalities. Wiener's account begins with utter uncertainty (the overwhelming threat of thermodynamic entropy), and describes life's struggle to establish the redundancies that give it viable form. Shannon theorizes a perfectly redundant environment and describes a means of keeping that dynamic and unpredictable system intact; Wiener starts with a

universe of chaos and considers the force that organizes it. For the former, information can be a threat to an arrangement's coherence and stability; for the latter, it is the very mechanism of survival.

The Problem of Information

The preceding accounts of information in the wartime and postwar American scientific and engineering literatures demonstrate at least four characteristics of information as articulated in this conjuncture: *information is non-substantial; information is non-representational; information is non-semantic; and information is a matter of organization.*

Information is Non-Substantial

"Information" refers not to some bounded and stable object but to something *relational, mutable, and processual*. Both Shannon and Wiener agree on this point. In a commentary on the "economic point of view" of information, for example, Wiener (1954) writes that information is "unsuited to being commodified" (p. 116) because, as an index of entropic activity, it is never stable or final. One cannot arrest an inform-ative process without some "depreciation of its value" (p. 120), for information is borne of dynamic interrelationships between cybernetic entities mutually affecting one another's activities. "Information is more a matter of process than of storage" (p. 121). So when Wiener suggests that "to live effectively is to live with adequate information" (p. 18), he is not insisting on the need to cultivate what might today be called a kind of "information literacy" (a repertoire of sensibilities about protecting one's information, sorting the "good" information from the

"bad"); he is commenting on the importance of recognizing how specific organizations made redundant through processes of information affect the way pattern-entities may thrive. The problem of information is the problem of maintaining organizational coherence among forces tending toward dispersion, not necessarily the control or management of some specific content.

For Shannon, too, information can be defined only through a series of relations—relations of successive symbols selected to create a message for encoding into a signal, or relations between an information source and a receiver. As another name for a situation's relative degree of uncertainty, "information" joins "mass" or even "height" as a way to describe some aspect of that situation, not some *object* in it. In other words, to speak of "the information" inherent to a given situation would be to invoke an entire series of relationships—symbol to symbol, source to receiver—just as speaking of some object's "mass" evinces that object's relationship to gravity. Recall Shannon's (1993a) anecdote: "The information I obtain when you say something to me corresponds to the amount of uncertainty I had, previous to your speaking, of what you were going to say" (p. 173). To "obtain" information is not to take possession of some-thing; it is to gather a certain definition, a new compartment. Information does not somehow "pass" unidirectionally between two stable individuals as much as it is *produced* out of the ongoing becoming-symmetrical or becoming-asymmetrical of entities establishing some minimal degree of relationality (the becoming-probable or becoming-improbable of an event with regard to a given arrangement of things).

In these American accounts, information may be insubstantial, but this is not to say it is *immaterial*. Information is as real and effective as the entities in whose relationships it participates, as real as the conditions out of which it is produced and into which it intervenes. Some popular accounts of information tend to depict information as ephemeral, and some academic accounts construe it as a kind of pure form possessing "no dimensions, no materiality" (Hayles, 1999, p. 18). But as Taylor (2011) writes (with a nod to Derrida), "the opposition between form and content, or information and matter, upon which such arguments rest is no more defensible than the opposition between speech and writing" (p. 106). Information does in fact participate in the very material processes and practices it organizes. It is not immaterial but *incorporeal*; it subsists alongside the processes into which it intervenes. And it cannot be reduced to a function or some property of a situation.

Information is Non-Semantic and Non-Representational

Shannon's (1948) now-famous remark that "semantic aspects of communication are irrelevant to the engineering problem" (p. 379) of transmitting signals neatly encapsulates one hallmark of American information theory: its refusal to treat "meaning" as a concept relevant to the study of information. For Shannon, "messages have *meaning*" when they "refer to or are correlated according to some system with certain physical or conceptual entities" (p. 379, emphasis in original). Messages are not significant for what they *represent* or *signify* (the "concepts" to which they are attached or that otherwise give them some semantic dimension), but are notable instead for what they generate (the entropy they create or resolve).

Of course, semantic theories of information exist (see Floridi, 2010, 2011, for an overview). Floridi (2010) likens the difference between Shannon's mathematical account of information and semantic theories of information "to the difference between a Newtonian description of the physical laws describing the dynamics of a tennis game and the description of the same game as a Wimbledon final by a commentator" (p. 48). Unlike mathematical theories of information, semantic theories attempt to address questions like "how is information related to error, truth and knowledge?" (p. 52). Information becomes relevant to these issues only when its definition expands beyond the scope Americans like Shannon and Wiener ascribed to it; it must become that which functions to *represent* some state of affairs with greater or lesser fidelity. In this way, then, information can be "true" (if it accomplishes this task) and "false" (if it doesn't)—unlike in mathematical theories of communication, where this distinction is untenable (as if the "mass" of an object could be "false").

To demonstrate the seeming singularity (or idiosyncrasy) of American information theory's eschewal of semantics, critics will often juxtapose the work of Shannon and Wiener with theorists working in alternative contexts (see Day, 2001). Hayles (1999), for example, contrasts American information theory with the work of British physicist Donald MacKay (see also a discussion of MacKay in Hansen, 2004, pp. 77-79). Hayles suggests that MacKay's theory of information (developed years after Shannon and Wiener had solidified their positions in information's official histories) differs from American accounts in that it "triangulated between reflexivity, information, and meaning" (p. 56). Hayles argues that while American cyberneticists, engineers, and mathematicians

effectively *decontextualize* information (rendering it a "quantity weightless as sunshine, moving in a rarefied realm of pure probability, not tied down to bodies or material instantiations," [p. 56]), MacKay's theory conceives information as *representational*, "links it with reflexivity" (p. 57), and makes it a matter of embodied subjectivity. Though the preceding account of information challenges a view of American information as dematerialized and decontextualized, MacKay's understanding of "meaning" remains illustrative of the particular problematic motivating theories of information in multiple contexts.

MacKay (1969) did in fact develop a representational dimension of information, which he offered as a complement to both Shannon's and Wiener's respective theorizations. He does not deny that information involves a *selective* function of influencing possibilities by modulating uncertainty and unpredictability in specific situations. But he claims to supplement mathematical theories by elaborating what he calls information's *descriptive* function, one that is (unsurprisingly) of particular use to "biologists or physicists looking down a microscope or taking readings on a measuring instrument" (pp. 12-13):

Our first problem here is to transform our experience into a symbolic picture or description of what we believe to be the case. Our picture, be it a graph or a drawing, or a scientific statement, depends for its every feature on our actual observations. Each element in the picture therefore formally represents and has its origin in one corresponding elementary feature of the experience pictured. Nothing can legitimately appear in the picture, in other words, unless we have evidence for it by way of experienced observations. (p. 13)

For MacKay, then, descriptive information generated through scientific observation functions to *reflect* the material world by standing, to a certain degree, outside it. This facet of information is useful to a knowing subject working to achieve adequate representation of some natural state, and MacKay's empiricism allows for the possibility that information might pertain to problems of fidelity (precision or reliability, as MacKay writes, or something that can be true or false). And yet this is not what MacKay meant by "meaning."

MacKay stresses that the selective and descriptive functions of information are not antithetical or mutually exclusive. Indeed, he sought to *reconcile* information's mathematical and semantic—or what he called its "mechanical" and its "meaningful" (p. 21)—dimensions. To do this he advances a strategic definition of meaning that has more in common with Shannon and Wiener than perhaps some commentators admit. For MacKay, "meaning" is not a matter of reading descriptive information against the object(s) it (ostensibly) re-presents, but of *activating certain possibilities for action*.

Behavioristic signal theories, which consider some desirable change in a target entity's behavior an adequate criterion for "effectiveness," made MacKay (1969) uncomfortable. So, too, did two approaches to semantics MacKay indicates were popular at the time: the "structuralist" approach (which MacKay identifies in the logical atomism of Bertrand Russell) and the "operationalist" approach (which he associates with Wittgenstein). The former assert, MacKay claims, that the meaning of a message is a matter of that message's formal composition from a set of irreducible units; to understand the meaning of the message, one need simply understand the logical structure of its component

parts, which align with facts about the world. Operationalists, on the other hand, suggest that a message's meaning is its *use*; the formal composition of a message guarantees nothing about the role it plays (or might play) in everyday interactions. MacKay found both these theories of meaning insufficient for describing the function of a message.

Information systems, he recalls, are equally concerned with the future as they are with the present; messages do not influence "necessarily what you do—as some behaviourists have suggested—but what you would be *ready* to do *if* given (relevant) circumstances arose" (p. 22, emphasis in original). MacKay called this anticipatory comportment a state of *conditional readiness*. In this way, "it is not your behaviour, but rather your state of *conditional readiness* for behaviour, which betokens the meaning (to you) of the message you heard" (p. 22, emphasis in original). In this way, "it is not your behaviour, but rather your state of *conditional readiness* for behaviour, which betokens the meaning (to you) of the message you heard" (p. 22, emphasis in original). Receivers can, of course, comport themselves in ways that information sources don't anticipate (MacKay called this the "effective meaning" of a message), but the "meaning" of a message is always its nondeterministic effect on an entity's capabilities: "its selective function on the range of your states of conditional readiness" (p. 24). Rather than contradict Shannon and Wiener, MacKay here reinforces their depictions of information as something involving non-representational acts of selection, something equally pertinent "in relation either to human beings or to mechanical systems" (p. 22).

Indeed, for MacKay (1969) "meaning" is this very "selective power" (p. 26), what he calls the "readying function" (p. 491) a message performs on one's state of conditional readiness. To explain this power, he invokes an example familiar to Wiener: the railroad switching station. Through this example Wiener made communication a matter of feedback loops that organize actions into a homeostatic regime (message-forms spreading into and feeding back from the loosely coordinated actions of signalman, levers, and tracks); MacKay likewise thematizes the coordination of actions, but with an emphasis on the organization of potential:

Think of a railway signal-box controlling a large shunting-yard. At any given moment, the configuration of levers in the box defines what the yard is *ready* to do to any waggon that happens to come along. There may in fact be no waggons moving; there may be some tracks on which no waggons will move for years; but this is no obstacle to a definition of the total state of conditional readiness of the yard, as betokened by the total configuration of lever-settings, which determines what would happen *if* any given circumstance arose. A change of a lever that controls a disused siding may cause no visible change in the activity of the yard; but it makes a perfectly definite change in its state of conditional readiness. (pp. 22-23, emphasis in original)

Here MacKay describes the way in which a particular configuration of material relations is capable of channeling action in both the present and future. Through processes and practices of what MacKay calls "communication," this configuration might change, and with it, the range of actions it makes possible. "The object of communication," MacKay (1969) writes

[...] is to select some particular conditional readiness in the recipient from the range of states that are possible. The intended meaning of the communication is then definable as the selective function that it is intended to exercise on the range of possible states. Its effective meaning is the selective function that it actually performs. (p. 28)

For MacKay, communication is the act of selecting from a set of possibilities the range of states that might take effect; meaning is the particular configuration activated.

Like Shannon and Wiener, MacKay's theory of information addresses the role messages play in communicative situations. For Shannon they are events; for Wiener they are forms; for MacKay, they are *keys*. A message is not a "bearer" of meaning or a "descriptor" of reality but a *trigger* that actuates selective power. To explain this metaphor, MacKay (1969) returns to the railway yard, focusing this time on the role of the signal-box that locks or unlocks certain configurations of train track. Into these boxes, drivers insert keys that activate the track-switching levers, performing certain selective functions. "Insert a key of a given shape into the box," writes MacKay, "and you make a certain selection from the range of possible configurations of the signal-levers. Insert another, and the selection you make is different" (p. 25). MacKay stresses that selective power does not reside "in" the key (such that the key might be applied to any situation with vaguely repeatable effects that can simply be "read off" its form, as structuralists might claim), nor can it be located in the box itself (such that the key's ability to take effect can be attributed to some function of another machine, as the operationalists would have it). The message-key, says MacKay, *exercises* its selective power amidst a field of

elements specifically arranged to facilitate its effects (remember MacKay's previous qualification that messages have meaning "if given (relevant) circumstances" [p. 22, emphasis in original]). Message-keys are not matters of reference but of *actuation*. They trigger nonlinear and nondeterministic series of material relations that attempt to modulate activity. These modulations are their "meaning," and the information they "convey" is their selective power.

For Shannon, Wiener, and their British interlocutor MacKay, then, information is a matter not of semantic *interpretation* but non-semantic *activation*: differentially channeling certain fluctuations in particular directions, replicating patterns at numerous points, and reducing the likelihood that aberrations in those patternings might interfere with their seamless transmission and integration. For this reason, Floridi (2010) distinguishes semantic theories of information from mathematical ones—or what he calls *syntactic* theories of information, predicated as they are on arrangement and organization.

Information is a Matter of Organization

For both Shannon and Wiener, information is relevant and applicable only to some collectivity. More specifically, it is a matter of that collectivity's *becoming (dis)organized*. As Terranova (2004b) notes, because the question of information is "not so much a question of meanings that are encoded and decoded in texts but a question of inclusion and exclusion, connection and disconnection," the target of informatic operations is always the dynamics of *the milieu* (p. 52), the overall field of forces in which it operates. Information

pertains to the likelihood that certain organizations of elements will occur instead of others, that particular moments of selection will open or foreclose certain distributions of those elements.

When discussing information's target domain, Shannon and Wiener use the term "ensemble," an artifact of their interest in statistical mechanics, where ensembles are collections of all those *possible states* that might characterize a system (every *potential arrangement* of particles in a set) along with the probability that any distribution of elements *actually occurs*. Shannon's (1948) formula for calculating the amount of information present in a system is predicated on such a probability distribution; so is Wiener's (1985a). Both are attempts to characterize an ensemble's *actual* and *potential* configurations (what is produced through an event of selection and what is therefore excluded; for more on this relationship, see Terranova, 2004a).

Shannon may have been concerned with *transmission*, but his work with signal modulation addresses the problem of message replication from the standpoint of the ensemble. For Shannon (1993a), information is always "associated with a given situation" (p. 173) as a particular selected sequence determines that situations's relative degree of entropic uncertainty. Information is *only* relevant and discernible "when there is a choice of possible messages" that might be activated (1993a, p. 173); messages themselves are simply "one sample from the ensemble of possible messages that might have been produced by the information source" (1993f, p. 180). For this reason, Weaver (Shannon and Weaver, 1963) will speak of "message situations" (p. 17) rather than simply *messages*; fundamental to a message-event is its effect on a probabilistic field.

Wiener (1985b) felt similarly, stressing that a message does not somehow autonomously "carry" information in isolation, "but only as a possible form of communication among other forms which might have replaced it" (p. 844).

Elsewhere he writes (uncharacteristically adopting Shannon's language):

[...] the significance of a signal is determined not only by that signal itself, but by the whole set of signals I might have sent in place of the actual one. In other words, significance is a property belonging to ensembles. (Wiener, 1964, p. 433)

For Wiener, messages and other pattern-entities depend on *their relationship to a fluctuating field* for their significance or singularity. What specific organizations of patterns take hold? How are activities controlled and coordinated through the amplification or diminution of signals between and among them? In light of constant pressures to dissipate, how do systems self-organize without recourse to some transcendent or prime mover? These are the questions concerning a cyberneticist.

Toward a New Problematic

Many popular glosses of American postwar information theories depict them as theories of something ephemeral, decontextualized, dematerialized, and unsuitably abstract. In these accounts, information is principally a matter of transmission and fidelity, of replicating meaning or instruction across a chasm, of rational and individual "choice." But an historical and conjunctural analysis of American information theories discloses a project with different concerns—not least of which, the exigencies posed by universal contingency. Here information offers not simply a means of more accurately replicating

symbols at a distance, but rather salvation from a world constantly threatening to come undone, a world with no guarantees but the promise of entropic uncertainty and diffusion.

And yet it was a promise doubly valenced. Indeed, the writing of both Shannon and Weaver expresses *both* the anxiety *and* the hope generated by the realization that "things could be otherwise than they are because 'things' are the result of selection" (Rasch, 2000, p. 52). The technical work of information's twin fathers, the apparatuses they designed and constructed, demonstrate a preoccupation with the (never decontextualized but always quite situated and material) problem of controlling human and nonhuman bodies by arranging their environments in attempts to anticipate their actions and harness their potentials, a problem of effecting changes in what certain configurations *might do*—a problem, that is, of *agency*. This concern persisted in particular throughout cybernetics' development as an intellectual project, one indebted to the theories of information it helped foster in the first half of the 20th century. The second half of that century would see cybernetics' distinctive approach to machines extrapolated in productive ways across a diverse number of fields. But thinkers in those fields retained an important interrogatory posture toward those machines, one Ashby (1956) explains on the first page of his cybernetic primer:

Cybernetics [...] is a "theory of machines," but it treats, not things but *ways of behaving*. It does not ask "what *is* this thing?" but "*what does it do?*" (p. 1, emphasis in original)

The cybernetic emphasis on effects over essences—on capacities over properties—influenced a generation of thinkers concerned with the problem of agency, and they are the subject of the following chapter.

CHAPTER 3: HOW TO THINK ABOUT MACHINES

The Cybernetic Problematic

While Wiener and Bigelow struggled to engineer devices that could track, predict, and react to aircraft flight patterns, they also wrestled with the ontological implications of these machines that seemed to act with purpose. They advanced their universal theory of human, animal, and machine behavior not only in technical reports on the intricacies of servomechanisms, but also in the domain of philosophy.

In 1943, they published "Behavior, Purpose and Teleology," an austere, seven-page position paper in *Philosophy of Science*. It concerned scientific approaches to studying the activities of a wide range of actors. Written with Arturo Rosenblueth, a Harvard neurophysiologist and one of Wiener's closest friends and collaborators, the essay "has two goals": "The first is to define the behavioristic study of natural events and to classify behavior. The second is to stress the importance of the concept of purpose" (Rosenblueth et al, 1943, p. 18). But both these aims served another: to unhinge the concept of "purpose" from its more traditional, humanistic moorings and give it purchase in studies of a wide range of entities. The authors sought "a uniform behavioristic analysis [...] applicable to both machines and living organisms, regardless of the complexity of the behavior" (p. 22). What would be the scientific implications,

they wondered, of acknowledging that both living and nonliving beings demonstrate purposeful, goal-oriented behavior? Does this seemingly shared propensity for non-random, directed activity indeed *trouble* the very distinction between living and nonliving? What does it mean—to use a term Rosenblueth, Wiener, and Bigelow do not—to say that nonhuman animals and machines demonstrate *agency*?

In order to understand the ramifications of cybernetics' particular response to this question, this chapter maps post-cybernetic theoretical and analytical trajectories that emerged across the globe following cybernetics' wartime articulation. This (albeit partial) history demonstrates ways in which key cybernetic tenets—particularly its emphasis on the complexity of relations among heterogeneous actors and a penchant for thinking "machinically" about these systems' activities—persisted in multiple iterations of the cybernetic project. While these iterations frequently counterpose themselves against one another as a way of highlighting the uniqueness of their respective contributions, each might be read as a response to the cybernetic problematic that prompted the development of American information theories: the organization of chaos into contingent relations that define the capacities of various actors. In other words, each advances a theory of *agency* that complicates Enlightenment accounts of unencumbered, individual, efficacious behavior, a theory concerned instead with the ways in which agency is the product of specific relationalities in complex systems of heterogeneous actors.

Cyberneticists stressed *repetition* when describing the force that instantiates such organization (that arrests the flux of an entropic universe and installs in it some semblance of order). Post-cybernetic accounts of this force offer different tropes (e.g., *redundancy*, *recursion*, the *refrain*) to articulate this process. These accounts (re)iterate cybernetic impulses in provocative ways, even if most were unable to completely evade the liberal humanism that haunted cybernetics from the start.

The Purpose of Purpose

By strategically leveling the agential playing field, cyberneticists signaled a specific analytical comportment toward the objects they both studied and constructed. They treated *both* humans *and* nonhumans as agents capable of action that might significantly alter the world. Rather than view nonhumans as inert objects entirely available to scientific investigation, they approached their objects as mysterious, opaque, (even surprising) things—like "something," Ashby (1965) writes, "that has just fallen from a Flying Saucer" (p. 87). Ashby called these objects "Black Boxes," or "systems whose internal mechanisms are not fully open to inspection" (p. 86; for a brief genealogy, see Galloway, 2014). Instead, cyberneticists insist scientific inquiry has available to it *only actions* (Ashby describes these as "inputs" and "outputs"), which one might use to characterize the nature and abilities of the entity under scrutiny. Black boxes tend to obscure the complexity of their makeups by directing attention to the work they do: what they accomplish, facilitate, or obstruct. In this way, they *participate* in constructing the results of scientific investigation, for they enter into feedback relations with those attempting to study them and therefore open

themselves to the reciprocal play of actions that characterizes these relations. "By thus acting on the Box, and by allowing the Box to affect him and his recording apparatus, the experimenter is *coupling* himself to the Box, so that the two together form a system" (p. 87, emphasis in original). Like any other feedback relation, scientific inquiry is mutually informative.

Rosenblueth, Wiener, and Bigelow (1943) demonstrate this cybernetic imaginary, calling their approach to non-humanistic agency "behavioristic" because it positions the locus of purposive activity *outside* the acting entity. This move represents a radical departure from more psychologically-inflected "behavioristic" modes of analysis, which typically attend to ways in which environmental stimuli generate internal alterations in their targets. Purpose and will, the scientists argued instead, cannot be deduced from that entity's *internal* properties (an approach to the study of organisms the trio called "functionalism") but are instead discernible only through analysis of that entity's ongoing relationships with other entities and its environment. Behavior—"any change of an entity with respect to its surroundings" (p. 18)—is *purposeful* when undertaken in pursuit of some goal, "a final condition in which the behaving object reaches a definite correlation in time or in space with respect to another object or event" (p. 18). Some entities are involved in action but are themselves passive, acting as the *result* of some transfer of energy generated in a relationship (e.g., a baseball moves, but only because someone throws it); others achieve goals but are not purposeful (the authors suggest, for example, that a roulette wheel seems specifically crafted to act this way).

The cyberneticists, however, were concerned with those entities demonstrating *teleological* behavior: active, purposeful behavior that achieves some goal through a series of decisive adjustments in coordination with the particular set of relationships of which it is a part—that is, through *feedback*. "All purposeful behavior may be considered to require negative feed-back" (Rosenbleuth et al, 1943, p. 19). Purposeful behavior is *teleological* insofar as the *goal* toward which an entity directs its behavior *influences* the nature of the behavior itself. The goal exerts this influence when the behaving entity adjusts its behavior in response to feedback about its progress relative to the goal, feedback that may reveal some gap or "difference between the state of the behaving object at any time and the final state interpreted as the purpose" (p. 24). Linear, uni-directional causality is the stuff of functionalism; "teleology is concerned with behavior, not with functional relationships" (p. 24).

The philosophy proved popular enough that in 1944 Wiener convened the first meeting of the Teleological Society, a working group devoted to elaborating its implications across the physical, engineering, and social sciences (Galison, 1994). But not everyone found Wiener's refashioned notion of purpose so revolutionary or appealing. Responding to "Behavior, Purpose and Teleology" seven years after its initial publication, philosopher Richard Taylor accused Wiener and his co-authors of advancing a definition of purpose "so broad that it fails to distinguish, even in some general way, the feature that it is intended to describe" (Taylor, 1950a, p. 311). That feature, Taylor explained through multiple critiques (see also Taylor, 1950b) was *intent*. Wiener and his colleagues had in his view completely ignored this fundamental facet of purposeful

behavior. In a response to Taylor, for example, Rosenblueth and Wiener (1950) assert the centrality of observable behavior to the study of purpose by suggesting that "if a man wakes up at night and shoots his gun at his image in the mirror, his reaction is quite as purposeful as if he had shot at a burglar" (p. 312). Taylor found this explanation of the scenario ridiculous, "for the question immediately arises, *What* is the man's purpose? Is it to destroy his mirror, or to shoot a burglar? [...] Presumably, the man's purpose might be to shoot a burglar, and yet, unhappily, he *behaves* as if his purpose were to destroy his mirror" (Taylor, 1950b, p. 328, emphasis in original). Taylor considered observable behavior a *necessary* but not *sufficient* component of purpose, for purposeful behavior involves some *desire* for a given object, event, or correlation as well as a *belief* that such an object, event, or correlation is indeed achievable through a certain ensemble of behaviors. In short, an entity must *wish* to pursue a goal if it can be said to act with purpose. Purpose *implies* intent, something decidedly *internal* to an entity and unavailable to someone observing that entity's behavior (someone like a cyberneticist, for example).

Taylor thought the breadth of the cybernetic definition of purposeful behavior rendered it analytically useless. If "purposeful behavior" is simply any behavior one might interpret as directed toward a goal, toward a final condition in which an entity reaches some "correlation" with another, then purposiveness "appears to be ubiquitous" (Taylor, 1950b, p. 330). After all, "Any behaving object, it would seem, ultimately reaches some 'final condition' or 'definite correlation' with respect to other objects or events" (p. 330, emphasis in original). Taylor began eyeing the objects in his study and contemplating their

activities: the pipe smoke drifting above his head in "a definite correlation with certain features of the environment, viz., air-currents in the room," the rocking chair sitting motionless by his side, which "may, I suppose, be interpreted as directed to a final condition, rest, relative to another object of its environment, the floor" (p. 330). Surely these objects seemed to meet Rosenblueth's, Wiener's, and Bigelow's criteria for purposeful entities—but then, what *didn't*? And more importantly, "what [...] is to be gained by thus calling tobacco pipes [and] rocking chairs [...] *purposeful*? What, for example, is science able to learn about these objects [...] by regarding them in this light?" (p. 330, emphasis in original). What (to borrow a phrase from cyberneticist Heinz von Foerster) is the *purpose* of purpose? What does one gain by attributing agency to nonhuman entities?

A Cybernetics of Cybernetics

The crux of Taylor's issue with the peculiar definition of purposeful behavior Rosenblueth, Wiener, and Bigelow advance in "Behavior, Purpose and Teleology" rests on a vexing turn of phrase. The cyberneticists suggest that "the term purposeful is meant to denote that the act or behavior *may be interpreted* as directed to the attainment of a goal [...]" (p. 18, emphasis added). By defining purposeful behavior this way, Wiener and his colleagues seem to make such behavior a matter of perspective, a matter of an observer's ability to *attribute* agency to an entity by *reflecting* on *observations* regarding the relationships among particular entities in a field. In short, they appear to render cybernetic

agency a matter of interpretive attribution—an epistemological rather than ontological enterprise—opening the door to waves of speculation regarding the role observing entities play in systems defined by an ability to self-direct.

This very issue would define cybernetics' second age. Heinz von Foerster, the Austrian physicist widely credited as the father of "second-order cybernetics," attributes the break with Wienerian thinking to a shift in analytic comportment. "The cybernetics of *observed* systems we may consider to be first-order cybernetics," Foerster (2003a) writes, "while second-order cybernetics is the cybernetics of *observing* systems" (p. 285, emphasis added). Second-order cybernetics concerns the ways in which the entity *observing* a complex system (an entity that is itself a complex system) is always already *imbricated* in that system to the extent that the pair are mutually constitutive. It addresses the consequences of extending the effects of feedback relations to the entity observing those relations. Second-order cybernetics is, in von Foerster's terms, "a *cybernetics of cybernetics*" (p. 286, emphasis in original).

The epistemological issues this shift portends may not have overtly concerned Rosenblueth, Wiener, and Bigelow, and yet second-order cybernetics owes one of its principal epistemological insights to the trio's particular spin on teleological behavior. Second-order thinkers like von Foerster took seriously the first-order mandate against disembedding an actor from the complex system of feedback relations that govern its activity. The circular causality inherent to these systems (whereby an entity's goal is in fact the cause of its current behavior, and the effects of that behavior feed back into the entity as causes of future behavior) troubled the simplicity of behavioral models predicated on a

neat linearity that would secure a singular agent as simply either the source or target of a stimulus. Using the neuroscience of his day, von Foerster demonstrated that such linear explanations were untenable. In a 1973 essay entitled "Constructing a Reality," von Foerster explains multiple ways in which human physiological systems work not merely to *represent* reality (i.e., "take in" the objective world through various receptors that transmit that world to an agent) but rather to *construct* that reality *in* and *with* the agent. The eye and the brain, for example, *work on* the material they receive from their environment in ways that correlate with the relative degrees of openness to it. What's more, they do so *recursively*: the cognitive products they construct from/with their inputs inform the organizations they subsequently use to work on *additional* inputs. Von Foerster (2003b) calls this activity "computing": "any operation (not necessarily numerical) that transforms, modifies, rearranges, orders, and so on, observed physical entities ('objects') or their representations ('symbols')" (p. 216). Cognition is the computation of a reality.

To compute a reality is to reduce its overwhelming complexity in such a way as to render it both intelligible and manageable. Von Foerster (2003c) considered this "the essential contribution of cybernetics to epistemology": "the ability to change an open system into a closed system, especially as regards the closing of a linear, open, infinite causal nexus into closed, finite, circular causality" (p. 230). A cybernetics of *observing* systems investigates ways acts of perception are constitutive. "Cause" and "effect," for example, are the products of an activity whereby an observing system parses a flow of stimuli and straightens what would otherwise be a never-ending cycle of events. This is why

von Foerster insisted that "an epistemology is, for all practical purposes, a cybernetics" (p. 231): the way the world is *known* is precisely the way that world is *constructed* through the circularity of cuts that in-form an ability to make cuts. What we know is what we compute; what we compute is what we know. "Closed circular causality, thus, bridges the gap between effective and final cause, between motive and purpose" (p. 230).

But von Foerster did not limit the purchase of his constructivism to epistemology alone. He saw in cybernetics a renewed existentialism: becoming aware of the fundamentality of parsing operations stressed the *constructedness* of autonomy from a field of overlapping relationalities. My cutting a flow of recursions always already implicates another in ways that enable and constrain its possibilities. In this way, von Foerster (2003c) writes, cyberneticists "have the responsibility to partake in the solution of the social and ethical problems of our times" (p. 244). This is cybernetics' ethical imperative: "Act always so as to increase the number of choices" (von Foerster, 2003b, p. 227). From a cybernetic perspective, ethical behavior is that which both recognizes and values agents' responsibilities for defining fields of action. In von Foerster's explanation of recursive cutting's constitutive power is the inkling of a second-order cybernetic theory of agency.

Just as first-order cyberneticists dispersed action across a milieu of heterogenous entities, so too did second-order cyberneticists address their epistemology and their ethics *to a field*. Thinking cybernetically involves a characteristic manner of thought, what anthropologist and second-order cyberneticist Gregory Bateson (1972a) calls "cybernetic explanation" (p. 405).

Cybernetics, Bateson suggests, examines not singular entities but the *fields of possibilities* in which those entities are embedded; it comports itself to the complexity of an environment of open-ended possibilities, then questions why that environment affords certain occurrences and not others. Bateson writes that cybernetic explanation eschews the *positivity* of the autonomous actor and focuses instead on the system of constitutive "restraints" (p. 405) that govern any actor's abilities (that define, in other words, what an actor *is* by what it is capable of *doing*). These restraints, he says, "can in all cases be regarded as factors which determine inequality of probability" (pp. 405-406), that encourage some forms of behavior and thought while discouraging others. Because (as von Foerster, too, had already demonstrated) second-order cybernetics refuses to conceive an actor as something disembedded from its environment, Bateson's description of cybernetic explanation cannot be read as yet another instantiation of some agent/structure dichotomy. Agency here is never a matter of *force outside the system*, but rather of a force *immanent to* the system itself, as that system finds ways to implement patterns or redundancies among those material, energetic, and informational forces responsible for giving it some stability (see also Bateson, 1972b). Despite Bateson's unfortunate choice of the term "constraints" as a marker of determination (a term that unfortunately invokes a dualism between an agent-positivity and a structure-negativity), second-order cyberneticists gradually fashioned a *systemic* understanding of agency, one in which a system of overlapping forces *itself* acts as agent.

Like his second-order counterparts, Bateson acknowledged that pure redundancy in such systems was unlikely, untenable, and unwelcome, for cybernetic systems are always open to (indeed, they *rely on*) some outside that they themselves demarcate as a consequence of their own parsing activity. Self-regulating systems *emerge* from a complex interplay of forces that instigate those systems by troubling their ability to maintain coherence and triggering further organization-maintaining practices. Bateson (1972a) claims, therefore, that "noise [is] the only possible source of *new patterns*" (p. 416, emphasis in original). Redundancy is a repetition of the same; recursivity is a repetition that generates the new, as a system returns to itself only in relation to the alterity to which it must repond.

In this way, second-order cyberneticists pose a challenge to conceptualizations of agency as autonomy in the face of external determinations. For von Foerster (2003b), for example, autonomy is precisely a system's ability to regulate its own regulatory mechanisms, a process that necessarily implicates that system's coupling with its outside. This is the principal aim of those recursive computations that construct worlds: the "*regulation of regulation*" (p. 226, emphasis in original). In their overview of the contributions second-order cybernetic thinking makes to contemporary social theory, Clarke and Hansen (2009) recognize the centrality of recursive regulation to a renewed understanding of nonhumanistic agency, noting that "in stark constradistinction to any naive conception of autonomy as the absolute self-sufficiency of a substantial subject, this concept demarcates the paradoxical reality that environmental entanglement correlates with organismic (or

systemic) self-regulation" (p. 7). Second order cyberneticists embraced this paradoxical relationship between openness and closure as a way of accounting for the emergence and durability of complex systems, perhaps no one more so than Chilean biologists Humberto Maturana and Francisco Varela.

Autopoiesis and Machinic Autonomy

For Maturana and Varela (1972), the ability to parse a complex system (to enact a constitutive cut that organizes a world) is pivotal not only to those processes by which an observer comes to *know* that world but also to the production of reality itself. "A universe comes into being when a space is severed in two" (p. 73) they write in *Autopoiesis and Cognition*, a work that, while extraordinarily influential among second-order cyberneticists concerned with the epistemological implications of circular causality, recuperates something of the ontological imperative Wiener and other first-order cyberneticists stressed decades prior.

The constitutive severing of space into two is an act of *distinction* that abstracts a collection of elements from an environment and makes of them some unity. In his solo-authored introduction to *Autopoiesis and Cognition*, Maturana explains that distinction is the "basic cognitive operation" (p. xix) an observer (human or nonhuman) performs. Distinction separates an entity from its background; it distinguishes, in Maturana and Varela's terms, a "unity" from a "medium." At the same time, it characterizes each "with the properties with which this operation endows them" (p. xix). Any unity, any system of elements constitutively cut-from (and therefore defined-against) its environment, is a *simple* unity. But for Maturana and Varela distinction can become a *recursive*

operation when it comes to bear once more on a simple unity and makes an additional distinction between that unity's "organization" and its "structure." The result is a *composite unity*. A composite unity-system's structure is "the actual components (all their properties included) and the actual relations holding between them that concretely realize a system as a particular member of the class (kind) of composite unities to which it belongs by its organization" (p. xx). Its organization is "the set of relations between its components that define it as a system of a particular class" (p. xx). A unity's structure, the concrete and specific relations among its elements in space, might change as a result of relations with other unities or with its medium; a unity's organization cannot change if that unity is to remain what it is. Maturana says simple unities generate a spatiality logically distinct from the spaces of their components; this is "a space that it defines through the properties that characterize it as a simple unity" (p. xix). The whole and its parts are ontologically adjacent.

Maturana and Varela (1972) explain that composite unities must work to maintain the organizations that give them their respective identities. They direct the network of components that comprise them to the continual reproduction (the perpetual realization) of those organizations. They generate themselves. They are (to use what is perhaps Maturana and Varela's most famous neologism) *autopoietic*. And for Maturana and Varela, autopoiesis is both the necessary and sufficient condition of life itself. Maturana clarifies this assertion by suggesting that "it is the circularity of its organization that makes a living system a unit of interactions, and it is this circularity that it must maintain in order to remain a living system and to retain its identity through

different interactions" (p. 9). Against evolutionist and reproductivist accounts of life, Maturana and Varela adopt a position similar to that of Wiener several decades prior: "life" simply names any entity capable of maintaining organization.

The Chilean biologists preferred a single term to designate such entities: "machines." Machines are not technologies, "concrete hardware systems, defined by the nature of their components and by the purpose that they fulfill in their operations as man-made artifacts" (Maturana & Varela, 1972, p. 77). Machines are systems of relations that form unities in space, systems defined by the precise organization of their components, which do not, by virtue of their being *this* or *that* type of component, determine in advance the functioning of the machine. Nor does a machine's organization dictate the properties of the components it organizes: "The organization of a machine [...] does not specify the properties of the components which realize the machine as a concrete system, it only specifies the relations which these must generate to constitute the machine or system as a unity" (p. 77). The "essence" of a machine is precisely the relations it establishes. For Maturana and Varela, machines are *systems* of relations that perform their functions by mobilizing structural materials with no necessary connection to those functions; "the organization of the machine is independent of the properties of its components which can be any," for "a given machine can be realized in many different manners by many different kinds of components" (p. 77). This theory of living systems is unabashedly a "mechanicism" (p. 76); machines are their own motors (Maturana and Varela take a "nonanimistic view" [p. 76] of machines, rejecting

any appeal to some transcendental animating force). Autopoietic machines are therefore those machines that organize the work of maintaining their organizations. They do this and nothing else.

Any machine not directed at the maintenance of its own organization is not an autopoietic machine; it is an *allopoietic* one. Allopoietic machines, Maturana and Varela (1972) suggest, are machines that "have as the product of their functioning something different from themselves" (p. 80). Take a car, they suggest, which is certainly a "concatenation of processes" (p. 79), yet not one specifically aimed at the maintenance of the car's organization. Maturana and Varela stress that autopoietic machines involve processes logically independent from the specific materials they organize, and they subordinate all activities "to the maintenance of their own organization" (p. 80). For this reason, Maturana and Varela characterize autopoietic systems as "homeostatic systems," a designation that is "a necessary consequence of the autopoietic organization" (p. 80). The cybernetic emphasis on physical entropy clearly undergirds this conception of autopoiesis.

Maturana and Varela (1972) call autopoietic systems "autonomous" (p. 80). But their definition of autonomy does not involve some kind of disembeddedness from a system. Autopoietic machines are autonomous to the extent that they are capable of folding their machinic activities back on themselves and achieving some operational closure. This closure is necessary only in the *organizational* register; a system's relative degrees of closure define its *structural* capacities to cope with its environment in ways that help it maintain its organizational homeostasis. Autonomy is, then, "the self-asserting

capacity of living systems to maintain their identity through the active compensation of deformations" (p. 73). For Maturana and Varela, openness and closure are not easy opposites; they depend on one another when a system is organizationally closed but structurally open. A machine needs its relations to remain what it is.

Moreover, autopoietic machines express some *individuality*; "that is, by keeping with their organization as an invariant through its continuous production they actively maintain an identity which is independent of their interactions with an observer" (Maturana & Varela, 1972, p. 80). Allopoietic machines, conversely, *depend* on an observer, who determines those machines' operations because their products are "different from themselves" (p. 81). Autopoietic machines are sealed monads; they realize their unities through no organizational processes but their own; "their operations specify their own boundaries in the processes of self-production" (p. 81). They are perfect. As Hayles (1999) elaborates, autopoietic machines "always operate in accord with their structures, whatever they may be" (p. 139). Any deficiency, any lack, any malfunction is the product of an observer who apprehends an autopoietic machine and, through some process of distinction, parses its boundaries, linearizes its circular auto-genesis, and generates for it some kind of "ideal" to which it never corresponds.

Similarly, autopoietic machines act only to reproduce their own organizations; they are otherwise "purposeless" (Maturana & Varela, 1972, p. 86). This is to say that a machine's organization only stipulates and governs *relations*, not intentions. "Thus," Maturana and Varela write, "the notions of

purpose and function *have no explanatory value* in the phenomenological domain which they pretend to illuminate, because they do not refer to processes indeed operating in the generation of its phenomena" (p. 86, emphasis in original). Maturana and Varela thus seem to agree with the notion of purpose Rosenblueth, Wiener, and Bigelow beget when they render it a matter of observer positionality: "purpose or aims [...] are not features of the organization of any machine (allo- or autopoietic); these notions belong to the domain of our discourse about our action" (p. 85).

To be sure, theirs is a realism that posits a domain distinct from human observation, perception, and intention. But it is a realism with a constructivist rather than a representationalist epistemology. Maturana and Varela do not suggest that observers somehow "misidentify" or "misconstrue" the operation of a machine when they apprehend it. An observer makes a *distinction* in a system, parsing it from a background and establishing a particular *descriptive domain* in which their distinctions operate. As it was for von Foerster and Bateson, observation is for Maturana and Varela (1972) not something that proceeds from outside a system, but rather an operation immanent to a system that is responsible for constituting and positioning the unities in it. Observation is a generative *act* characterized as a capacity to recursively take as its object the very collection of elements it has constituted as a unity and attempt to disembed this unity from a field. In Maturana and Varela's terms, machines are always *structurally coupled* to one another and to the milieu in which they have been connected through the constitutive cut of distinction; they reciprocally act on one another not through *transmission* but by *triggering* material

(re)arrangements. For this reason, Maturana and Varela cheekily suggest that autopoietic machines "have no inputs or outputs" (p. 81). That is, these machines do not simply "accept" stimuli from other systems or their environments; instead, unity and stimulus are always *interacting* in a manner coextensive with the capacities their particular organizations afford. Autopoietic machines can therefore "be perturbed by independent events and undergo internal structural changes which compensate these perturbations" (p. 81), just as the human nervous system, Maturana explains earlier in *Autopoiesis and Cognition*, reconfigures sense data in line with a body's degree of openness to that data, from which it constructs a phenomenal field. Perturbations too powerful may, however, threaten to dis-organize the machine and dissolve the relations that make it what it is. But any noticeable relation between such a trigger and its response belongs entirely to the domain of the observer: "any relation between these changes and the course of perturbations to which they may point to [sic], pertains to the domain in which the machine is observed, but not to its organization" (p. 81). Causality is an observer-dependent phenomenon.

Ultimately, one particular perturbation became too intense for the structural coupling that was Maturana and Varela. In later work that departs from the characterization of autopoiesis he developed with his colleague, Varela would attempt to redefine the scope of a concept he felt had been simultaneously stretched too thin and delimited unnecessarily (see Hayles, 1999). In Varela's view, autopoiesis pertained to *biological* life alone (particular cellular activity); the social systems to which others applied the term, he said,

did not really demonstrate the autopoietic characteristics for which he and Maturana had argued (see Protevi, 2009). What's more, he grew uncomfortable with autopoiesis' unyielding circularity, its emphasis on homeostatic closure and the tendency to so rigidly distinguish machines from their environments. As Hayles (1999) observes, Maturana and Varela's vocabulary belies a desire to preserve an individualistic notion of agency; for her, "closure and recursivity [...] play the foundational role in autopoietic theory that self-possession played in classic liberal theory" (p. 146). Hayles expresses uncertainty over autopoiesis' status as an observer-dependent feature of systems themselves:

If the theory says that the observer creates the [autopoietic] system by drawing distinctions, it risks undercutting the ontological primacy of organizational closure. If it says that autopoietic processes are an essential feature of reality, it risks undercutting its epistemological radicalism. (p. 145)

Autopoiesis and Cognition begins by seeming to assert the former; it concludes by appearing to argue the latter. In short, Maturana and Varela were in the end incapable of completely harmonizing and radicalizing their ontological realism and epistemological constructivism. Moreover, as Wolfe (1995) notes, Maturana and Varela's work, particularly the ethics they attempt to draw from it, seems haunted by a speciesism that reasserts the primacy of the human despite a theory of machines that would appear to de-privilege it. However, another critic of autopoiesis, an outspoken opponent of both French structuralism and Lacanian psychoanalysis, would nevertheless elaborate his

own theory of machinic systems, one that completely re-ontologizes the cybernetic question of agency and offers a thoroughly nonhumanistic account of the machinic production of reality. His name was Félix Guattari.

Machinic Desire and Ecological Subjectivity

The epistemological ambiguity Hayles identifies in the work of Maturana and Varela, where machines seem to be (simultaneously) the product of observational distinctions and autonomous from the realm of cognition, is evidence of the aporias a cybernetics of observing systems raised for those who engaged with it. Second-order cybernetics struggled to reconcile the relationship between observing systems and machines, in part because its practitioners never sufficiently resolved their own ontological and epistemological dilemmas. But while these scientists tussled over the degree to which observing systems constituted the systems they apprehended, radical psychoanalyst Félix Guattari simply inverted the productive relationship between these two entities. For him, machines are not the products of observing entities; observing entities are always and already the products of a process that both subtends and supersedes them. This insight would fuel Guattari's vigorous attack on the predominant theoretical paradigms of his day: psychoanalysis and structuralism.

Guattari (1995) called this process "machinic heterogenesis" (p. 33), a concept that emerged from an inversion of Maturana and Varela and significantly retooled the concept of autopoiesis. While he appreciates the

biologists' productive distinction between *machines* and mere technical *mechanisms*, Guattari sought something more dynamic than a notion of self-contained and self-sufficient autopoietic monads. He notes that

it is as biologists that Humberto Maturana and Francisco Varela proposed the concept of the autopoietic machine to define living systems. I think their notion of autopoiesis—as the auto-reproductive capacity of a structure or ecosystem—could be usefully enlarged to include social machines, economic machines and even the incorporeal machines of language, theory and aesthetic creation. (Guattari, 1995, p. 93)

Here Guattari takes aim at Varela's assertions about autopoiesis' limited applicability to biological systems. Moreover, he takes issue with the idea that "organization" could name something enduring, something that transcends any concrete and material instantiation (p. 39). Indeed, what Maturana and Varela called "organization" was for him the epitome of structuralist abstraction—an ideal/ized system of relations, the Saussurian *langue* that misunderstands "the essential dimension of machinic autopoiesis": novelty, generativity, "disequilibrium" (p. 37). He railed against theories "occupied by inputs and outputs whose purpose is to make the structure function according to a principle of eternal return," something "haunted by a desire for eternity" (p. 37). And he dismissed Varela's attempts to limit autopoiesis to biological processes, insisting instead that "autopoiesis, which uniquely describes autonomous entities—unitary, individuated and closed to input/output relationships—lacks characteristics essential to living organisms, like the fact that they are born, die and survive through genetic phylums" (p. 39).

Guattari imagined a more vibrant and dynamic future for the concept of autopoiesis, which "deserves to be rethought in terms of evolutionary, collective entities, which maintain diverse types of relations of alterity, rather than being implacably closed in on themselves" (pp. 39-40). A machine, Guattari suggests, always contains an "autopoietic node" that "gives it value" (p. 37), and that value is precisely (and somewhat paradoxically) its continual "breakdown, catastrophe—the menace of death" (p. 37). A machine does not merely reiterate the already-signified; it opens onto the not-yet-organized. Guattari sought a conception of machines capable of "[taking] us beyond Varela's characterization of autopoiesis as unitary individuation, with neither input nor output" and "towards a more collective machinism without delimited unity, whose autonomy accommodates diverse mediums [sic] of alterity" (p. 42). Machines cut across the biological, the social, the natural, the energetic, and the technical—"diverse mediums of alterity" indeed—to compose (from seemingly disparate materials with no necessary connection) the very dynamic organizations capable of reproducing themselves and, consequently, the power relations they enable: machinic heterogenesis.

In the end, while Guattari appreciated Maturana's and Varela's attempts to conceive self-organizing systems that were observer-independent, he found their rendering of autopoiesis too inflexible. Yet Guattari did not deny redundancy's productive potential. In fact, he seemed to appreciate Maturana's and Varela's attempt to theorize redundancy *qua* redundancy, a redundancy without a subject. But unlike his cyberneticist forebearers he did not unquivalently embrace redundancy as an attractive social and political force;

instead, he fiercely interrogated the normativity of homeostasis. Redundancy was for Guattari the force by which flows of (human and nonhuman) desire get arrested, pooled, and channeled in ways beneficial to entities capable of implementing those redundancies. Redundancy is an effect of power relations. Guattari (1984) recognizes the unsettling penchant for redundancy that French semiology borrows from American information theory when he writes:

Information theory has tried to save the bacon of the semiologies of signification by defining significative redundancies as being in inverse proportion to the quantity of information—but this is no more than a rearguard semiological skirmish. In fact, the transfer of information belongs to a diagrammatic process that has no direct relation with the significative redundancies of human 'understanding.' 'Before' the signifier, redundancy and information came together in a process of intrinsic diagrammatization. (p. 132)

Here Guattari adopts Shannon's definition of information as the antithesis of redundancy. But he also recognizes information as something *other than* an epistemological problem (i.e., of "understanding"). Outside the domain of semiology, "before" the signifier, informatic redundancy pertains to something else: the (re)arrangement (for Guattari, the "diagrammatization") of material elements in ways that inhibit entropic divergences, which, for Guattari, marked the possibility of flight from oppressive state and economic forces. Indeed, he was skeptical of "the dominant position that information theory occupied at the core of linguistics," which "led to the adoption of a definition of language as merely a means of transmitting messages, the remainder being simply noise and redundancy" (Guattari, 2011, p. 23). Redundancy and recursivity operate

on and with the already-signified, on and with those materials already overcoded with the significations powerful forces are able to impose on them as they draw them into their particular regimes of meaning and sensibility.

Guattari described (with assistance, he acknowledged, from frequent collaborator Gilles Deleuze) a repetition seemingly more fundamental, one that pertains to the material and energetic fluxes whose arresting and pooling serve as the precondition of signification: a *refrain*. Refrains are a-signifying repetitions both responsible for both the production of subjectivity and its dissolution or dispersion.

According to Guattari (1995), refrains function in at least three ways (see also Elliot, 2012, pp. 88-92). First, they establish a basic "ontological consistency" (p. 28), a rhythm that marks the emergence of a positive unity out of the ongoing flux of the universe—a basic unit of organization that forms its own universe amidst chaos. Second, through additional repetitions that entity establishes a territory for itself. Guattari calls these "intensive" repetitions. They draw together the elements that constitute the unity, that inscribe boundaries demarcating the unity from its environment. Repetition of these boundaries mark periphery and center, subject and object, home and not-home (Elliot, 2012). Finally, Guattari (1995) stresses a third function of the refrain: its ability to escape the pull of other refrains, to slip away from other territories and *take flight* into heretofore unknown registers. Beyond this, says Guattari, refrains assume limitless potential to instantiate new rhythms whose novelty extends to infinity: "The fourth term stands for the *n*th term: it is the opening onto multiplicity" (p. 31).

Machines (specifically those Guattari called "existential machines") work to *implement* refrains. They do this from a place *immanent* to those refrains. They fold desire onto itself in a kind of doubling-back, which serves as a ground for the production of fragile unities out of chaotic flux (Guattari, 1995, p. 28). As refrains are a-signifying, this is an operation analytically distinct from (but in some cases directly linked to) signifying practices. "The 'mechanism' of this turning around of being," Guattari writes "consists in the fact that some of the machine's discursive segments do not only play a functional or signifying role, but assume the existentialising function of pure intensive repetition that I have called the refrain function" (p. 53). Refrains in fact operate *between* or *within* the discursive and the "sensory" to

find substance in rhythmic and plastic forms, in prosodic segments, in facial traits, in the emblems of recognition, in leitmotifs, signatures, proper names or their invocational equivalents. (Guattari, 1996a, p. 162)

Yet Guattari's machines do not always serve to arrest, pool, and block, for the refrains they harness or modulate do not simply form universes and territorialize them. Refrains always *insinuate* themselves in one another. They rework one another, amplify or diminish the force of one another's formative repetitions. Refrains encounter other refrains in meetings that might reinforce, distort, modify, or de-form. In true cybernetic, autopoietic fashion, they can unite and stabilize. But they can also demolish and dismantle. If cybernetics' resistance to change and its emphasis on stability renders it essentially conservative (see Hayles, 1999), then Guattari does not attempt to counter this

conservatism by advocating the propagation of entropy, but by granting repetition the power to obliterate. Guattari's refrains are forms of redundancy that can rework and dismantle other redundancies.

For the first-order cyberneticists, machines were a technical matter. For second-order cyberneticists, machines were an epistemological (and, in some cases, ontological) matter. For Guattari, machines were a decidedly *political* matter. Despite the fact that his machines were radically a-subjective, Guattari nevertheless mobilized the concept of machinic heterogenesis in an effort to solve the problem of the production of subjectivity in capitalist social formations, for he sought some insight into those processes that might generate subjects capable of resisting oppressive forms of power dominant in the late 20th century. In cybernetics, Guattari discovered a language and conceptual logic that permitted a productive break with prevailing theoretical approaches to the critical question of subjectivity under an emerging global capitalism (again, structuralism and psychoanalysis; see Watson, 2009). By enacting a cybernetic reading that retools first- and second-order notions of machinic activity, Guattari (1984) recast the problem of subjectivity as something that transcends *purely* structural explanations. Machines infiltrate structures and rework them. In one of his earliest essays on the matter, "Machine and Structure," Guattari says that while "in reality, a machine is inseparable from its structural articulations," machines and structures function in a kind of reciprocal presupposition, for "conversely [...] each contingent structure is dominated (and this is what I want to demonstrate) by a system of machines, or at the very least by one logic machine" (p. 111). Guattari criticized structuralist

thinking for fetishizing abstract systems of sign-relations with little or no regard for the pragmatic fields of activity in which those systems operate (Guattari, 2011). Such thinking, Guattari thought, involved conceiving machines in terms always already organized through power relations granting those terms efficacy or legitimacy. Guattari deployed a machinic vocabulary to describe a process *anterior* to structural activity, logically *prior* to semiological operations, one outcome of which could be the production of subjectivities or subject positions from which seemingly autonomous actors appear to act and speak. As he writes

Standard agents of production are mobilized before the transformation of each individual into a speaker-listener capable of adopting a linguistic behavior compatible with the modes of competence that assign us to a particular position in the society of production. (Guattari, 2011, p. 38)

Or, put even more succinctly:

The sign will always have to refer to the semiologies of the power machines, and their particular syntagmatic and paradigmatic coordinates, if it is to produce any effect at all upon reality. (Guattari, 1984, p. 136)

One effect of structuralism's hegemony (in linguistics and beyond) was a rather naive and unproductive understanding of agency, Guattari thought. Structuralism's penchant for binary thinking too often reinforced a retrograde agent/structure dualism that constrained attempts to conceive new avenues for political action. Guattari (1984) explains how (in a structuralist imaginary) "the agent of action, whose definition here does not extend beyond this principle of reciprocal determination, is included in the structure," which "encloses the

subject, and will not let go as long as it is in a position to recuperate it within another structural determination" (p. 112). In short, for Guattari, structuralism cannot offer explanations of subject-formation that do not already operate within symbolic economies sanctioned by the forces of power in control of those economies. Thinking cybernetically and conceiving this process *machinically* allowed Guattari to glimpse a structure's underside, something not already of the subject even if it might (in some cases) be *responsible* for the subject. For Guattari, a machine "remains essentially remote" (p. 112) from acting subjects, so machinic thinking interrupts an easy isomorphism between *subject* and *agent* because it demonstrates that (in the expansive fields of action in which agency might occur) "the subject is always somewhere else" (p. 112). The locus of agency is not the signifying subject but the machines that can produce this subject.

Guattari's resistance to explanations of subject formation predicated on the instantiation of signifying semiologies that loop through an infinite play of signifiers in self-contained systems informs his desire to see autopoiesis become less rigidly self-referential. And later in his career, Guattari (2008) would propose that thinking machinically about the production of subjectivity means thinking *ecologically* (and here he specifically recalls Bateson) about the ways social, mental, and environmental processes become organized, distributed, and designated. Guattari returns the cybernetic problem of nonhumanistic, collective agency to a complex and crosscut field of forces in which existential and desiring machines alike work to implement or reinflect refrains that temper forms of living. Quite simply, agency is a function of the refrain, an ability to

insinuate repetitions that modify existing relations (and an ability that is itself the product of the relations that various refrains have either instantiated or prised apart). But by positioning himself against structuralist modes of thought, he unwittingly adopted the structuralist problematic—the status of the subject and the production of subjectivity—and in this way remained somewhat constrained by it. In his work with Gilles Deleuze, however, Guattari's theory of machines would finally free itself of subjectivist pretensions.

Toward a Machinic Ontology

Consistent with the cyberneticists who preceded them, Deleuze and Guattari (1977) define a machine by its behaviors, by *what it does*. "It represents nothing, but it produces. It means nothing, but it works" (p. 109). Yet their machine is not an exceptional type of entity, a privileged class of actor. A machine is *anything that organizes*. More specifically, machines are what *synthesize* reality itself, not by reconciling (and therefore negating) the already-formed into some higher order, but by cleaving portions of an abundance that always in some way exceeds them (through a parsing operation by now so familiar in the cybernetic tradition). Deleuze and Guattari write that "a machine may be defined as a *system of interruptions* or breaks" in material and energetic flows (p. 36, emphasis in original). But "these breaks should in no way be considered as a separation from reality," they write. "Rather, they operate along lines that vary according to whatever aspect of them we are considering" (p. 36). Machines give shape to chaos from a place inside that chaos; they attempt to instantiate repeatabilities from unpredictabilities.

In geometric fashion, Deleuze and Guattari (1987) call that place of chaotic flows the *plane of consistency*, a plane with no dimensions or dimensionality on which exist the sheer plentitude of unformed matters and functions, heterogeneous singularities or *haecceities* not (yet) composed into distinguishable associations, intensities and capacities not (yet) actualized. On this plane, the first (and most fundamental) of Deleuze and Guattari's machines begins to work. It is an *abstract machine*. The abstract machine is "in itself neither physical or corporeal, any more than it is semiotic" (p. 141); it is rather like a *diagram* that realizes itself in its own productive acts. A diagram is not a representational device *about* any given collection of elements, but "a cartography that is coextensive with a whole social field" (Deleuze, 1988, p. 34); it is *immanent* to the intensities and flows on which it acts. Such acts are a type of synthesis that Deleuze and Guattari (1977; see also Grossberg, 2010, 2014) call *connective*: they interrupt the otherwise smooth flow of singularities by punctuating it, slicing it, cutting it in a way that forges specific relationalities and introduces a boundary condition. Cutting a flow does not negate it. "Far from being the opposite of continuity, the break or interruption conditions this continuity: it presupposes or defines what it cuts into as an ideal continuity" (p. 36). Diagrams cut-connect to link singularities with no necessary association; they make and unmake connections between those entities and in so doing bestow some dimensionality to an otherwise chaotic, entropic flux.

Deleuze and Guattari (1987) liken the abstract machine to a lobster whose pincers dip into a flow of haecceities and extract (by collecting) *assemblages*, pivotal units of analysis in Deleuzian/Guattarian social and cultural criticism.

Simply put, an assemblage is any group of haecceities a machine has synthesized: a "constellation of singularities and traits deducted from the flow—selected, organized, stratified—in such a way as to converge (consistency) artificially and naturally" (Deleuze & Guattari, 1987, p. 406). In Deleuze and Guattari's native French the term for "assemblage," *agencement*, names not so much a *noun* as a *verb*, a dynamic *process of arrangement* by which elements with no necessary relation are nevertheless articulated and channeled in a particular direction as an *unstable unity* (see Anderson et al, 2012; Slack, 2011; Slack & Wise, 2005). Assemblages are the products of diagrammatic actualizations; they put diagrammatic actualizations *to work*. "The abstract machine is like the diagram of the assemblage," say Deleuze and Guattari (1987), while "the assemblage negotiates variables at this or that level of variation [...] and determines which variables will enter into constant relations" (p. 100).

The assemblage is a critical unit of analysis in Deleuzean/Guattarian theory. More specifically, then, Deleuze and Guattari claim that abstract machines extract (and connect into another unstable unity) two assemblages: one Deleuze and Guattari designate *content*; the other, *expression*. "Expression" names the assemblage of those singularities that *act*, that *intervene* in contents. "Content" names the assemblage of those singularities *acted upon*, the bodies, actions, passions, and qualities made available to and for activity. Both are *active*, but each in its own way; as Deleuze (1988) explains, "contents" are those materials made "determinable," while "expression" are those rendered "determining." This is to say that this crucial distinction defines which of those

materials an assemblage has gathered together are *acted upon* and which are *acting*. Content and expression are not related as signifier and signified (expression does not *represent* content), nor are they related as base and superstructure (content does not unilaterally *determine* expression). An abstract machine places two collectivities of bodies with no necessary relation in a state of *reciprocal presupposition*. Given the particular way an abstract machine has brought a constellation of machinic and enunciative elements into contact (two assemblages connected into one collectivity of reciprocally presupposing units), "expression" names those elements that *intervene* in those designated as content: expression "does not speak 'of' things; it speaks *on the same level as* states of things and states of content" (Deleuze & Guattari, 1987, p. 87, emphasis in original). Semiotic/expressive elements do not *represent* contents but "anticipate them or move them back, slow them down or speed them up, separate or combine them, delimit them in a different way" (p. 86).

By creating a contingent relation of reciprocal presupposition between content and expression, the abstract machine draws a line between the smooth and undifferentiated plane of consistency and the *plane of organization* (both of which, Deleuze and Guattari claim, actually exist on the same plane), *actualizing* particular haecceities by lending them a distinct dimensionality. The diagram "plays a piloting role" (p. 142) in relation to these concrete assemblages, which embody the content and expression that diagram generates. Content and expression (two assemblage-collectivities themselves) are like *dimensions* of the assemblage-collectivity produced by their being placed in reciprocal presupposition with and to one another. For this reason,

Deleuze and Guattari frequently liken an assemblage's content to its particular *machinic assemblage* and an assemblage's expression to its particular *collective assemblage of enunciation*; in this way, the two pairs of terms work in tandem. Once again, for Deleuze and Guattari every assemblage is a composition of *two* collectivities; every assemblage is, paradoxically, an assemblage of assemblages: a machinic assemblage is a *pragmatic system* "of bodies, of actions and passions, an intermingling of bodies reacting and to one another," and a *collective assemblage of enunciation* is a *semiotic system* "of acts and statements, of incorporeal transformations attributed to bodies" (p. 88; see also Wise, 2005).

Nothing about an assemblage is guaranteed, however, for in every moment and at every turn forces (both internal and external) seek to dis-assemble it. Assemblages achieve their character through *links* with other assemblages (links that define the capacities of the elements connected in and through them). Indeed, assemblages are *precisely* the links they establish, reinforce, or dismantle. They *embody* the machinic operations that produce them.

But the lobster's twin pincers bear doubly-articulated claws. Each assemblage—both expression and content—is doubled yet again, this time into *substance* and *form*. "Substance" refers to those materials made to be part of a content-assemblage or an expression-assemblage. "Form" refers to the ways these materials get ordered in each of these assemblages. The form of content is the order determinable materials receive when an abstract machine articulates content with expression; the form of expression is the order determining materials receive from the same encounter. Substances are the

product of what Deleuze and Guattari (see also Grossberg, 2010, 2014) call *territorializing machines*, which perform *conjunctive syntheses* that draw together various materials found in both content and expression collectivities ("include this *and* this *and* this," etc.). Forms are the product of *coding machines*, which perform *disjunctive syntheses* that inscribe differences in and among the materials gathered into a territory ("an element in this territory can be *either* this, *or* this, *or* this," etc.). Just as expression and content reciprocally presuppose one another, so too do substance and form (both of which exist on the plane of organization, which itself reciprocally presupposes the plane of consistency): "The tetravalence of the assemblage" (Deleuze & Guattari, 1987, p. 89). Machines work to bring various states of coherence to an otherwise chaotic world. They *(de/re)assemble* it.

While they do not use the term, Deleuze's and Guattari offer a nonhumanistic theory of *agency* rooted in the notion of *agencement*. Their work embraces multiple cybernetic tendencies: a refusal to privilege human actors as the sole motors of social and cultural change; an emphasis on external relations, couplings, and their effects as a means of defining or characterizing actors; a de-linearized causality; etc. Deleuze and Guattari extrapolate these tendencies to their logical posthumanist conclusions, radicalizing them on the road to an ontology that makes agency a matter of *arrangement*. Theirs is a philosophy of radical immanence in which no entity stands outside or above the field in which it is embedded, and this immanentism ensures that arrangement more than the activity of an actor capable of standing apart from the field of forces that constitute it. Deleuze and Guattari's account displaces individual

actors to underscore the *complexity of arrangement itself* as an ongoing process that determines entities' capacities to affect the particular organizations that define the ways they might affect a social formation. Through the specification of content and expression, Deleuze and Guattari are able to provide analytics useful for precisely determining the dynamics of any system of relations. In short, Deleuze and Guattari's machinic account of the production of reality describes the continual production of social formations from flows that are always either more or less random, more or less contingent, more or less predictable: the organization of repetitions, redundancies, and refrains in an entropic universe—a cybernetic problematic, to be sure.

Agency Without Reductionism

Rosenblueth and Wiener (1950) conclude their defense of cybernetic agency by stressing once again the approach's emphasis on complexity and reciprocity. Analysis of any behavior, they write, is "quite incomplete if the object is considered in isolation, for it is only a part of a larger system" (p. 326); any actor is always already in "a tight coupling with the environment" (p. 326). Assessing actor's *relations* with other actors in a field of forces affords insight into the ways complex systems might *coordinate* to structure that field in line with aims that cannot always be said to emerge from "within" a single entity. For Rosenblueth and Wiener, "the question of whether machines are or can be like men or the higher animals does not guide our choice" (p. 326) of traditional humanistic terminology like "purpose" and "teleology"; indeed, "this question is on the main irrelevant" for what the duo calls "scientific objectives" (p. 326). Granting to machines those properties previously exclusive to humans is not a

benefit of thinking agency nonhumanistically. This serves only to disembody yet another class of actors—machines (like servo mechanisms)—from their respective environments, a move at odds with cybernetic impulses. Instead, reconceiving the nature, function, and capacities of machines acts as a way of *underscoring* the difficulties that arise in analyses predicated on a priori divisions between actors and the circuits of reciprocal action that bind and regulate them.

In their multi-part exchange with Taylor, then, the cyberneticists articulate and refine a rather specific understanding of agency as a capacity of *certain* human, animal, and machinic actors: agential behavior is that which is *goal-oriented* (or, in cybernetic terms, "teleological"). It is goal-oriented insofar as it is *directed* or *oriented* toward a goal, the anticipated achievement of which *spurs* or *motivates* such behavior. But it is also goal-oriented in a second sense: agential behavior gains its orientation *from* a goal. This is to say that it is influenced by those feedback relations that modulate activities and concretely influence the way an entity *does in fact* pursue its goal. By foregrounding the primacy of *feedback*, cyberneticists stress that goal-oriented behavior is oriented *at* a goal at the same time it is oriented *by* a goal. Taylor seemed to neglect this. Thus, for the cyberneticists, agential behavior is always necessary *relational*; it is always unfolding *in a field of overlapping activities and forces* that govern ("steer") it. Conceiving agency as a linear, unidirectional process involving easily identifiable subjects and objects is therefore difficult and ultimately untenable from a cybernetic perspective.

What's more, one can never apprehend agential behavior by isolating an actor and locating agency "in" that actor. As Wiener and his colleagues made clear in their conversation with Taylor, cyberneticists effectively eschewed any notion of some internal "locus" of agency; they measured "intent" by assessing external behaviors ("You intended to shoot a gun"), not by appealing to an actor's internal state ("Did you *intend* to shoot a robber, or did you *intend* to shoot your mirror?"). They made agency a relational, field-oriented matter, one cut loose from its traditional location in interiority.

Cyberneticists' rhetorical work (such as that on display in this exchange with Taylor) demonstrates the meticulousness with which many scientists and engineers tackled the definitional work of forging their fledgling discipline. And the preceding account of agency—with its fine-grained distinctions between intention and will, behavior and teleology—reveals the degree to which these thinkers appropriated and refashioned the discursive resources at their disposal while pursuing a unifying theory of goal-oriented behavior. But their letters to Taylor also disclose the difficulty of speaking about the (notoriously slippery) issue of agency with even a modicum of clarity, a difficulty born of philosophical inheritances against which Wiener and his co-authors so ardently struggled.

As cyberneticists refused to elevate the workings of human actors over the complex systems in which they were embedded, they distributed agency across those systems and blurred customary *a priori* distinctions between agents and objects. They challenged Enlightenment-era definitions of agency that persisted in their own euro-modern social, historical, and political conjunctures. Indeed, as Wiener and his co-authors suggested, cybernetics was as much philosophical as

it was technical. That is, despite their stated "scientific" motivations for constructing a more inclusive theory of agency, Wiener, Rosenblueth, and Bigelow could not avoid doing the philosophical work of articulating the ontological and epistemological grounds for cybernetics.

Their work throws into stark relief the complexities that Enlightenment understandings of agency as a human actor's ability to achieve intended aims unhindered by other forces (be they other agents or social/material structures) elide. More specifically, when deployed in various contexts or discourses, the concept of agency might suture together any of the following concepts and their attendant issues:

- *Autonomy*: the degree to which an entity is able to act without determination or compulsion from extra-agential entities or structures;
- *Intention*: an agent's *purpose* or *motivation* in undertaking the actions it does;
- *Will*: an entity's sense of *volition* when undertaking these actions;
- *Desire*: the degree of an entity's affective investment in undertaking practices or achieving effects
- *Effect(s)*: the *results* of an agent's actions and the *consequences* for both the acting agent and other entities (both agential and non-agential)
- *Locus*: the *site* of agency
- *Teleology*: the *goal-directedness* of an entity's agential actions

The Enlightenment-era conception of agency that persists under euro-modernity (and therefore in many liberal and neoliberal social and political configurations) makes agency a matter of a self-possessed (will, intention)

individual human's (locus) ability to effect change in and to other entities (effects) largely unencumbered by outside forces (autonomy) that might derail the pursuit of its goals (teleology). Cyberneticists sought to unseat the human as primary or sole agent in a complex system of entities (locus), each of which affects and is affected by the others in reciprocal, nonlinear fashion (effects). Rosenblueth, Wiener, and Bigelow (1943) stress that cybernetic behavior—"any change of an entity with respect to its surroundings" (p. 18)—is *purposeful* only insofar as it "may be interpreted as directed to the attainment of a goal—i.e., to a final condition in which the behaving object reaches a definite correlation in time or space with respect to another object or event" (p. 18). Behavior and purpose are *both* relational; assessing change requires knowing something about the milieu in which that entity is embedded, and assessing purpose (intention) is a matter of examining that entity's behavior with respect to some situation vis-a-vis *another* entity. This was, recall, the source of Taylor's frustration with the cybernetic characterization of agency: he thought it made purpose (intention) too vague, and he argued for its reinstatement as something germane only to the singular, goal-directed actor (locus). The cyberneticists argued for a notion of agency as a series of *external relations*; Taylor fought to keep it a matter of *internal properties*. In so doing, he ignored an issue absolutely crucial to the cybernetic imaginary: feedback, which reconfigures relationships between autonomy, effect, and teleology.

Cybernetic ontology is therefore an ontology of the black box, one that, as Pickering (2010) suggests, resists Enlightenment modes of thought. Critiques of Enlightenment thinking tend to function as critiques of the *humanism* that

bifurcates the world into two domains: that of dynamic human culture and that of static nonhuman nature. Pickering emphasizes cybernetics' refusal to mimic this gesture, to expunge nonhuman actors from the privileged domain of human activity. Cybernetics, he says, does not so much bring the two distinct types of entities "together" again; it skirts altogether the foundational articulations that instantiate the "two-worlds model" in the first place. For this reason, cybernetics posed a strategic position from which to develop critiques of this ontological separation (as in the famous example of Haraway's [1985] cyborg, that cybernetic organism with its pleasurable boundary transgressions and perverse couplings). Its tendency to avoid traditional ontological binarism also made cybernetics a source of trepidation for staunch liberal humanists—even Wiener (see Hayles, 1999). Cybernetics, Pickering (2010) says, *celebrated* the black box as not merely a puzzle to ponder but a "partner in [...] a dance of agency" (p. 20; see also Pickering, 1995) that involves humans and nonhumans alike.

By eschewing the ontological rift between humans and nonhumans, cybernetics simultaneously tends to deprivilege the role consciousness plays in the production of social formations. The euro-modern separation of mind from body (in Descartes) and subject from object (in Kant) encourages scientific inquiry concerning ways in which subjects with only partial and inadequate access to an otherwise real world might nevertheless re-present that world to a mind that hovers just outside it. But unlike euro-modern sciences concerned with accurately mapping the world, cybernetics does not "seek to pin the world down in timeless representations; rather, it "directly thematizes the

unpredictable liveliness of the world" (Pickering, 2002, p. 430). For Pickering (2010), cybernetics is an *ontological* project asking not just about the way the world might be *known*, but also with the way the world might be *constructed* (see also Escobar, 2007). For critical social and cultural theory, it recuperates the real in a manner that runs counter to euro-modern impulses that construe criticism as a predominantly *epistemological* enterprise aimed at interrogating the way an always already mediated world shapes the consciousness of actors and groups with differentially distributed abilities to know and speak about it (Grossberg, 1996a, 1998).

Cybernetics also tends to dismantle euro-modernist spatial logics that disembed actors from the field of determinations that produce them and juxtapose those actors against a more or less monolithic set of structural forces working to either enable or constrain their ability for authentic, genuine action. In such scenarios, both agent and structure acquire particular positive or negative valences: as Bennett (2010) explains, "structure can only act negatively, as a constraint on human agency, or passively, as an enabling background context for it" (p. 29). Agents, often presumed to be human, on the other hand act as positive animating forces that enliven structural arrangements by engaging, appropriating, challenging, resisting, or subverting them. Agency *resides in* individual agents, who possess it to greater or lesser degrees as a consequence of their designation *as* agents, a designation that precedes the machinic acts that *produce* those designations. Cybernetic thinking, on the other hand, tends to engage with the *complexity* of the fields that *constitute* actors.

Engaging with this complexity is necessary for understanding the work of power today. This is especially clear from the writing of Raymond Williams (1977), one social theorist who conceives agency in a manner similar to the cyberneticists. Williams notes that accounts of social formations predicated on simple dualisms between agent and structure tend to encourage forms of reductionist thinking that (while perhaps convenient) are often unproductive and place critics in "an extremely awkward and disabling position" (p. 93). By positing structural determination as mere "setting of limits" (p. 87) on otherwise dynamic (too often human) agential activity, researchers tend to presuppose two elements: a transcendent structure whose internal logic "controls or decides the outcome of an action or process, beyond or irrespective of the wills or desires of its agents" (p. 84) and an autonomous agent capable of existing more or less *outside* the determining effects of that structure. The result, Williams writes, is "an alienated, objectivist 'society,' working 'unconsciously,'" and a "comprehension of individuals as 'pre-social' or even anti-social" (p. 87). Both moves *internalize* agency, doing precisely what Rosenblueth, Wiener, and Bigelow resist—making it a *property* of either agent or structure.

But Williams (1977) offers a different reading of "determination" and, therefore, of agency: "a complex and interrelated process of limits and pressures," one located in "the whole social process itself and nowhere else" (p. 87). He warns against accepting any "abstraction of determinism, based on the isolation of autonomous categories, which are seen as controlling or which can be used for prediction" (pp. 87-88). "Determination," he notes, can through

everyday use accrue individualistic overtones—just like those closely-associated (and equally slippery) concepts Rosenblueth, Wiener, and Bigelow sought to redefine: "to determine or to be determined," Williams writes, "is an act of will or *purpose*" (p. 87, emphasis added). Nonetheless Williams does for "determination" what the early cyberneticists hoped to do for their chosen terms (and what Taylor struggled to do in his critiques of cybernetics): divorce it from individualism and make it a matter of "complex relations" (p. 87). He stresses a particular social formation's *irreducibility* to either agential practices or structural conditions, and resolves the tension between agent and structure not with some neat dialectic that fuses (and homogenizes) yet ultimately retains the terms, but with a radical reworking of the notion of determination itself. Determination, for Williams, is a *positive, productive process*; his is a theory of multilinear, crosscutting effectivities whose nature or valance cannot be thought in advance of their actual deployment and operation. Faced with a model of social formations already organized into components called "agents" and "structures," Williams performs a move in line with many contemporary critiques of euro-modern ontology: he jettisons the binary, offering a notion of agency capable of resisting the forms of reductionism he elaborates. In this way, he gestures toward a theory of agency—of the capacity to affect the determination of a social formation—that needn't necessarily begin or end with a single actor, a theory that attends to "historically lived situations and the authentic complexities of practice" (p. 88).

By underscoring the importance of *complexity* for critical social and cultural theory, Williams offers an avenue for thinking cultural practices outside the narrow scope of isolated, individual intention, for admitting that "the author of an action, the speaker of a discourse, may not be the actual agency which is, through such actions and discourses, struggling to bend history in specific ways, to specific interests and goals" (Grossberg, 1992, p. 113). Resisting individualistic theories of agency might be seen as part and parcel of a search for what Stuart Hall (1980) calls "a non-reductive determinacy," a problem the solution of which depends on the ability "to supersede the endless oscillations between idealism and reductionism" (p. 72). If the question of agency is in part the question of ways in which social formations get arranged such that they organize relations of power and define spaces of possibility, then potential answers to this question need not necessarily begin or end with singular actors (let alone singular *humans*, though for Williams these processes certainly can—and likely do—involve them). For while critique may in fact function to improve the conditions of those individuals who are both products and relays of power relations (humans and nonhumans alike) it must begin to do so by recognizing the complexity of the fields in which they operate.

In its own ways, cybernetics grappled with this complexity in much the same way Williams did. Williams offers a reading of agency that locates agency not "in" the singular actor (locus) but rather in the field of forces that articulate to produce particular social formations. He downplays subjective interiorities (will) and structural imaginaries to arrive at a reading of effectivity as *nonlinear* (effect), whereby an single actor's actions are always already overdetermined

by the *multilinear* forces that immanently organize and channel them. And yet he maintained a humanistic teleology, hoping his analysis of culture might produce different ways of (human) life. Cyberneticist he was not.

In the decades that followed Taylor's heated exchange with the cyberneticists, post-cybernetic thinkers grappled with the notions of complexity their work begat. Each posited an answer to the question of the relationship between agents and machines. In the hands of Deleuze and Guattari, however, this project reached a kind of apotheosis when it (re)enters the realm of ontology. And in recent decades, Deleuze and Guattari's machinic ontology has precipitated development of numerous nonhumanistic theories of agency—each of which could provide conceptual resources for analyzing contemporary informatic politics. The next chapter concerns these theories and their affordances.

CHAPTER 4: MAPPING INFORMATION (THEORY)

Plotting a Course

While he tended toward optimism in his sweeping prognostications, Wiener was not at all sanguine about the consequences of a proliferation of purpose-driven servomechanisms. In an unpublished 1949 essay for the *New York Times*, he reflected on the advent of a "new age of machines" (Wiener, 1949a, p. 1). Of this new age, electronic computers were a paradigm exemplar. Indeed, for Wiener these machines were *harbingers* of this new era, which promised both unparalleled prosperity and heretofore unfathomable consequences. "These new machines have a great capacity for upsetting the present basis of industry," Wiener writes, "and of reducing the economic value of the routine factory employee to a point at which he is not worth hiring at any price" (p. 7). Wiener says new technologies portend a future of "unmitigated cruelty" and require an approach "both humane and intelligent" (p. 7), as purposeful, calculating machines threaten to outstrip our mastery, our *agency*: "We can be humble and live a good life with the aid of the machines, or we can be arrogant and die" (p. 8). Evidently, Wiener's new science of control opened avenues of thought, research, and practice that were not altogether beneficial to humankind.

Wiener's trepidation over the oncoming age of intelligent machines belies cyberneticists' resistance to the more radical implications of their work, which blurred traditional distinctions between the human and the nonhuman. Today, cybernetics' attention to non-humanistic agency resonates with a particular body of contemporary critical cultural theory that questions the nature, function, and role of "the human." Concern with the role nonhuman elements play in the organization of social life animates this recent work. The kinship is striking (if occasionally tacit), for concern with the cybernetic problematic persists in many recent theoretical accounts of nonhuman actors and their activities in social formations. Emerging as it does in the wake of Deleuze's and Guattari's machinic ontology, such projects attempt to orient critical attention to questions regarding the ways in which a *multiplicity* of elements participate in producing and organizing these formations (see Escobar, 2007, for an overview). Moreover, this work typically seeks to account for the activities of actors shunted aside (and out of critical view) by a (largely euro-modern) penchant for binary thinking that neatly cleaves reality into discrete realms: the human (or the symbolic, the subjective, the cultural, the interpretive) and the nonhuman (or the material, the objective, the natural, the inert). Efforts to police the boundary between these domains are acts of what Latour (1993) calls *purification*, the effective exorcism of plants, animals, and inorganic nature from the province of human reason and politics. As the previous chapter explained, cybernetics' effective rebuke of this enduring, categorical difference

between humans and machines represents an alternative to purifying tendencies (even if cyberneticists themselves often refused to confront this implication of their work).

This chapter examines in more detail the problematic that a cybernetic comportment toward the world disclosed. It treats this problematic—agency—by locating it as part of a *problem-space*, a particular confluence of historical tendencies or forces that interlock to organize thought and action (Grossberg, 2010). Doing so affords some insight into the discursive and material conditions through which media and cultural critics might theorize information and information technologies. More specifically, then, this chapter unpacks various attempts to theorize nonhumanistic agency today. It argues that the Deleuzean/Guattarian project actually helps *situate* and *specify* each of these attempts; in this way, it presents a particular framework for addressing the problem of information today.

As previous chapters have argued, cybernetics concerns itself with the organization of complex collections of heterogeneous elements into repetitions or redundancies for the purpose of orchestrating or modulating specific actions in the present and future (for the making-more-probable of certain effectivities)—a problem-space of *agency*. This chapter begins, therefore, with an examination of certain themes that characterize this space: "control" and "governance." It then examines two approaches to this problem-space: the genealogy of Michel Foucault and the radical conjuncturalism of Lawrence Grossberg, each of which embodies a Deleuzean/Guattarian orientation toward power relations (an orientation useful for addressing the concrete ways

informatic discourses, practices, and technologies structure political possibilities today. But these approaches only gesture toward ways one might heed the cybernetic imperative to conceptualize agency beyond "the human." To explore this imperative more deeply, this chapter then turns to three contemporary theoretical attempts to account for the role of nonhumans in the organization of social formations: actor-network theory, vital materialism, and agential realism. Using the Deleuzean/Guattarian machinic ontology as a meta-model, it charts these positions and elaborates their affordances for conceiving informatic politics today. Ultimately, this chapter concludes with its own recursive maneuver when it argues that these contemporary accounts actually help clarify earlier attempts to conceive the pressing problem of organizing a contingent universe—namely, accounts from Shannon and Wiener. Revisiting the work of these figures in this way helps elucidate the respective aims and scopes of their projects and situates them more firmly in the problem-space this chapter reconstructs.

Problem-Spaces of Control

When selecting the name of his pioneering science, Wiener was keenly aware of "cybernetics" etymological inheritances. "In choosing this term," he writes, "we wish to recognize that the first significant paper on feedback mechanisms is an article on governors [...] We also wish to refer to the fact that the steering engines of a ship are indeed one of the earliest and best-developed forms of feedback mechanisms" (Wiener, 1961, pp. 11-12). Cybernetics is the science of government, the science of *steering* goal-seeking humans, animals, and machines in particular directions toward specific ends. It achieves its aims

not through procedures aimed directly at these entities themselves (procedures meant to directly restrain or inhibit individual movements) but through the organization of a field of possible alternatives, through the making-more-probable of some alternatives over others. Wiener called it the science of control.

Control, says Deleuze (1992), channeling the cyberneticists, does not operate through repression or enclosure, but through *putting in motion* an entire field of entities whose movements and coordinates might become objects of and for intervention. Control appears "ultrarapid" and "free-floating," proceeding with heretofore unrealized speed and precision while diffusing throughout the social fabric. Like Wiener, Deleuze treats the computing machine as evidence of a new historical moment—not because they somehow *cause* certain historical circumstances, he clarifies, "but because they express those social forms capable of generating them and using them" (p. 6). Here Deleuze refers to *technical* machines, the concrete, material devices germane to particular social formations. But the tendencies he and Guattari observed in the late 20th century certainly shaped their ontological imaginary about *machines in general*, an imaginary which, as the previous chapter demonstrated, emerges coextensively with developments in computerized technologies. What Wiener calls the "new machine age" is for Deleuze an emerging ensemble of relations between materials, qualities, signs, discourses, and practices with the ability to reorient lived realities: a diagram.

Recall that for Deleuze and Guattari machines synthesize reality out of the virtual by way of various *redundancies*, loopings and poolings that arrest desire and channel it in specific, calculated (if not entirely guaranteed) directions. These redundancies take several forms, perform various functions. Yet for Deleuze and Guattari, they are fundamental to the production not only of actual conditions of existence (the concrete and specific social organizations that establish possibilities for living and thriving) but also of potentials for disrupting those organizations. Their indebtedness to the cyberneticists and information theorists that preceded them is clear.

And yet Deleuze and Guattari (1987) did not speak too favorably of information theory, which they claimed "takes its point of departure from a homogeneous set of ready-made *signifying* messages that are functioning already as elements in biunivocal relationships, or the elements of which are biunivocally organized between messages" (p. 179, emphasis in original). Presumably adopting a Shannonian description of communication situations (though really reciting one more indebted to Weaver, as Guattari tended to do), the authors criticize the notion of that *set of possible messages* upon which an *act of selection* operates. As Chapter 2 explained, Weaver often described Shannon's "communication" as some transfer between two discrete minds, whereby one acts (with conscious intent) to mitigate misunderstandings by selecting for transmission appropriate symbols from a set of possible symbols. But Deleuze and Guattari underscore a troubling fact: the presence of a *set* implies some prior act of organization, some moment of selection and circumscription logically prior to the one Shannon describes. This act

establishes the set of messages (out of which the event of selection occurs) as a *set of possible messages in the first place*. Mutual knowledge of this set is therefore integral for establishing and maintaining communication between two parties (as Weaver would have it), both of which must always already share a message-space (thus, information theory's inherent "biunivocality," according to Deleuze and Guattari). "The picking of a combination depends on a certain number of *subjective* binary choices that increase proportionally to the number of elements" (p. 179) write Deleuze and Guattari, obviously describing the logic of Shannon's bits. In this way, they say, the concept of information is itself predicated on particular regimes of significance that establish quite specific parameters for the communication situations it was designed to track and measure, a regime that "carries out the prior gridding that makes it possible for the signifying elements to become discernible, and for the subjective choices to be implemented" (p. 180). In short, Deleuze and Guattari wonder how to begin thinking redundancy and the activation of potentials *outside or apart from* pre-established fields (the same problem, remember, that motivated MacKay's own empiricist concept of descriptive information). Redundancy must also be something other than the repetition of the already-established; it must be a force that *itself* instantiates, inscribes, works on, or disassembles distinctions.

Earlier in *A Thousand Plateaus*, Deleuze and Guattari experiment with this notion of a primordial redundancy, bringing it to bear on the field of linguistics through an analysis of the "order-word" (a concept meant to place speech and action more firmly on the same plane and in reciprocal presupposition). They call the relation of speech and action "a relation of *redundancy*" (p. 79,

emphasis in original); the order-word, the "relation of every word or every statement to implicit presuppositions" (p. 79) embedded in wider, pragmatic systems, is not *itself* informatic but rather *intimately related to the informational*:

The most general schema of information science posits in principle an ideal state of maximum information and makes redundancy merely a limitative condition serving to decrease this theoretical maximum in order to prevent it from being drowned out by noise. We are saying that redundancy of the order-word is instead primary [...]. (p. 79)

Emphasizing information's utter contingency (its articulation in and through broader systems of action and value) Deleuze and Guattari (1987) also underscore the role redundancy tends to play in popular accounts of mathematical information theories: mere limit-condition, a force that can do nothing but reify and oppress. American information theory makes redundancy a matter of *negation*, a force that arrests or stymies otherwise dynamic, energetic fluxes. In their view, such informational thinking already speaks the language of the powerful, one that aims to synthesize subjectivities amenable to their programs and logics. What's needed, they argue, is some notion of redundancy that exists outside the logics of identity that underpin Weaverian readings of Shannon's "communication" (where the success of a transmission is predicated on the successful duplication of content).

Their unchecked adoption of a Weaverian communication model yokes Deleuze and Guattari's critiques to a received view of information as the *content* of communication, the stuff that acts in a representational register to ensure symmetry between entities in a biunivocal relationship. It is this figure

they then choose to attack. For example, Deleuze and Guattari (1987) insist that language "is not the communication of information but something quite different: the transmission of order-words" (p. 79). Information theories, they claim, both traffic in and perpetuate regimes of *signifiance*, a certain type of circular, semiologically redundant sign-activity that tends toward the continual production of subjectivities clustered about a master signifier (p. 131-133). Construed as the stuff transferred between intentional subjects operating with and through a shared set of conventions, information is (in their view) already overcoded with social, technical, and economic order-words, for some apparatus of power has *already operated* to make it intelligible *as* that stuff. In other words, information-as-content has already been articulated through actions that place it in the service of dominant systems of meaning and, of course, power. Their concern is rather *language* that "is neither informational nor communicational" (p. 75). Language is precisely that system of order-words that can *subvert* insidious biunivocality, the force that subtends both information and communication because it is more abstract than both.

So for Deleuze and Guattari (1987), "it becomes apparent that information and communication, and even signifiance and subjectification, are subordinate to redundancy" (p. 79). As American information theorists like Shannon and Weaver had posited it, "information" addresses the problem of selecting and coding the already-organized, of orchestrating bodies and signs a more abstract system of language had already made salient and significant. This is precisely why Deleuze and Guattari viewed information theory as an instrument of power

bound up in a constellation of discourses and technical machines that reinforced it, and it is why both information theory and cybernetics became hallmarks of that emerging diagram of power Deleuze would later call "control."

For Deleuze and Guattari, mapping those diagrams that organize relations between bodies, statements, acts, signs, and practices permits concrete investigation of the relations of *power* these diagrams orchestrate and facilitate. Deleuze (1988) especially described the ways in which diagrams work to effect relations of power, that is, to make feasible (or infeasible) the exercise of certain capacities, to *establish contact* "between unformed matter [...] and unformalized functions" (p. 77) and assemble them into the institutional forms that govern everyday life. To map reality is to rediscover the circuits through which some influence over future and potential *actions* flows. It is to inhabit the cybernetic problem-space and apprehend the way a field of potential actions might be restructured, augmented, or diminished. It is to attend to the power of governance.

The Governance of Power, the Power of Governance

Speaking at the Collège de France decades after the publication of *Cybernetics*, Michel Foucault (2004) traced what he called "a bit of an inventory of this problem of government" (p. 88). The 16th century, Foucault claimed, saw increased circulation of materials addressing the problem of *governing*.

Governing stood as a new technique of rule specifically opposed to those of sovereignty, the form of power most of these political polemics identified with Machiavelli's Prince. Whereas the Prince "exists in a relationship of singularity and externality, of transcendence" to that which he rules, government involves

the *immanence* of rule, the diffusion of new techniques and technologies for the coordination and maintenance of the state from some place *internal* to the state. As Foucault puts it:

Whereas the end of sovereignty is internal to itself and gets its instruments from itself in the form of law, the end of government is internal to the things it directs; it is to be sought in perfection, maximization, or intensification of the processes it directs, and the instruments of government will become diverse tactics rather than laws. (p. 99)

From the 16th to the 18th centuries, then, the problem(-space) of government took shape. Government intervenes *in an economy of things*, in a field of relationships it attempts to control and manage. Government "arranges things" (Foucault, 2004, p. 98); it apprehends *relationships* between forces and factors and attempts to reconfigure them. Foucault explains, for example, how government takes hold of "men [sic] in their relationships with things like customs, habits, ways of acting and thinking [...] things like accidents, misfortunes, famine, epidemics, and death" (p. 96). Logics and practices of government invest in populations to coordinate specific flows of bodies in dispersed and loosely-defined fields. Perhaps without knowing it, Foucault had shown that Wiener's "new machine age" was anything but. Indeed, the techniques and technologies of concern to Wiener expressed centuries-old concerns.

In its earliest American formations, cybernetics was an intellectual project that coupled computerization with the logics and practices of government. Quite simply, it functioned as a collection of discourses and techniques of

power. Indeed, for Foucault (1978, 1983) power implies the modulation of potentials: the conduct of conduct, or *governance*. As Foucault conceived it, power is the capacity to determine capacities, to act on and modify actions, to intervene and configure the "disparate field of possibilities brought to bear upon permanent structures" (Foucault, 1983, p. 219). Power is not a possession, nor does it involve consent. Power is not a simple matter of individual actions. Rather, it "brings into play relations between individuals" and works on "an ensemble of actions which induce others and follow from one another" (p. 217). This is to say that power is not synonymous with Enlightenment agency (as an agent's relative ability to free itself from constraints and act more or less uninhibited by other agents). Power instead involves the *production* and *distribution* of "free" entities themselves.

Against Enlightenment notions of power and agency, Foucault (1978) describes power relations as "both intentional and nonsubjective" (p. 94). This is to say that they *involve* subjects but do not *emanate* from subjects: "they are imbued, through and through, with calculation" as "there is no power that is exercised without a series of aims and objectives," but "this does not mean that [power relations] result from the choice or decision of an individual subject" (p. 95). Foucault dismantles a euro-modern binary that tends to juxtapose agency and power, as if the ostensible "possession" of the latter permits an actor to immediately and transparently augment or diminish the former in itself or another. For Foucault, power and agency are *immanent* to one another; that is, power is immanent to *the very processes of organization itself*, processes that bear directly on the *differential distribution of capacities* to influence the fields

of forces that define not only what agents *can do* (for, as Foucault notes, agents still act quite intentionally) but also what they *are* (how they are made visible and legible as agents in the first place, how systems of relations articulate them as agents to begin with). Power and agency are inextricably bound; neither can somehow "precede" the other.

In theorizing power this way, Foucault (1983) occupies the same problem-space the cyberneticists do. His aim is to assess "the way in which the conduct of individuals or groups might be directed": "governance" (p. 221). Like Wiener, Foucault prefers the term because it allows him to speak of those processes by which fields of action get organized. Both are concerned with *conduct*, a "way of behaving within a more or less open field of possibilities" (pp. 220-221) that is (at the same time) the regulation of others; this is feedback by another name. What's more, both Foucault and the cyberneticists are at pains to foreground reciprocity and a notion of "freedom" that runs counter to received Enlightenment views. Recall from Chapter 2 Ashby's insistence that cybernetics' only concern was *feedback* relations, those in which agents reciprocally influence one another's potentials for effective action. Foucault (1983) might say that cybernetics concerns itself only with *freedom*: not those agents who have somehow managed to extricate themselves from power relations (for this is impossible) or those situations "where determining factors saturate the whole" (p. 221), but rather those possibilities for being-otherwise, possibilities that are themselves arrayed across fields organized to permit or delimit them. As MacKay's theory of information stressed, power is a matter of

acting on *what one can do*, what an actor *could do* or *thinks it should do* given a field of possibilities. Power works to modulate the field of possibilities; it is not simply an ability to act.

Foucault (1983) is even more specific in his description of power relations when he discusses their relationship to what he calls "relationships of communication" (p. 217), or those relations between already-subjectivated speakers and listeners, which have themselves been produced as relays of power. Communication relationships involve the exchange of messages, statements, and meanings that harness, propel, thwart, redirect, or amplify the power relations that generate them. Power relationships and relationships of communication are *themselves* always in relationship with *another* type of relation: relations determining "objective capacities" (p. 217-218), or the concrete, specific characteristics and abilities actors demonstrate as a result of their articulation to regimes of power and regimes of communication. These are not three separate domains—"on one hand the field of things, of perfected technique, work, and the transformation of the real; on the other that of signs, communication, reciprocity, and the production of meaning; finally that of the domination of the means of constraint, of inequality and the action of men upon other men [sic]" (p. 218)—but three interlocking technologies that exist to a greater or lesser extent in any social formation, where they "overlap one another, support one another reciprocally, and use each other mutually as means to an end" (p. 218). They exist always in a "block of capacity-

communication-power." Abstraction-expression-content: three machinic systems participate in "modifying the field of information between partners" and "produce effects of power" (p. 218).

As did Deleuze and Guattari, Foucault harbors an uncritical understanding of both "communication" and "information" that makes any easy conflation of his writing on power with the American cybernetic imaginary somewhat more complicated. Foucault (1983) clearly adopts a Weaverian reading of the relationship between communication and information when he describes

relationships of communication which transmit information by means of a language, a system of signs, or any other symbolic medium. No doubt communicating is always a certain way of acting upon another person or persons. But the production and circulation of elements of meaning can have as their objective or as their consequence certain results in the realm of power; the latter are not simply an aspect of the former" (p. 217)

For Foucault (like Deleuze and Guattari), information is the content of communication, the meaningful "stuff" of transmission. Power, he says, functions more fundamentally than systems of "information": it works to organize the conditions for informational transactions to occur and become intelligible as such. But cyberneticists like Wiener (as Chapter 2 explained) rejected this view of information. For them, the concept of information aligns much more closely with Foucault's relations of power, for their understanding of communication was entirely divorced from the kind of semantic "meaning" Foucault seems to think fits part and parcel with it.

Deleuze, Guattari, and Foucault elaborated the mechanisms that undergird received notions of language, address, meaning-making, and subjectivation, for they sought some alternative to the inadequate structural-semiological models their contemporaries used to address these issues. For their liking, "information" and "communication" were too tightly bound to these models; they named processes and practices that occurred *after* abstract systems of language and regimes of power had taken effect. But their critiques of information and communication occlude the fact that they were indeed chasing the same problematic as the information theorists, particularly the cyberneticists. Indeed, cybernetic communication involves *precisely* the act of modulating conduct, of acting on the present or future actions and capacities of another. It is an operation on the field of potentials that might unfold around an actor. Wiener (1954) famously used "communication" and "control" synonymously: "When I control the actions of another person, I communicate a message to him (p. 16). Foucault (1983) thinks "relationships of communication imply finalized activities (even if only the correct putting into operation of elements of meaning)" (p. 218). Deleuze and Guattari (1987) insist that language is "the transmission of the word as order-word, not the communication of a sign as information" (p. 77). But for the information theorists, information is not sign-as-content-stuff, nor is it that which traffics in the realm of finalizations. "A message," Wiener (1949b) writes, "need not be the result of a conscious human effort for the transmission of ideas" (p. 2). Indeed, as the notion of cybernetic feedback maintains, information is precisely that which belongs to the not-yet-but-will-be, the unfinalized, the open, the field.

From Epoch to Conjuncture

Foucault's is an epochal understanding of the problem Deleuze and Guattari defined. But while Wiener, too, advances a kind of epochal understanding of the cybernetic project (as product of some "new machine age"), Foucault offers a means of reading the cybernetic project *genealogically* (Foucault, 2010). His is an endeavor aimed not at uncovering cybernetics' supposed origins but rather its *conditions and points of emergence*, the statements and acts that operate in the *present* to secure the trajectory and efficacy of specific relations of power. In this way it represents one attempt to clarify the Deleuzian/Guattarian effort to map the power relations that produce the real. Lawrence Grossberg's radical conjuncturalism is another.

Radical conjuncturalism is a response to the influence of euro-modernism in critical social and cultural theory, one that, as Wiley (2005) argues (though he calls Grossberg's practice "spatial materialism"), intervenes philosophically to prevent theory and criticism from unwittingly reinforcing the very logics and tendencies they frequently set out to critique. Such tendencies include: an ontological dualism between the phenomenal and the noumenal that fosters an epistemological preoccupation with representation; a persistent textualism; a pervasive temporalism that promotes linear and causal thinking on issues of identity and change; the conflation of identity and subjectivity with agency in a politics of difference that perpetually defers positive critique; and an emphasis on "the local" as a concrete site of resistance against seemingly more abstract, oppressive power relations. Radical conjuncturalism thus equips critical social and cultural theory (particularly the project of cultural studies) to effectively

assess and subsequently intervene in the power relations shaping everyday life—to "construct itself as a response to the demands of its context" (Grossberg, 1998, p. 3). Remaining sensitive to these demands requires for Grossberg a critique of analytic concepts theorists (too often uncritically) import from euro-modern thought. Agency is one of these concepts.

Grossberg begins by rejecting the Kantian distinction between reality and representation that in so much contemporary theory has rendered agency a matter of a *speaking position* (of a subject's ability to *re-present* reality in some strategic or beneficial way). Euro-modernity construes subjects as agents who, despite an inability to access the real itself, can perhaps strategically re-signify it. In euro-modern epistemic formations, then, "individuals, defined primarily by social identities, are taken as the locus of both sovereignty and agency" (Grossberg, 2010, p. 78). For Grossberg (1992), euro-modern critique is thus a preoccupation with actors' relative abilities to "construct a correspondence between two parallel, nonintersecting planes—language and reality" (p. 48). Rather than proffer another theory of the way in which reality and its representations may (or may not) coincide, radical conjuncturalism represents an effort to problematize and ultimately recuperate *the real itself* as an object of concern in critical theory. Grossberg argues that under euro-modernism "reality" becomes nothing more than the backdrop for more dynamic representational (i.e., signifying) activities—"a transcendental whole existing outside theory and practices" (Grossberg, 1992, p. 48). Following Deleuze and Guattari, he suggests a model of reality as *becoming* ("a multiplicity of planes of effects and the ways they intersect, traverse and disrupt each other," p. 48), as

an ongoing production of positive differences that actualize particular virtualities. The task of critical theory, therefore, is to understand the ways in which various realities are constituted such that they afford certain modes of action, investment, and existence.

Radical conjuncturalism is a rebuke of anthropocentrism. Grossberg distinguishes the operations of individual agents from those of *agencies*, or what he calls (following Gramsci), "tendential forces" (Grossberg, 1992, p. 123). This distinction is not simply Grossberg's way of restaging the agent/structure dichotomy, for in radical conjuncturalism agencies "do not exist independently of or in some opposition to individuals, actors, identities, and subjects" (p. 123). Agents, "the sites of practices and struggles to control the direction and destiny" (p. 124) of a particular social formation, are inseparable from and positioned in relation to agential forces, which "map out the long-term directions and investments which have already been so deeply inscribed upon the shape of history that they seem to play themselves out in a constantly indeterminate future" (p. 123). More simply put, both agencies and agents are active, albeit in distinct but related ways. Agencies embody the ongoing struggles that define a given field of possibilities, and agents operate, "whether knowingly or unknowingly, on behalf of particular agencies" (p. 122)—though perhaps even in ways that reconfigure or redirect those agencies. For Grossberg, agential forces operate *anterior to* or *in excess of* subjectivity; they are processes that work to *define possibilities* for not only subjective experience but also for generating particular alliances and attachments that traffic outside economies of signification. And so Grossberg's particular materialism is *spatial*

insofar as it concerns ways in which social formations both organize and afford various emplacements, orientations, alignments, and movements. For Grossberg (1993), "the question of agency is how access and investment are distributed within a particular structured mobility" (p. 16)—how certain agencies have arranged spaces in ways that permit or inhibit concrete *connections* shaping what agents can do.

Again following Deleuze and Guattari, Grossberg (1992, 1996b, 2010, 2014) attributes responsibility for the production of reality to *machines*, a-subjective processes that perform the work of organizing the real. Recall that for Deleuze and Guattari reality is actualized out of the virtual (the plane of consistency) through machinic processes. Deleuze and Guattari's "virtual" is *immanent* to the actual, as both are *real*. Deleuze and Guattari (1977, 1987) offer Grossberg a conceptual vocabulary useful for tracking the various operations (the machinic syntheses) that produce social formations. Like Deleuze and Guattari, Grossberg (2010) prefers the term "machine" in order "to avoid humanistic and voluntaristic notions of agency" (p. 36) when discussing these operations. For Grossberg (again, following Deleuze and Guattari), three machines are fundamental to the production of social formations. First are abstract machines (what Grossberg prefers to call "stratifying machines") that operate on the plane of consistency to actualize virtualities and arrange them on the plane of organization as content and expression. Grossberg (2010) describes the relationship between expression and content as one between "a nonsubjective agency and a nonpassive materiality" (p. 37):

This is not simply a reinscription of the distinction between the subject and object, but rather a production of a relation between particular possibilities of acting or *agency* and particular possibilities of being acted upon (...). (p. 190, emphasis added)

Next, Grossberg attributes to *territorializing machines* the work of linking "events into relations of proximity and distance, defining distances and proximities, mobilities and stabilities" (p. 38). The result (ala Deleuze and Guattari) is the organization of *substance* of both content and expression. Producing the *form* of a given collectivity (content and expression both) is the task of *coding machines*, which for Grossberg "inscribe grids of differentiation" (p. 38) across these collectivities. This degree of specificity permits radical conjuncturalism to offer fine-grained accounts of the ways various machinic processes instantiate various operations of power. Given a particular element in a social formation, radical conjuncturalism is able to ask *how that element functions* as part of an assemblage—that is, how it has been connected to other elements in a field of forces and what it does as part of that field. Does this entity function as an abstract machine, producing stratifications of the real and aligning visibilities and articulabilities? Or does it operate within a field already diagrammed, establishing territories or coding elements that have been brought together? But as Grossberg (1992) writes: "pointing out [...] that the pieces 'fit' together [...] is not the same as defining the mode of that articulation, the nature of that fit" (p. 56).

With the aim of specifying "the nature of the fit" between elements in a given social formation, radical conjuncturalism offers another resource: *articulation*. Broadly speaking, "articulation" names a connection produced

between elements with no necessary relationship (Hall, 1985)—a connection that defines the capacities of the elements articulated—as well as the *process* of making and unmaking these connections. According to Hall (1986):

Articulation is thus the form of the connection that *can* make a unity of two different elements, under certain conditions. It is a linkage that is not necessary, determined, absolute and essential for all time. You have to ask, under what circumstances *can* a connection be forged or made? So the 'unity' of a discourse is really the articulation of different, distinct elements which can be re-articulated in different ways because they have no necessary 'belongingness' (p. 53, emphasis in original)

In this way, radical conjuncturalism offers its own response to the easy linearity of euro-modern causality. Slack (1996) suggests that "articulation can be understood as a way of characterizing a social formation without falling into the twin traps of reductionism and essentialism" (p. 113); indeed, it provides a resource for thinking agency outside personological, euro-modern models that would render agency a simple matter of human conduct or presuppose some simple homology between a structure's characteristics and its concrete effects. The notion of articulation emphasizes the fact that *no set of determinations is ever guaranteed*; rather, it stresses the *nature* and *form* of linkages between heterogeneous elements that define the elements' specific capacities as they have been organized in a given social formation. Agency, then, involves making and unmaking the connections that define an entity's capacities. Put another way, agency refers to an entity's ability to perform (dis)articulatory work—to align various resources in useful and advantageous ways, or, as Grossberg (1992) writes, "to reposition practices within a shifting field of forces, to redefine the possibilities of life by redefining the field of relations" (p. 54).

This is the fundamental unit of analysis for the spatial materialist: *practices*. A practice is a "mode by which effects are produced and reality transformed" (Grossberg, 1992, p. 51). Like cybernetic black-boxes, *behaviors* and *effects* mark practices: they are what they *do* in the complex fields of which they are a part. Grossberg echoes a now-familiar cybernetic theme when he asserts that the *internal properties* of a practice guarantee nothing about *how* it operates: "Its origin, whether biographical (in the intentions of the actor) or social (in the economic relations of its existence) is, to a large extent, irrelevant" (p. 51). For Grossberg, "practice" reflects a sense of *action*, the *dynamism* and *unpredictability* inherent in a field of articulated forces, so that

what is important [...] is what practices are available, how they are deployed or taken up and how they transform the world. It is not merely a question of what, in any instance, people do in fact do, but of the possibilities available to them: of the means available for transforming reality, as well as those actually taken up. (p. 51)

Practices are not exclusive to humans, but are composed of entire regimes of bodies, actions, knowledges, techniques, affects, and signs coordinated in ways that produce effects. But as Grossberg suggests, these effects *are also of a field*; the effect of a cause is always its influence on an arrangement of force-relations (a "context," for Grossberg). Effects affect the distributions of elements that define possibilities. Indeed, as Grossberg indicates, *agency* is this very capacity to induce transformation, to alter the various articulations that determine the concrete specificity (and therefore the function) of an entity.

The foregoing explanation of Grossberg's machinism now permits a more nuanced discussion of radical conjuncturalism's particular understanding of agency. Wiley (2005) notes that in radical conjuncturalism "agency" is a complicated affair, if only because it operates in several distinct but interrelated modes. Grossberg (2014) has also acknowledged agency's multi-dimensionality, suggesting that the term applies differently with regard to the specific functionality of a machinic ensemble. Practices that stratify the real through a connective synthesis are agential enactments different from those that perform the organizational work of coding or territorializing the distributions such stratifications constitute, or what Grossberg calls the work of creating "rhythms and repetitions, places and spaces" (p. 24). These agential practices are different still from the work of organizing differential access to these locations ("inserting people into maps and empowering them with access to virtual capacities"), *and* those practices involved in *actualizing* "capacities available at particular sites" (p. 24).

The *machinic* nature of agency (as the practice of articulating or dis-articulating other practices) necessitates speaking of agency in a variety of registers. In this way, Grossberg can describe agency as "the product of diagrams of mobility and placement which define or map the possibilities of where and how specific vectors of influence can stop and be placed" (1996a, p. 102), "how access and investment are distributed within a particular structured mobility" (1993, p. 16), "particular sites of activity and power" (1996a, p. 99), "the articulations of subject positions into specific places (sites of investment) and spaces (fields of activity)" (1993, p. 15), and "the empowerment enabled at

particular sites and along particular vectors" (1993, p. 15)—all without contradiction, for "agency" is germane to machinic practices at various sites and scales, and acquires different effectivity when glimpsed from the perspective of either agents or agencies. Ultimately, for Grossberg (1992), "there can be no universal theory of agency" because "agency can only be described in its contextual enactments" (p. 123). Agency exists only "in the differential and competing relations among historical forces at play" (p. 123)—forces radical conjuncturalism seeks to track.

Radical conjuncturalism pries apart one-dimensional renderings of both agency and assemblage in order to specify the complex dynamics of any confederation. It draws attention to the bi-planar nature of assemblages (which are always already both machinic and enunciative) and offers tools for assessing the effectivity of various machinic operations. By incorporating the Deleuzeo-Guattarian language of "coding" and "territorializing" machines, radical conjuncturalism is able to provide nuanced and precise accounts of the ways actors function in and against their respective fields.

Grossberg expresses concern for the ways in which particular actors seem to operate autonomously (to achieve effects without, against, or in spite of the interrelations that in fact make their actions possible). This is a concern, in other words, for what Grossberg (2010) calls "embedded disembeddedness," a state in which an actor seems to gain some autonomy from its context, even while "the form of its embeddedness defines it as disembedded" (p. 92). Grossberg deploys the term in an analysis of the way various domains (the economic, the political, the cultural, etc.) seems to act relatively autonomously

from one another in a given social totality; nevertheless, it serves as a useful heuristic for discussing articulations among *agents* and *agencies*. One might conceive the latter, Grossberg's (1992) "tendential forces" (p. 123), as akin to *abstract machines*, those diagrams that organize fields of visibilities and articulabilities. Agents (for Grossberg, the locus of "practices and struggles to control the direction and destiny" of a social formation [p. 124]) are the assemblages that occupy more squarely various positions on a plane of organization. Agencies and agents are of course in a constant state of reciprocal presupposition, but the *manners* in which they are reciprocally influential become critical objects of inquiry. Examining a given assemblage or practice's machinic function is simply not sufficient to provide adequate insight into the nature of a given artifact, project, or formation; only mapping the crosscutting articulations *between* machines can yield such insight. If a particular actor might seem to act autonomously (that is, *disembedded* from a field of forces), then the question of its effectivity is not simply "*What can this machine do?*" but "*How is this machine capable of producing this effect?*" As Grossberg (2010) puts it:

How is something relationally produced as autonomous, without thereby giving up its relationality? How can something be produced as self-producing? How can something be regulated in ways that continuously producing it as self-regulating? (p. 92)

Using language that is more than vaguely cybernetic, Grossberg here stresses that *effective action* is always *embedded in* (and *indebted to*) a *field*. An actor's agency—its ability to influence the conditions that articulate to

govern or regulate its relative capacities—is always already a matter of the "fit" constituted between locations in a diagram, resources those diagrams make available, and the practices that mobilize them (a "fit" that indeed defines the entities fitted together). Machinic activities (machinic *practices*) are never as straightforward or transparent as their attendant narratives tend to make them seem. Radical conjuncturalism firmly foregrounds this principle, offering a useful corrective for the more naive or celebratory accounts of agency that tend to populate descriptions of informatic systems leaning heavily on forms of social or technological determinism.

In addition to articulation, radical conjuncturalism's antidote to determinism includes the notion of conjuncture; indeed, this is Grossberg's preferred conceptual lens for comprehending social formations' complexities. Drawn from Marxist political analysis, "conjuncture" names a certain articulation of forces co-constituting a field (or *terrain*) that affords various opportunities for political action. As Grossberg (2010) insists, however, "a conjuncture is not defined a priori by location, territory, or diagram," but is rather "characterized by an articulation, accumulation, and condensation of contradictions, a fusion of different currents or circumstances" (p. 40). Thinking conjuncturally about relations of power helps critical social and cultural theory avoid strict determinisms that would locate the "causes" of certain circumstances in some singular actor. Instead, Grossberg's conjuncturalism underscores the complex and crosscut nature of a given social formation, the "origins" of which cannot be reduced to something like the nation-state (Grossberg, 2010, p. 42). Instead, conjunctural thinking expresses radical

conjuncturalism's particular approach to issues emerging from a cybernetic problem-space: the construction and maintenance of stable unities out of a heterogeneous multiplicity, out of some more-or-less predictable flux. For Grossberg (following Antonio Gramsci and Stuart Hall), conjunctures are *temporary and provisional settlements* in a complex field of forces, contingent balances always requiring maintenance. "A conjuncture," writes Grossberg (2010), "must always be seen as the result of a complex and fragile set of articulations, which requires various labors to maintain its ever-changing shape and density" (p. 42). More than purely historical or epochal, Grossberg's conjuncturalism is another attempt to mobilize Deleuze and Guattari's critical project of mapping social relations.

Because radical conjuncturalism embraces as many theories of agency as are necessary for describing machinic functions of agents and agencies at any level of abstraction, it offers an analytic useful for disentangling and mapping the formations in which information and information technologies tend to traffic (and which they articulate). Yet without a thoroughgoing schematization of agency's multiple modalities, radical conjuncturalism cannot offer researchers more than a methodological imperative (indeed, its commitment to radical contextualism demands this). The theory appears less a readymade set of descriptions awaiting application to a wide range of issues and more a *spirit of investigation* that might guide analysis of information technologies and other entities whose practices constitute contexts. In contemporary critical social and cultural theory, additional theoretical projects have attempted to accomplish this.

From Model to Meta-Model

Both Foucault's and Grossberg's projects represent the concretization or crystallization of Deleuze and Guattari's ontology in epochal and conjunctural modes, respectively, but neither offers a *specific* theory of agency appropriate to the task of mapping the relations between human and nonhuman actors in and across various social formations (the former does not so much address "agency" as he does "power/knowledge" and the latter is more concerned with the way *agency in general* might be conceived as a function of various machines).

Recently, however, contemporary critical social and cultural theory has witnessed the propagation of many such theories, each of which represents a post-Deleuze/Guattarian attempt at theorizing the agency of the nonhuman. These approaches tend to reflect early cybernetic proclivities: a rejection of *a priori* ontological distinctions between human and nonhuman actors; a focus on complexity; an emphasis on actors' *behaviors* and *capacities* as indicators of their nature and function; and a refusal to disembed single actors from the fields of actions and forces that constitute those actors. And while these contemporary accounts might at first blush appear divergent and contradictory, one might argue that their differences are indeed a result of their tendency to stress various elements of the Deleuzian/Guattarian schema (itself an outgrowth of cybernetic thinking, as the previous chapter explained). For this reason, then, the conceptual cartography Deleuze and Guattari proffer as part of their machinic ontology can become something of a *meta-model* for contemporary critical social and cultural theory that takes seriously the role of

nonhuman actors in the articulation of social formations (for more on the specific function of meta-modeling, particularly in the work of Guattari, see Watson, 2009). A brief examination of three such theories—Bruno Latour's actor-network theory, Jane Bennett's vital materialism, and Karen Barad's agential realism—demonstrates how this is the case. This chapter then concludes by assessing the particular figures of agency each position articulates.

Actor-Network Theory

Bruno Latour founds his critique of euro-modernity (and his concomitant rebuke of the metaphysical rift between humans and nonhumans) on the principle of irreduction. "Nothing," he writes, "is, by itself, either reducible or irreducible to anything else" (Latour, 1998a, p. 158). This seemingly paradoxical statement expresses Latour's insistence that no social actor (or *actant*, to use Latour's preferred term) can be automatically explained by another. For him, *no actant is necessarily* determined by another actant; however, *any actant can be made* to associate with another actant through appropriate efforts. And, in light of this radical contingency, such efforts define worlds.

Neither human nor nonhuman, an actant is a *singular unit of action*, simply that which *accomplishes something* in relation *to* and *with* other actants. For Latour, an actant is *inseparable* from these relations, which completely determine the actant in its concrete and unrepeatable specificity. An actant *is* what it *does* to, with, against, atop, and in coordination with other actants. Apart from these relations, it cannot exist. As Harman (2009) writes, actants are "always completely deployed in their relations with the world, and the more

they are cut off from these relations, the less real they become" (p. 19). Latour has another name for actants (one by now familiar to anyone interested in cybernetics), these bundles of action-relation that are inseparable from the work they perform. He calls them black boxes.

Like a cyberneticist, Latour (1987; 1991; 2005) emphasizes an actant's *actions*. An actant *is* what it *does*, what it performs or accomplishes. It possesses no enduring interiority or stable set of properties that might define in advance how it operates or how it relates to other actants. Harman (2009) sounds like Ashby when he writes that with Latour's actants, "the internal properties of a black box do not count as long as we are concerned only with its input and output" (p. 33). In fact, Latour's black box is precisely that which *purports* to possess some immutable character as a result of the particular relations it manages to build and sustain. For this is a critical feature of life as an actant: the ability to form a *network* of relations. Actants engage one another in what Latour (1988b) calls "trials of strength," engagements in which actants attempt to recruit and enroll one another in their (immanent) projects and programs, growing stronger (more real) as they do. Actant-collectivities feature "spokespersons," or "some people defining who they are, what they should be, what they have been" (Latour, 2005, p. 31). All actants jockey to prolong their existence, to exert their durability in the world through their trials of strength, the success or failure of which depends on an actant's ability to effectively mask (to *black box*) the ongoing work of sustaining the fragile relations that make it possible. "If you still believe groupings exist 'by

themselves,' writes Latour (2005), "for instance the 'individual,' just try to remember how much labor had to be done before each of you could 'take your life into your own hands'" (p. 32).

Latour (1987) calls every black-box actant "a machination, a strategem, a kind of cunning" (p. 129) that organizes and mobilizes actors with no necessary connection to one another. This process requires constant negotiation. And it is *controversial* (Latour, 2005). Some actants are more easily enrolled into networks than others. Some break away at inopportune times. Still others attempt to redefine the aim, direction, and scope of the network. In short, Latour's actants always *mediate* one another through complex processes of *translation*, the work of *forging associations* that link actants in particular contingent relationships. Mediation involves forming and managing these relationships, arranging fields of action (or "bending space"), establishing dependencies between and among actants, and enforcing particular forms or grammars of action across these heterogeneous groupings (Callon & Latour, 1981).

If actions define actants, then these actions are not the straightforward, transparent, or linear actions of euro-modern causality. For Latour (2005), "action is not done under the full control of consciousness; action should rather be felt as a node, a knot, and a conglomerate of many surprising sets of agencies that have to be slowly disentangled" (p. 44). In other words, action is *dislocated* from its more traditional locus in the singular, intentional subject and instead "borrowed, distributed, suggested, influenced, dominated, betrayed, translated" (p. 46) between and among actants striving to exert some influence

in a network. "Action" names something pertinent to a *state of affairs*, not a property of a body; an actor is "the moving target of a vast array of entities swarming around it" (p. 46). As Sayes (2014) puts it, Latour's actor-network theory insists that "an uncertainty concerning just what it is that is acting must be implemented at the same time as one introduces uncertainty concerning just what action is" (p. 141). As it was for early cyberneticists like Wiener, action is for Latour multi-directional and reciprocal.

Latour's (2005) attempt to refashion action outside the epistemological confines of euro-modernity is a contribution to what he calls "about the most difficult problem there is in philosophy" (p. 51): agency. If actants are defined precisely by their relations, and these relations are the mechanisms by which multidirectional actions are disbursed across networks, then "agency" cannot resemble some kind of free will (action uninhibited by the influence of others), even if an actant attempts to *make it seem so* as a way of justifying its own capacity to differentially influence a particular set of relationships (i.e., when an actant masks the relations that define it in order to assert that its power is the result of some force outside those relations). Indeed, for Latour agency is always *controversial* because it involves an actant's ability to downplay its reliance on a complicated and contingent set of relations (to naturalize or presuppose these as something stable and reliable). But actants do not *possess* agency, as if an actant could acquire more or less agency by virtue of its status as *this* or *that* type of actant. Agency is rather wholly relational, something *distributed* across an entire network of associations between actants with disproportionate abilities to influence those associations. *This* is "agency" for

Latour: the ability to make a difference in and to the set of relations that organize the multilinear directionality and effectivity of actions. Matters of agency are therefore irreducible to explanations predicated on a single source or target (e.g., a human and its intentional actions). Understanding the specificity of particular social formations—how certain collectivities of actants have come together, in what ways, and with what effects—means locating the traces of the complex and variegated actions actants perform to maintain their ties, stake their positions, and discredit or disassemble others.

Vital Materialism

Jane Bennett's vital materialism is a project both ontological and ethico-political. In its ontological mode, vital materialism seeks ways of investigating and expressing *thing-power*, "the curious ability of inanimate things to animate, to act, to produce effects dramatic and subtle" (Bennett, 2010, p. 6), while acknowledging that nonhuman "things" always exceed human capacity to represent them (let alone completely comprehend them). Like actor-network theory, vital materialism refuses the euro-modern hierarchy between human and nonhuman animals, plants, and minerals, and instead "draws attention to an efficacy of objects in excess of the human meanings, designs, or purposes they express or serve" (p. 20). For Bennett, nonhuman *things* are not inert materials to be overcome, oppressive structures to be subverted, available resources to be consumed, or stable backgrounds of contextual variables to be controlled; they are lively and forceful actors participating in the construction and organization of material realities.

As an ethico-political project, vital materialism aims "to encourage more intelligent and sustainable engagements with vibrant matter and lively things" (p. viii). Bennett seeks a way of accounting for the way these "lively things" participate in the distribution, modulation, and regulation of power relations that enable or constrain forms of life (modes of being or flourishing). Expressing frustration with a humanist bias running through contemporary politics, Bennett suggests that attention to the thing-power of nonhuman actants might radically reframe contemporary notions of action, power, responsibility, and agency (see also Bennett, 2004). "A lot happens to the concept of agency once nonhuman things are figured less as social constructions and more as actors and once humans themselves are assessed not as autonyms but as vital materialities" (p. 21). Thing-power enlivens our understanding of the nonhuman and tempers our bias for the human.

But thing-power is not somehow exclusive to nonhuman actants; Bennett (2010) does not simply invert the euro-modern balance of agential privilege. Thing-power pertains instead to a broader manifold that subtends and gives shape to *both* humans *and* nonhumans. "Human power is itself a *kind* of thing-power" (p. 10, emphasis added), and Bennett's vital materialism explores the possibility of this *singular force* animating the ongoing relations between bodies that figure from a self-same process of unfolding materiality. It

affirms a figure of matter as an active principle, and a universe of this lively materiality that is always in various states of congealment and diffusion, materialities that are active and creative without needing to be experienced or conceived as partaking in divinity or purposiveness. (p. 93)

Thing-power is without recourse to a transcendent animating term; the power of things is indeed their own, immanent liveliness. Indeed, Bennett theorizes and embraces a force *immanent* to matter itself—the force *of* matter, in its infinite variability. Here Bennett (2010) clearly owes a debt to another philosopher of thing-power: Spinoza (1996), who, in his *Ethics*, elaborated precisely that singular force-material from which all beings—human and nonhuman like—figure. Spinoza called it either "God" or "Nature," as either would suffice to name the single, infinite, and eternal substance conceived only in and through itself. For Spinoza, every body is a modification, a *mode*, of this substance's infinite attributes, and every body is itself *composite*, a collectivity of other bodies composed from the same, singular, eternal stuff. Bodies are bodies of bodies, which are themselves bodies of even more bodies. Yet while any body is in fact a *collectivity* of others, it cannot be *reduced* to its constituent parts; it cannot be explained as the mere result of some specific combination of elements that are purportedly more fundamental. Composite bodies are therefore *collective singularities*. And all bodies both *affect* and are *affected by* other bodies in ways that modify their abilities. In doing so, they augment or diminish something central to Bennett's theory of thing-power: their ability to *persist in being* and *maximize the power of* the very singular body-collectives they are.

Spinoza explains that bodies enter into relations with other bodies that are in some cases detrimental to their ability to remain coherently associated. Forceful enough, such encounters can destroy a body-collective by diffusing the bodies that compose it. But bodies can also relate to other bodies in ways that

enhance their coherence. Such encounters can *augment* their ability to remain productively associated. Spinoza argues that bodies do not enter into relations in accordance with some pre-established criteria (for such criteria would therefore somehow transcend God or Nature, an impossibility for Spinoza). Instead, Spinoza (1996) says, bodies enter into relations with other bodies simply because these relations might enable them to endure. This enduring, this striving to persist as a concrete mode of God's infinite being, is for Spinoza the essence of a(ny) thing: "Each thing," he writes, "as far as it can by its own power, strives to persevere in its being. [...] The striving by which each thing strives to persevere in its being is nothing but the actual essence of the thing" (p. 75). Spinoza called this striving the *conatus*: a desire, immanent to all things (because it is the *essence* of all things), to persist and become (in Spinoza's terms) more perfect. For Bennett, *conatus* names the thing-power of the thing, the force of its ability to actively and continuously exist.

Emphasizing a particular collectivity's *conatus* is Bennett's way of accounting for a kind of nonhuman or asubjective *will* that might account for an aggregate body's durability and persistence despite its heterogeneous makeup. Leveraging the Spinozan *conatus*, then, Bennett (2010) can begin to outline vital materialism's implications for traditional notions of agency, vitality, life, and politics. "If we do not know just how it is that human agency operates," she asks, "how can we be so sure that the processes through which nonhumans make their mark are qualitatively different?" (p. 34). Arguing once more for the universality of thing-power, Bennett suggests a rethinking of agency as *collective*, "distributed across an ontologically heterogeneous field" (p. 23) of

bodies. Vital materialism's agency is a "confederate agency of many striving macro- and microactants" (p. 23) affecting other actants and being affected by them in turn. In line with Deleuze and Guattari, Bennett calls these confederations *assemblages*, "ad hoc groupings of diverse elements, of vibrant materials of all sorts [...] living, throbbing, confederations that are able to function despite the persistent presence of energies that confound them from within" (pp. 23-24). Assemblages are collective and conative bodies, and for Bennett each "owes its agentic capacity to the vitality of the materialities that constitute it" (p. 34). Thinking body-collectives as assemblages allows Bennett to stress that they are defined neither by some essential or invariant set of properties, nor by those of their component parts. Rather, assemblages acquire their particular character *as a consequence of their connection with other assemblages*: the connections an assemblage *does* or *does not* make with other bodies are precisely that which give an assemblage its identity, which *enable its persistence*. Like a cybernetic black box, an assemblage *is* what it *can do*, or how it draws together, stakes out, organizes, mobilizes, and distributes the capacities of the elements it assembles. The hallmark of an assemblage is what it makes possible; *agencement* is the ongoing modification of a potential for action.

Describing the *agency of an assemblage*, Bennett therefore suggests rethinking three terms typically associated with the concept of agency: *efficacy*, *trajectory*, and *causality*. An assemblage's *efficacy* refers to its "creativity," its "capacity to make something new appear or occur" and to "make a difference that calls for response" (pp. 31-32), something like the Latourian notion of

agency. Additionally, while an assemblage does not adhere to a preordained *telos*, it does mark some *trajectory*, "a directionality or movement *away* from somewhere even if the toward-which it moves is obscure or even absent" (p. 32). Here Bennett's Spinozan influence again distances her from the cybernetic definition of teleology: the purpose or *goal* of an agent's striving is an increase in its perfection. Finally, an assemblage effects multilinear determinations characterized by its particular *causality*, which emerges from within it and cannot be predicted or completely controlled by it. Assemblages have *uneven topographies*; unlike actor-network theory, which seems to presuppose a particular spatial imaginary (the network), vital materialism insists that an assemblage's particular configuration differentially distributes capabilities to *influence* that assemblage. Bennett's discussion of an assemblage's agency augments the Latourian notion that agency is simply *distributed* by focusing on the *effects, consequences* and *directionalities* of those distributions. As Wise (1997) indicates, Latour's agential vocabulary "is far too passive and (shall we say) disinterested to adequately describe the actual process" (p. 34). Bennett, on the other hand, draws attention to the particular *character* and *consequences* of a given arrangement in search of a thing-power that both subtends and supersedes the human. In her vital materialism, cybernetic *behavior, purpose, and will* operate in new registers.

Agential Realism

Karen Barad's (2007) agential realism finds inspiration in the "philosophy-physics" of Niels Bohr, whose work in quantum physics (specifically his notion that atoms were not as stable, discrete, bounded, or determinate as once

thought) "not only revolutionized physics but shook the very foundation of Western epistemology" (p. 97) by challenging both Cartesianism and Newtonianism. Bohr offers Barad an alternative to the "representationalist triadic structure of words, knowers, and things" (p. 97) so prevalent in various social constructionisms that subordinate "matter" to ostensibly more dynamic forces (like "language" or "culture"; see also Barad, 2003). Instead, Barad is "interested in understanding the epistemological and ontological issues that quantum physics forces us to confront, such as the conditions of possibility for objectivity, the nature of measurement, the nature of nature and meaning making, and the relationship between discursive practices and the material world" (p. 24). Barad's interest, in other words, is *mattering*. She adumbrates a radically realist ontology's consequences for the way one might conceive agency.

Agential realism's fundamental unit is neither the actant nor the assemblage but the *phenomenon*. Barad notes that Bohr (unlike his Newtonian contemporaries) refused the Kantianism that distinguishes between objects of observation and agencies of observation that come to bear on them. For both Bohr and Barad, phenomena are not re-presentations of the world for a subject somehow able to stand apart from it, but the very entanglement of observer and observed in a primordial relationality that precedes them both: "ontologically primitive relations [...] without preexisting relata" (p. 139). For agential realism, then, "the primary ontological units are not 'things' but phenomena, dynamic

topological reconfigurings / entanglements / relationalities / (re)articulations of the world" (p. 141) itself, not mediations *of* that world that something existing *outside* the world manages to produce.

Phenomena, then, arise not from the *interaction* of distantiated knower and known, but through what Barad calls *intra-actions* that in fact *produce* these two entities. "Intra-action" names for Barad "*the mutual constitution of objects and agencies of observation within phenomena*" (p. 197, emphasis in original); it is the event-process that determines the boundaries and properties of phenomena, that enacts a *cut* constitutive of subject and object. The power to effect intra-active cuts resides with *apparatuses*, which Barad describes as "*the material conditions of possibility and impossibility of mattering*" (p. 148, emphasis in original). They are "*boundary drawing practices*" (p. 206, emphasis in original) that "enact what matters and what is excluded from mattering" (p. 148). For Barad, "mattering" means both "becoming significant," demanding attention and/or response, as well as "materializing." And critically for Barad, apparatuses are *not* subjects; they are the processes through which subjects and objects are produced and sorted *in the first place*. She writes:

Apparatuses are not merely about us. And they are not merely assemblages that include nonhumans as well as humans. Rather, apparatuses are specific material reconfigurings of the world that do not merely emerge in time but iteratively reconfigure spacetime-matter as part of the ongoing dynamism of becoming. (p. 142)

Via Foucault, Barad argues that apparatuses facilitate power-relations not by *representing* the world in particular ways, but through the *differential applications of force* that constitute particular intra-active matterings. For

instance, Barad suggests that fetal imaging apparatuses do not merely *represent* the fetus, but rather *constitute* the *phenomenon* of the fetus, which cannot exist outside regimes of material and discursive intra-actions (e.g., among what Latour might call a *network* of medical discourses, piezoelectric crystals, cathode rays or LCD screens, juridical imperatives, etc.). In this way, prenatal imaging technologies *produce* the fetus-as-phenomenon and ascribe certain subjective qualities to it (see also Casper, 1994; Stormer, 2010). Apparatuses effect intra-actions not by "detect[ing] difference that are already in place; rather they contribute to the production and reconfiguration of difference" (p. 232) between humans and nonhumans, between culture and nature. Barad hopes her agential realism might espouse some sensitivity to (and accountability for) the ways certain material and discursive practices enact those cuts that open or foreclose opportunities for "mattering" as intra-actions differentially constitute phenomena that figure from the self-same stuff of the world through a singular, dynamic process of ongoing (re)configuration. "This dynamism," Barad writes, "is agency" (p. 141, emphasis in original).

Agency for Barad is neither a possession nor an attribute but "an enactment" (p. 214). Agency cannot be the property of either a human or a nonhuman (as agential intra-actions are what produces them both). It is the performativity of all that is: "The universe is agential intra-activity in its becoming" (p. 141). Agential realism conceives agency as an "ongoing flow [...] through which part of the world makes itself differentially intelligible to another part of the world" (p. 140); for Barad "the ongoing ebb and flow of agency" (p. 140) discloses something about the way that multiple modes of being might be

produced and enacted—but not because agency is counterposed with structure (as the ability to generate difference despite oppression). Barad's agential realism "does not take sides in the traditional debates between determinism and free will but rather poses an altogether different way of thinking about temporality, spatiality, and possibility" (p. 177), for agency is that through which "causal structures are stabilized and destabilized" (p. 140)—not the way agents might overcome the limits of space and time (see Brophy, 2010, on intra-activity and cyberutopia) but "the making of spacetime itself" (p. 140). Space, time, and matter are not the external limits to iterative becoming (the "structures" for an otherwise free play of movement), but are in fact produced by those becomings. Likewise, causality is neither an issue of strict determinism or free will, but the enactment of exclusions produced intra-actively, exclusions that condition possibilities for action. In an emphatic summary statement, Barad argues:

Agency is 'doing' or 'being' in its intra-activity. It is the enactment of iterative changes to particular practices—iterative reconfigurings of topological manifolds of spacetime-matter relations—through the dynamics of intra-activity. Agency is about changing possibilities of change entailed in reconfiguring material-discursive apparatuses of bodily production, including the boundary articulations and exclusions that are marked by those practices in the enactment of a causal structure (p. 178, emphasis in original)

Elsewhere, Barad calls matter *congealed agency* (p. 151; see also Colls, 2007), but not because agency is a force ontologically *separate* from matter. In line with Bennett (2010), Barad insists that "there is a vitality to the liveliness of intra-activity, not in the sense of a new form of vitalism, but rather in terms of a new sense of aliveness" (p. 177). She celebrates "the world's effervescence,

its exuberant creativeness," which "can never be contained or suspended" because "agency never ends; it can never 'run out'" (p. 177). But unlike Bennett, Barad does not locate agency *in* or *of* the assemblage; again, her apparatuses "are not merely assemblages" (p. 142) because assemblages already consist of bodies and relations produced and sorted according to agential intra-actions ontologically anterior to them. Similarly, Barad is at odds with Latour's actor-network theory because in agential realism agency is neither "restricted to the possibilities for human action" nor "is it simply the case that agency should be granted to nonhumans as well as humans, or that agency can be distributed over nonhuman and human forms" (p. 178). For Barad, "what is at issue [...] are the possibilities for the iterative reconfiguring of the materiality of the human, nonhuman, cyborgian, and other such forms" (p. 178). Agency is instead about the production of realities through the making of cuts—and "cuts are agentially enacted not by willful individuals, but by the larger material arrangement of which 'we' are a 'part'" (p. 178). For Barad, "the world is an open process of mattering through which mattering itself acquires meaning and form through the realization of differential agential possibilities" (p. 141). While she appreciates Butler's understanding of mattering as *materialization*, Barad pushes the concept further to describe "matter as an active 'agent' in its ongoing materialization" (p. 151) outside a locus in (human) bodily practices. For Barad, matter's materialization is always already influenced by specific apparatuses, which "*are the material conditions of*

possibility and impossibility of mattering" (p. 148, emphasis in original). Agency is a matter of mattering, the ongoing production of arrangements that determine what matters and what doesn't.

Charting Ontologies (Three Agential Territories)

Actor-network theory, vital materialism, and agential realism each offer critical social and cultural theory an account of agency dislocated from a locus in the individual actor (human or otherwise). Each of these accounts (as well as each's respective theory of agency) draws on resources particular to certain "regions" or "moments" in the Deleuzeo-Guattarian ontological meta-model. Charting these theories via this meta-model clarifies the aim and scope of their respective projects. Doing so is particularly important insofar as each represents a viable resource for analyzing the effectivity of information and information technologies today.

Actor-Network Theory

Actor-network theory offers a compelling and sophisticated theoretical vocabulary for discussing (in great detail) the regimes and enrollments individual black-box actants might initiate, sustain, or subvert as they shape particular social formations, and its dedication to tracking (again, in great detail) the effects of human and nonhuman actions does impose a welcome degree of rigor on such discussions.

However, actor-network theory situates its analyses firmly in the realm of the actual (that is, *on the plane of organization*) and therefore struggles to account for actants that might well lie *outside* a particular networked set of

relations—for only that which is networked can play a role in organizing the social. In his later work (see, e.g., Latour, 2005), Latour invents the concept of "plasma" to account for "*what is in between* the meshes of [...] circuitry" (p. 242, emphasis in original). Plasma is "that which is not formatted, not yet measured [...] not yet covered, surveyed, mobilized, or subjectified" (p. 244); it is a "reserve [...] for every formatted, localized, continuous, accountable action to be carried out in" (p. 245). Latour thus distinguishes between two qualitatively different *types* of material: the *active* actual (formatted and networked) and the *passive* potential (the reserve in which steeps more interesting and dynamic activity). Latour conceives a *binary relationality*: for him, an actant is seemingly *either* connected and actualized via trials of strength *or* disconnected and relegated to the reserve. With regard to the Deleauzean meta-model, one might say Latourian analysis *prefers the plane of organization*. More specifically, acts of inclusive connection are relatively *unproblematic* for Latour (because enrollment into networks is *always* occurring in the Latourian imaginary), so territorializing operations concern him *less* than the *coding* functions of actants capable of speaking on behalf of (and therefore characterizing) the collections of actions that constitute an actor. Actor-network theory is primarily a theory of coding machines.

Latour offers little explanation of the way in which the "unformatted" gets "formatted" into specific actor-networks (the way potentials get actualized). In this way, actor-network theory's preoccupation with the actual blinds it to the diagrammatic (stratifying) activities that produce and organize collectivities or populations (like "human" and "nonhuman") in a social formation. Moreover, by

distributing agency so widely across a social field, Latour risks deproblematizing it. Slack and Wise (2005) argue, for example, that actor-network theory "tends to treat agency as if it were somehow universally available" (p. 123). The authors suggest that "the approach does not foreground variations in the availability of agency or the role of power in the construction and stabilization of networks" (p. 123). Latour tends to conflate *action* and *enrollment* with *agency itself* when he eliminates euro-modernity's nature/culture divide; agency is for him a matter of *stabilization* on the plane of organization, and he glimpses it in any location actors refuse to remain at rest—that is to say, everywhere.

Vital Materialism

Vital materialism demonstrates a now-familiar penchant for charting the fields of possibility a particular social formation may afford, and Bennett (2010) expresses a desire to "rewrite the default grammar of agency," for it is "a grammar that assigns activity to people and passivity to things" (p. 119). Of chief concern for vital materialists, then, are the ways in which concrete organizations of actors espouse, affirm, enforce, or disrupt arrangements that secure certain asymmetries of ability to influence those very organizations.

By attributing agency to *assemblages*, Bennett situates analysis squarely on the plane of organization (and is in this way akin to Latour). Bennett's actants (that is, her assemblages) are confederations of *already-stratified* materials, although because she leans on Deleuze and Guattari's process ontology (not to mention a strikingly Wienerian cosmological imaginary), she is able to claim that "all bodies are [...] but temporary congealments of a

materiality that is a process of becoming, is hustle and flow punctuated by sedimentation and substance" (p. 49). This is, after all, how Bennett's materialism is a *vital* one; matter *itself* contorts in conjunction with the bodily activities that shape it. Nevertheless, Bennett attends principally to "conative" actors' capacities for efficacy, trajectory, and causality—properties discernable only on the plane of the already-organized. By specifying these dimensions of agential activity, Bennett seems to seek some explanation of *potential actions* actors may perform, the multiple functions they may enact. In this way, then, vital materialism stands to offer *more specific accounts* of agential activities in particular social formations. While actor-network theory attends primarily to the particular *coding* functions actants might enact (i.e., their relative abilities to characterize the function or effects of certain connections), vital materialism is concerned foremost with the *territorializing* operations of assemblages; Bennett's conative assemblages gather "tone" and "energy" (p. 35) through precisely what they *draw together*.

But while she borrows much from Deleuze and Guattari, Bennett curiously neglects the philosophers' distinction between the *machinic assemblage* and the *collective assemblage of enunciation*, the twin, irreducible, and reciprocally presupposing dimensions of any assemblage. Recall that for Deleuze and Guattari analysis of an assemblage and its effectivities involves deciphering precisely *which* of those bodies gathered into the assemblage have been consigned the ability to *act* and which have been attributed the capacity to be *acted upon*. The machinic assemblage (that *pragmatic* system) and the collective assemblage of enunciation (that *semiotic* system) respectively name

collections of bodies with differentially-distributed capacities for *influence*. Bennett's expressed desire to discover the source of such differential distributions makes her decision to omit this useful analytic distinction even more perplexing. Critical studies of information and information technologies might benefit from this distinction, however, as "information" might operate differently as part of different contexts, ensembles, and discursive regimes. As previous chapters have demonstrated, for example, some actors tend to construe information as an *object*, some-thing on which otherwise more "active" subjects operate. Other accounts of information (such as those articulated in postwar mathematical, engineering, and cybernetic literatures) explicitly reject the notion that information can function as object-ive content. Instead, they urge consideration of information's *expressive* function. A theory of nonhumanistic agency sufficient for making sense of contemporary informatic politics must account for this critical distinction.

Agential Realism

Agential realism characterizes agency as the ongoing production of iterative "cuts" that determine topological manifolds, and is therefore (unlike actor-network theory) attentive to the manner in which the *potential* becomes *actual*. Barad's apparatuses are indeed something like *abstract machines*, entities that intra-actively stratify the unformed matters and functions into specific populations with concrete possibilities for relating to one another (i.e., into *phenomena*, which name some relationship between what has been designated "subject" and what has been designated "object"). This is to say that for agential realists agency is primarily the province of entities whose

boundary-producing activities *draw diagrams* that distribute possibilities for action(s) and perception(s)—that is to say, for *mattering*. As Barad (2007) puts it:

[...] *Phenomena are the ontological inseparability/entanglement of intra-acting "agencies"*. That is, phenomena are ontological primitive relations—relations without preexisting relations. [...] It is through specific agential intra-actions that the boundaries and properties of the components of phenomena become determinate and that particular concepts (that is, particular material articulations of the world) become meaningful. (p. 139, emphasis in original)

Agency is for Barad (2007) a capacity of the universe itself, an "ongoing flow [...] through which part of the world makes itself differentially intelligible to another part of the world and through which causal structures are stabilized and destabilized" (p. 140). She is even more explicit when she plainly states that "the universe is agential intra-activity in its becoming" (p. 141). Barad imagines an infinitely agential universe in which boundary-drawing apparatuses' activities intra-actively cut and re-cut (configure and re-configure, fold and re-fold) the *undifferentiated* in order to produce the conditions of possibility any arrangement of *differentiated* actors affords. An apparatus acts always and only in that moment when the potential becomes actual, when a plane of organization materializes on or against a plane of consistency. If for Latour *nothing* seems to act diagrammatically, for Barad *everything* does.

Agential realism therefore has difficulty grappling with actors that don't seem to engage in boundary-drawing activities—machines, in other words, that do not *diagram* but might *code*, *territorialize*, or perform an additional organization function. If actor-network theory threatens to deproblematize

agency by accounting for agency as just another effect of differentially distributed actors (actors with disproportionate influence the origin of which remains a mystery), then agential realism proposes to do the same by making agency an ontological *a priori*, by making a very specific notion of agency (as boundary-drawing) a universal tendency. But as Chapter 2 has shown (and as the conclusion to this chapter will further demonstrate), competing definitions of information exist precisely because they apprehend the agential problematic in different ways, in different contexts or from different vantage points. While provocative, agential realism's one-dimensional understanding of agency cannot account for the complexity or diversity of machinic activities in which informatic technologies might participate.

Relationality, or Power's Cardinal Directions

Certainly the foregoing analysis of contemporary non-humanistic theories of agency does not exhaust the available repertoire of such projects ongoing today, but this sample is representative of the way in which such theories tend to occupy various positions in a Deleuzean/Guattarian ontological meta-model. It also exposes the extent to which each perspective is capable of addressing not only those relations that constitute and organize agency in a given social formations but also those *relations of power* immanent to the fields in which these agential activities occur. Deleuze and Guattari distinguish between multiple machinic activities in order to adequately map these power relations, but not every style or mode of relational thinking adopts their analytic with the same degree(s) of specificity. Moreover, many such theories tend to equate *action* with *agency* and therefore risk deproblematizing the very thing Deleuze

and Guattari mean to *underscore* with their emphasis on critical mapping: the very ways in which some actions are more efficacious than others, in which some actions articulate to effects others do not—or, to paraphrase Bateson, the ways in which differences can make different differences. Attention to these articulations is attention to power relations.

An Orientation Toward Power

The turn to non-humanistic agency, says Mark Andrejevic (2013), is not only a popular trend in the rarefied fields of critical social and cultural theory; it also tracks particular tendencies in contemporary popular politics. For Andrejevic, the (re)turn to complexity coincides with the rise of a "post-comprehension" paradigm in popular cultural and political discourses, a paradigm which, in light of increasing amounts of "data" (or what Andrejevic calls "information"), tends to downplay the efficacy of cohesive narratives and elevates (even celebrates) correlative logics over causal ones in explanations of social forces and formations. Here, Andrejevic writes, "post-comprehension refers to a reconfigured concept of agency in which questions of desire, motivation, and intension, are bracketed" (p. 141). Post-comprehension discourses tend to foreground a "rapidly expanding scope of relevant variables—a scope that soon becomes 'too big to know'" and consequently favor a particular epistemological device: "patterns that cannot be modeled and, in this respect, are inexplicable—patterns that simply emerge from the database and can be neither anticipated nor explained once they emerge" (p. 142). The result, says Andrejevic, is a kind of "post-human pluralism" in which "knowledge [...] has operational efficacy but no descriptive, explanatory, or even causal

purchase" (p. 142). Moreover, it's a pluralism that tends to rest neatly alongside neoliberal logics championing the chaotic-but-generative capacities of markets. For Andrejevic, accounts of nonhumanistic agency that equate critique with the production of relational descriptions might stymie their own political potentials.

Pressing not merely for *descriptions* of relational complexity but rather analysis of the concrete ways in which those complex relations actually organize fields of (actual and potential) activity, Grossberg (1992) stresses attending to the ways in which particular articulations of practices *function*. Generating politically useful insights about the organization of social life is not simply a matter of "bringing the pieces together and noting that they are connected" (p. 56). The point, recall, is to describe "the *mode* of that articulation, the nature of that fit" (p. 56, emphasis added). Put another way, the spatial materialist would insist that "arguing that a particular articulation is taken up is [not] the same as describing the *way* it is taken up" (p. 56, emphasis added). Relationally-oriented approaches to cultural theory and criticism often stop short of such descriptions, relying instead in the endless proliferation of contextual descriptions meant to constitute the analysis' political purchase. But as Grossberg asks: "Without understanding the form of power of a particular line or connection, how can one imagine the possibility of its being broken?" (p. 56).

And in her compelling critique of relational ontologies, Sue Ruddick (2012) cautions new materialists not to become enamored with their own theoretical detours. The risk of a tendency to uncritically celebrate relational complexity, she writes, is that "we might quickly become lost, enthralled perhaps by

seemingly endless points of connection and disjunction, complex webs of interconnection" (pp. 208-209). Relational thinking, Ruddick argues, is by itself no guarantor of politically useful knowledge; more than an ongoing series of "connections and disjunctions," relationality is foremost a way of accounting for *asymmetries of influence* among those relations. In other words, any analysis of *relations* must always already involve investigating *relations of power*. "It is not simply the relationship *between* things that is called into question," Ruddick says. "[I]t is the ways in which this relationship engages the 'things' themselves—what is brought into play in each multiplicity" (p. 208). In their haste to grant nonhuman actors access to agential relations, in their frequent conflation of *action* and *agency*, and in their myopic view of the Deleuzean/Guattarian meta-model, too many contemporary nonhumanistic theories of agency tend to presuppose (or even dismiss) the question of power, the question of *whether* and *how* some forms of relation (and some modalities of action) achieve differential effectivity in a given social formation.

These critiques share a common thread: dissatisfaction with contemporary accounts of nonhumanistic agency that tend to equate *action* or *effect* with *agency itself* and therefore ignore the differential relations of power that distribute capacities for access, influence, and investment in various social formations. This is to say: they recall the importance of attending to power relations.

Latour (2005) is not silent on the issue of power, which he treats as something like a *connection of asymmetrical influence*. Resisting the tendency to theorize transcendent and monolithic structures of power, Latour (2005)

instead claims that "power, like society, is the final result of a process and not a reservoir, a stock, or a capital that will automatically provide an explanation" (p. 64). But construing power as chiefly the *result* of some series of actions risks ignoring the very activities that *organize* differential abilities to make a difference. In other words, because for actor-network theory agency is simply some ability to make a difference in a network of actants, the theory has difficulty accounting for the *type* or *kind* of difference an actor might make—and whether or not these differences *make a difference* to agential activities in multiple registers (though according to Harman, 2014, Latour has recently attempted to rectify this). Unfortunately, Latour's tendency to downplay the role power plays in the organization and maintenance of relations between actants has inspired some social and cultural theorists sensitive to the operations of nonhuman actors to dismiss the term "power" as "too anthropocentric" and therefore of marginal relevance to the question of non-humanistic agency in general (Bryant, 2013, p. 13).

Like Latour, Barad's (2007) agential realism tends to grant agency a kind of ontological primacy or transcendental status when it posits agency as the universe's infinite becoming, "doing/being in its intra-activity" (p. 235). At times, Barad describes power as *coterminus* with this becoming. Describing Butlerian and Foucaultian approaches to this issue, for example, Barad writes that "power is not an external force that acts on a subject; there is only a reiterated acting that is power in its stabilizing and sedimenting effects" (p. 235). Power is

[...] transmitted through the repeated application of pressure on the body. The body reacts to the forces, manifest as shifting material alignments and changes in potential, and becomes not simply the receiver but also the transmitter or local source of the signal or sign that operates through it. (p. 189)

Power is, in other words, an ability to modulate or arrest the infinite becoming of the universe and produce specific actualizations (the ability to make intra-active cuts that stabilize spacetimes and organize what *can* and *can't* matter). To Barad, however, the analytical or political purchase of this seems somewhat mundane, as she is rather more ready to ontologize, stating simply that agential realism's primary contribution to theorizing power is that the study of power

is not limited to the social. That is, *the forces at work in the materialization of bodies are not only social, and the materialized bodies are not all human*. [...] Crucial to an agential realist conception of power is a reworking of causality as intra-activity. Indeed, what is at issue is the very nature of causal relations: causal relations to not pre-exist but rather are intra-actively produced" (p. 235, emphasis in original)

Barad explains neither how the agential realist insight that power relations involve extra-human bodies is exclusive to agential realism nor how this claim contradicts or confirms other nonhumanistic theories of agency already occupying the same problem-space.

Bennett's vital materialism is theoretically well-positioned to track ways in which more-than-human assemblages invest particular actors with differing degrees of ability to affect the organization of a social formation. But recall that her peculiar appropriation of Deleuze and Guattari fails to take into account the

pair's distinction between *machinic assemblages* and *collective assemblages of enunciation*, a distinction designed in fact to generate the kind of analytic insights Bennett seeks. Recall, too, that for Deleuze and Guattari the machinic assemblage (a given assemblage's *contents*) are very *active* indeed; they are simply not *agential* in the sense that an assemblage's *expressive* elements are. Again, "expressions or expresseds are inserted into or intervene in contents, not to represent them but to anticipate them or move them back, slow them down or speed them up, separate or combine them, delimit them in a different way" (Deleuze & Guattari, 1987, p. 86). Abstract machines grant bodies designated as "expressive" the ability to influence machinic contents in ways they themselves are not entirely influenced—a relation of power.

For Bennett (2010), however, power is chiefly "thing-power" (p. 2), "that which refuses to dissolve completely into the milieu of human knowledge" (p. 3), the power to "exceed their status as objects and to manifest traces of independence or aliveness" (p. xvi). Put more simply, thing-power is the power to "make things happen, to produce effects" (p. 5). But Bennett has little to say about the *kind* of effect a thing might have. For Deleuze and Guattari, an assemblage's contents have effects (they perform actions, they affect other bodies), but they are not agential (they have not been granted the capacity for their actions and effects to affect the fields in which they are embedded).

Two Mathematicians, Two Maps

Wiener and Shannon are in their own ways advancing accounts of the agency of the nonhuman, so one might therefore subject their theories to similar treatment in a way that reveals something critical about their

differences—and about the nature of the problem-space they occupy. What remains of this chapter will do just that. It offers one final map(ping) to return this discussion to the question of information. Utilizing Deleuze and Guattari's ontological, machinic vocabulary, one might account for the seemingly radical disjunction of Wiener's and Shannon's respective theories of information by putting the mathematicians in conversation with the post-cybernetic, machinic philosophers whose nonhumanistic and a-subjective ontology resonates with them. Placing these theories on Deleuze and Guattari's ontological map helps clarify their aims (even as it explains their divergences).

Wiener's Abstract Machine

Reflecting in his autobiography on the role cybernetics played in his life and career, Wiener (1956) cannot help but offer another doleful description of the harsh universe desperately in need of cybernetic science:

We are swimming upstream against a great torrent of disorganization, which tends to reduce everything to the heat-death of equilibrium and sameness described in the second law of thermodynamics. What Maxwell, Boltzmann, and Gibbs meant by this heat death in physics has a counterpart in the ethics of Kierkegaard, who pointed out that we live in a chaotic moral universe. (p. 324)

As previous chapters have explained, Wiener viewed cybernetics as the universal science capable of tracking and perfecting ways life that might stave off the effects of this relentless, entropic cosmos. It was a necessary affair, even if it could never function as a final one: "We are not fighting for a definitive victory in the indefinite future," he writes. "It is the greatest possible victory to be, to continue to be, and to have been. No defeat can deprive us of the success

of having existed for some moment of time in a universe that seems indifferent to us" (p. 325). For Wiener, cybernetics assisted in "our main obligation": "to establish arbitrary enclaves of order and system" (p. 324). The formal articulation of information as the principle means by which life generates and maintains these enclaves was for Wiener a matter of survival on the grandest scale imaginable.

Wiener's information functions like an abstract machine. It is that cutting-across that occurs on chaotic planes of consistency and arranges particles in productive and useful ways. As the inverse of entropy, "information" names the force that gathers together "life" and shields it from the entropic tides that threaten to sweep it away. And as no mere "thing," information is instead that process of taking-form (i.e., "in-formation") against the ever-present threat of death by diffusion. Affirming this reading of Wiener's information as an abstract machine (and invoking Bateson in the process) Faucher (2014) stresses that in the Wienerian sense information "not only makes the difference but is difference—or, rather, information is *differential selection within the milieu in which the thing is constituted as resonance between content and expression, always in a composition of assemblages*" (p. 186, emphasis in original). Studying information furnishes the *measure* of a milieu's relative degree of organization, its openness or resistance to change.

Wiener described the dissolution of life as a movement from heterogeneity to homogeneity; his early work in Brownian motion shaped this imaginary (Wiener, 1938; see McMillan, 1989, for further explanation). Wiener seemed to fear little else more than he feared a world without difference or definition, the

complete diffusion of the complexly ordered into a vast, undifferentiated expanse. Deleuze and Guattari explained the production of the actual from the virtual by completing the circuit: they depict the redundant looping, pooling, or gridding an abstract machine effects on heterogeneous haecceities to bring them into some contingent but effective alignment. Wiener fears the ultimate collapse of the heterogeneous into the homogeneous; Deleuze and Guattari are wary of the homogenization of the heterogeneous. But these thinkers all pivot around a common concern: the (de-/re-)construction of arrangements from a redundant force immanent to them. For Wiener, agency is a capacity to *resist entropy* by installing productive patternings. A quest for variety and potential, an aversion to complete closure and the eradication of difference, animate Wiener and Deleuze and Guattari alike. As Wiener (1961) reminds his readers: "The transmission of information is impossible save as a transmission of alternatives" (p. 10). Wiener (1956) regarded the maintenance of heterogeneity as "an insolence against the gods and the iron necessity that they impose" (p. 325). To theorize information is to theorize the process by which the conditions for life itself become fundamentally organized even while (even in spite of the fact that) everything will inevitably be otherwise. "Here lies the tragedy, but here lies the glory too" (p. 325).

Shannon's Expressive Ensemble

In 1956, the same year Wiener published his autobiographical recapitulation of information's cosmic importance, Claude Shannon penned his own assessment of information theory's scope and purchase for the second half of the twentieth century. Published on a single page in *IEEE Transactions*—

Information Theory, the piece was but four paragraphs long. In it, Shannon (1993c) observes that "the subject of information theory has certainly been sold, if not oversold" through its articulation "with such fashionable fields as computing machines, cybernetics, and automation" as well as "biology, psychology, linguistics, fundamental physics, economics, the theory of organization, and many others" (p. 462). Information theory's "heady draught of popularity" did not please Shannon, who fervently reminds readers that "while we feel that information theory is indeed a valuable tool in providing fundamental insights into the nature of communication problems and will continue to grow in importance, it is certainly no panacea for the communication engineer or, *a fortiori*, for anyone else." Shannon implores those ostensibly working on or with "information" to remember that "the basic results of the subject are aimed in a very specific direction, a direction that is not necessary relevant to such fields as psychology, economics, and other social sciences." The title of Shannon's polemic neatly encapsulates his assessment of the field: "The Bandwagon."

Shannon (1993c) resisted the broad application of his work to non-engineering endeavors (something he sternly reminds zealous readers is "not a trivial matter of translating words to a new domain" [p. 462]), because he felt his mathematical theory of information described not a universal principle but a *particular expressive ensemble*, what in Deleuzean/Guattarian parlance one might call a *collective assemblage of enunciation*. For Shannon, information was not responsible for bringing entire worlds into existence (as it seemed to do for Wiener); it existed on the plane of the already-actualized as a particular

measure of redundancy between relatively dis/organized unities. Recall that Shannon's informatic imaginary begins at precisely the opposite point Wiener's does: not with a chaotic field of homogeneity eventually ordered by informatic accumulation (the circulation of message-forms), but with a perfectly predictable arrangement of elements the certain repeatability of which information threatened (even though perfect predictability in practice proves impossible). Indeed, Shannon's theorization of information as *synonymous* with uncertainty positioned information not as an *ordering force* but as a force of *destabilization*, something to be mitigated through the engineering of communication technologies. Information is (in Shannon's cryptographic sense) chaotic; it increases proportionally to the degree of uncertainty (or "surprise") inhering in *in a given milieu or arrangement*, a definition which implies some prior act of stratification that produces entities thus arranged (entities like an "information source" and a "receiver").

Shannon was clear: information is useful and important insofar as it can help engineer communicative situations with conditions optimal for the reproduction of certain configurations (the replicability of certain message-events). The mathematical theory of communication is one attempt to link particular substances (symbols, equations) to particular forms (logarithmic mathematics, Boolean logic)—and then to bring this expressive ensemble to bear on other materials (electrical switches, telephony systems) such that these *contents* begin to arrange and align with expressive imperatives. As a *theory* of information (a set of resources that form a collective assemblage of enunciation) it offers a method for generating clear, effective connections

between events unfolding across milieus; it measures (that is, cuts into) systems of entropic uncertainty by assessing the degree of "surprise" (in bits) those milieus afford. "Information" becomes a way of assessing the arrangement of myriad ensembles (machinic assemblages of bodies, statements, acts, signs, and other materials); the term names a way of apprehending a field probabilistically—so that the arrangement of these contents might be sufficiently repeated. Shannon's theory of information belongs to a collective assemblage of enunciation.

Conclusion: A Cartographic Theory of Communication

One year after the explosive release of his essay "A Mathematical Theory of Communication," Claude Shannon published "Communication in the Presence of Noise," a brief but powerful paper that pushed information theory in an intriguing direction. Appearing in the *Proceedings of the Institute of Radio Engineers* (now the Institute of Electrical and Electronics Engineers, or IEEE), the paper offers a method of "representing any communication system geometrically" (Shannon, 1949, p. 10). The work benefits communication engineering in an important way, Shannon claims:

The advantage of this geometrical representation of the signals is that we can use the vocabulary and the results of geometry in the communication problem. Essentially, we have replaced a complex entity (say, a television signal) in a simple environment (the signal requires only a plane for its representations as $f(t)$) by a simple entity (a point) in a complex environment [...] (p. 12)

So Shannon re-imagined his classic communication model geometrically (as a series of points, vectors, and planes) to demonstrate the utility of a thoroughly spatialized approach to signal transmission. Recall that for Shannon messages are neither meaning-bearing units nor packets that move through channels but rather *events of selection* that modify particular arrangements (generating or ameliorating information). In "Communication in the Presence of Noise," Shannon is able to capitalize on the conceptual purchase of this earlier maneuver by explaining messages as concrete *spatialities*. Underscoring this move, Shannon here refers to messages as points among larger "message spaces" and to transmitting and receiving entities as spatialization processes:

The input of the transmitter is a message; that is, one point in the message space. Its output is a signal—one point in the signal space. Whatever form of encoding or modulation is performed, the transmitter must establish some correspondence between the points in the two spaces. (p. 14)

In short: for Shannon, communication becomes not the transmission of ethereal signals through an otherwise inert (if potentially resistive) channel, but the reproduction of spatial arrangements at multiple locations.

Shannon is even more direct when he reminds readers that

The geometrical name for such a correspondence is a mapping. The transmitter maps the message space onto the signal space. In the same way, the receiver maps the signal space back onto the message space. (p. 14)

Of course, the process is never guaranteed or seamless; perturbations (the noises to which the title of Shannon's essay refers) occur in the form of spatial distortions, "small region[s] of uncertainty about each point in the space" (p. 11), "a warping of the space, so that each point is moved" (p. 13). Clearly, for Shannon "mapping" is not the act of re-presenting a spatial arrangement to an observing entity—one in which, as Pickles (2004) explains, "information is conveyed" by an entity seeking to "devise better approximations between raw data and the map image" (p. 33). This is in fact a common description of Shannon's communication process predicated on the misunderstanding that his "information" serves a representative function. It is related instead (as previous chapters have demonstrated) to the *ongoing process of arrangement* through which message spaces are assembled, secured, contested, and (re)shaped. If communication is a process of mapping, then it involves the effective replication of arrangements, forging those connections (drawing those lines) that establish the contours of the possible (see Pickles, 2004) and ensure the upkeep of the systems designed to police those contours.

The mapping problem occupied Wiener too. In fact, he insisted that his infamous Yellow Peril was devoted entirely to it. *The Extrapolation, Interpolation, and Smoothing of Stationary Time Series* is, Wiener (1949b) says,

an attempt to unite the theory and practice of two fields of work which are of vital importance in the present emergency, and which have a complete natural methodological unity, but which have up to the present drawn their inspiration from two entirely distinct traditions, and which are widely different in their vocabulary and the training of their personnel. (p. 1)

The "two fields" in question were statistical mechanics and communication engineering, the articulation of which (as Chapter 2 explained) fueled the cybernetic imaginary. The Yellow Peril was declassified in 1949 (the same year Shannon released his application of geometrical principles to communication engineering), and its publication revealed one of Wiener's most sustained ruminations on the fruitful combination of mathematics and engineering for the purpose of prediction and control.

In the opening pages of *Extrapolation, Interpolation*, Wiener explains that "natural methodological unity" between "time series in statistics" and "communication engineering" (p. 1). He felt the two had heretofore been artificially (and unproductively) separated in a way that "has often blinded the communications and the power engineers to the essential unity of their problems" (p. 3). Wiener explains that

methods involving probability theory and correlation are part of the traditional stock in trade of the statistician, but, on the other hand the use of the complex plane is quite foreign to his training. The complex plane of function has a long history in communication technique, but statistical methods do not, and, as things stand at present, a man may be a practiced communications engineer without even being aware of their existence. (pp. 8-9)

Wiener's articulation is clear: he is writing to fuse these methods "into a common technique which, in the opinion of the author, is more effective than either existing technique alone" (p. 9): more effective, that is, at drawing more accurate inferences about future behavior from past performances—the cybernetic fixation. Central to this endeavor was the specification of the *message* as the fundamental unit of analysis for cybernetics (though Wiener

does not use this term explicitly, as his eponymous volume was still years away), albeit a notion of "message" radically reworked. Indeed, communication engineering and statistical mechanics converge in the concept of the message, for the former is "the study of messages and their transmission" while the latter enables their elaboration as "some sort of array of measurable quantities distributed in time" (p. 2). Unlike Shannon, his occasional student and interlocutor, Wiener mapped the message not in space but as a function of time:

This time series is then subjected to transmission by an apparatus which carries it through a succession of stages, at each of which the time series appears by transformation as a new time series. These operations, although carried out by electrical or mechanical or other such means, are in no way essentially different from the operations computationally carried out by the time-series statistician with slide rule and computing machine (p. 2)

Recall that Wiener's communication model lacks the moments of encoding and decoding present in Shannon's, so Wiener here speaks more directly about the transmission of messages. Nevertheless, Wiener describes a transmission process that is anything but simple or transparent; it is rather a "succession of stages" through which a message is transformed (meticulously reproduced from moment to moment). As they would be in his *Cybernetics*, messages are for Wiener propagated *forms of organization*, not the stuff of human meaning or cognition. "A message need not be the result of a conscious human effort for the transmission of ideas," he writes (p. 2), for records of current and voltage kept on instruments at an electrical substation "are as truly messages as a telephone conversation" (p. 2). Messages are foremost *patterns*, and

in that moment in which circuits of large power are used to transmit a pattern or to control the time behavior of a machine, power engineering differs from communication engineering only in the energy levels involved and in the particular apparatus used suitable for such energy levels, but is not in fact a separate branch of engineering from communications. (p. 3)

Wiener's concern here is the accuracy with which one might predict the successful propagation of such a pattern, the *probability* with which a pattern that has occurred in the past may appear again in the future, for then one might predict and control its future activities; this explains Wiener's related preoccupation with extrapolation (as evidenced by the Yellow Peril's formal title).

If Shannon plots the convergence or divergence of configurations in space, then Wiener charts the same phenomenon in time. But remembering Wiener's particular conceptualization of messages indicates the cyberneticist's conformity with Shannon on this point. Communication is principally about the replication or distortion of organizational configurations. In their attempts to conceive the problem of information spatially, the mathematicians connected conceptual resources in generative ways. Wiener, for one, surely thought he'd hit on something critical: "The proper field of communication engineering is far wider than that generally assigned to it," he declares (p. 2).

Previous chapters have shown how cyberneticists endeavored to make this statement true, how they worked to broaden the purview of emerging communication sciences until they could speak with authority about matters on a cosmological scale. Along the way, they advanced a radically new notion of machinic activity, drawing a series of equivalences between human, animal, and

machine behavior that set the stage for several post-cybernetic thinkers. They also gestured toward an understanding of agency unmoored from its Enlightenment articulations, offering instead a manner of conceiving agency as something distributed across a field of patterned forces. As the previous chapter argued, Deleuze and Guattari's radically immanent machinic ontology represents a sustained and influential engagement with these insights, one that has inspired numerous contemporary accounts of the ways nonhuman actors shape everyday life.

Shannon's concerns were limited: he studied the reproduction and modulation of electrical signals with technical machines. Wiener's aspirations were grander, and yet both scientists' methods for solving their respective problems—and the conceptual resources each marshaled to enact them—continued to resonate with those inhabiting the problem-space the study of information disclosed. Deleuze and Guattari in particular relocated communication engineering's idiosyncratic conceptualization of the machine to an explicitly ontological register, an effort with wide-ranging influence in contemporary social and cultural theory.

And Deleuze and Guattari *also* turned to mapping as a practice critical to their own geometrically-inclined work. For them (as the previous chapter explains), machines operate in part by *mapping spaces*, by drawing the lines of connection and disconnection that constitute affiliations and breaks, proximities and influences. But Deleuze and Guattari also *advocated* mapping as a *critical project*, a matter not of re-presenting the real in a new (ostensibly more liberatory) way, but of *re-configuring* it. For them, maps are "entirely oriented

toward an experimentation in contact with the real"; they foster "connections between fields" and are "detachable, reversible, susceptible to constant modification" (Deleuze & Guattari, 1987, p. 12). This is what mapping entails for machines of all kinds—including, as Shannon and Wiener clearly thought, signal- or message-propagating machines.

Shannon and Wiener's deep investment in cartographic imaginaries underscores the need for *critical* mappings of the intellectual spaces they both mobilized, inhabited, and produced in their work on information. Charting the intellectual terrain such work generated is indeed crucial for understanding the contours of the problem-space it both obfuscates and discloses—and this chapter has begun such work. But as Faucher (2013) reminds us, "no matter how complex the conceptual map by which we choose to represent information in motley contexts, the map is not the territory" (p. 189). The next (and final) chapter will survey this territory.

CHAPTER 5: ON INFORMATION POLITICS

Grammars and Modalities (or, Some Redundancy)

All this returns us to the problem—or rather, the *problem-space*—of information. A *problem-space* (recall from Chapter 1) is a particular constellation of forces, a dynamic set of tensions that appear to interlock (however tenuously) around certain issues or efforts. As a *problem* suddenly pressing and relevant during and after the Second World War, "information" defines such a *problem-space*; it names not some *singular* or *nominal* entity, but rather discloses (and, in part, organizes) a dispersed field of concerns. In so doing, it becomes increasingly central to numerous 21st-century activities and struggles. This chapters examines some of those struggles.

But first, a bit of redundancy: Chapter 1 outlined ways information figures in multiple "grammars"—various popular, discursive articulations that construct different (often fractured, inconsistent, and contradictory) sets of tensions—which determine both *what* information *is* and *how* information *works*. These were:

- The political-economic (information as a bounded and discrete object available for appropriation)
- The cultural (information as the amorphous "stuff" of meaningful expression, which by its very nature supersedes constraints)

- The documental (information as both thing and process of recording and retrieval, something that participates in complicated relationships with "data," "knowledge," and truth)
- The metaphysical (information as a universal substrate underpinning material reality)

Other grammars will (likely already do) exist. But these are four of information's most powerful and pervasive *popular* configurations, which constitute the political terrain across which struggles over information occur. They articulate (often disparate) logics and materials into seemingly natural, enduring notions about information's *role, function, and dynamics* in contemporary social formations.

As Chapter 1 also explained, one such notion (which cuts across the first three grammars especially) is that information is a *resource*, something a social actor might variously *use, misuse, or use up*. Under the influence of what Balnaves and Willson (2011) call the "resource doctrine of information" (p. 44), many popular narratives fail to question this status. What's more, Balnaves and Willson remind us that the resource doctrine regulates not only the ways in which one might conceive *information itself*, but also the ways one might imagine that which exists *in relation to* information. For example, the authors suggest that the doctrine "carries with it explicit assumptions about rationality" (p. 43); it articulates a particular mode of subjectivity that thinks about, concerns itself with, or otherwise relates to information. One might say, then, that for Balnaves and Willson, informational problem-spaces organize and

authorize certain kinds of *subjects* that can or cannot—should or should not—engage with informational resources in particular ways toward particular ends. They ask subjects to imagine themselves as certain kinds of *agents*.

Previous chapters have demonstrated that "agency" is *at stake* in discussions of information. This is to say, agency is a *problematic* that analyses of information (as a problem-space) *disclose*. Chapters 3 and 4 especially have shown that "agency" is no less complex or polysemic a concept than "information," despite its occupying a good deal of thought in contemporary critical social theory. And as Chapter 2 explained, agency has been decidedly germane to discussions of information since the advent of mathematical information theory and cybernetics. Indeed, American information theorists wrestled productively with the implications of their work for traditional, Enlightenment-influenced conceptualizations of agency—even though they did not use that term to describe the issue that concerned them. Predicated on the realization of the universe's unavoidable contingency, such work influenced decades of writing in fields like anthropology, biology, and continental philosophy. It catalyzed a new agential imaginary.

Information's status as a resource raises important questions: for *whom* or *what* is information a resource today? What does information's popular articulation as a resource tell us about the way we *conceive* agency today? And how do such conceptions influence our understanding of the ways we *struggle* over information *within* informational problem-spaces? Locating answers to such questions becomes increasingly critical when information emerges as something to which an increasing number of political problems and issues

become articulated. To a significant extent, however, rather stringent and delimiting conceptualizations of information *constrain* possible answers to these questions; answers to these questions figure almost exclusively from a specific understanding of information's multiple dynamics—an understanding the resource doctrine instantiates.

This final chapter examines the popular politics of information, and does so in order to expose the resource doctrine's grip on popular understandings of information. It argues that information's popular discursive grammars are distinct precisely because they articulate different modes (or "modalities") of information's expressivity—in short, its *semiotics*. To do this, the current chapter utilizes conceptual tools that emerging from one important engagement with information theory: that of Félix Guattari.

Consider information's semiotic dynamics as the particular *modalities* of its expressivity. Recall (from Chapter 3) that for Deleuze and Guattari (1987) every assemblage consists of both *content* (a machinic assemblage) and *expression* (a collective assemblage of enunciation). At times, Deleuze and Guattari (1987) refer to assemblages' expressive dimension as a *semiotic* one, "a regime of signs" (p. 504). Particular to every regime of signs is the manner in which those signs articulate to certain contents, the way bodies designated as *expression* take hold of and intervene in those designated as *content*. The relationship between those things we call "signs" and those things we call "referents" is particular to any given assemblage; the mode of their (inter)action is far from predetermined. Further, both content and expression embody another coupling—one of *form* and *substance*—making the *relationship*

between content and expression much more complex than most standard semiological accounts (of interaction between disembodied *sign* and embodied *thing*) can describe.

Deleuze and Guattari (1987) are clear: "content" and "expression" are not synonyms for "signified" and "signifier." Instead, these terms name collections of heterogeneous elements marshaled and put into relations with specific dynamics and consequences. Indeed, an ability to parse or differentiate the specific mechanics of a given relationship between content and expression—between the "*pragmatic*" collection of bodies that is *acted upon* and the "*semiotic*" collection of bodies that *acts*—is one benefit of Deleuze and Guattari's assemblage-oriented analysis, and these mechanics do not immediately (or necessarily) align with the logics and effectivities of representational, signifying semiologies. A more nuanced approach to expression—a more nuanced *semiotics*—assists in elaborating the complexity of a given social formation (or assemblage).

Guattari offers such a semiotics. Watson (2009) notes that Guattari's search for a theory of signs capable of addressing this complexity predates—and in many ways prefigures—his eventual engagements with Deleuze. As previous chapters have explained, Guattari's frustration with the conceptual and political limitations of structuralist semiology motivated his search for "an inventory of raw materials and spare parts used not only by language, but also by many other types of messages, signals, modes of expression, or transmission [that] are essential to many processes and work in social, ecological, cellular, and atomic systems" (Watson, 2009, p. 46). In a series of early essays and

letters, Guattari sketched what he would eventually call a "mixed semiotics"—a semiotics more robust than that which Guattari found in structuralism, one that identifies the multiple, distinct but interlocking modes of semiotization present in contemporary social formations. Not surprisingly, several commentators (including collaborator Deleuze) have noted the theoretical eclecticism with which Guattari approached this endeavor. Influences from biology, physics, mathematics, and (most importantly here) cybernetics and information theory are acutely evident in this early work, especially as Guattari's disillusionment with Lacanian psychoanalysis deepened (see Watson, 2009, pp. 45-54, for more detail). Guattari continually refined this work both as part of and subsequent to his writing with Deleuze. This chapter, too, will amend Guattari's earlier semiotic conceptualization in order to align them with the shape they took later in Guattari's career. While together Deleuze and Guattari offer an intricate and compelling *ontology*, Guattari's solo compositions demonstrate a persistent engagement with the particularities of *expression*; to some extent, they "operationalize" the Deleuzean-Guattarian ontology, and are for this reason most useful for the current analysis.

More specifically, this chapter adopts Guattari's mixed semiotics in order to parse and subsequently analyze the political terrain on which various struggles over "information" occur today. Guattari himself was concerned with such matters, and wrote frequently about "the rapidly evolving machinic realms of scientific theory and information technology" (Watson, 2009, p. 45). Crucially, Guattari insisted that digital, computational information technologies function not just to circulate well-formed symbols; they also *intervene in the material*

conditions under which those symbols become intelligible as such. In fact, they *foreground* this function. "Today's information and communication machines do not merely convey representational contents," he writes, "but also contribute to the fabrication of new *assemblages* of enunciation, individual and collective" (Guattari, 1996b, p. 96, emphasis in original). Thus, this chapter explores the conceptual and political purchase of a "mixed semiotic" approach to struggles over information. It aims to parse and clarify the multiple and overlapping functions "information" assumes in contemporary organizations of power. Understanding the politics of information today means means understanding those ways in which various discursive grammars of information draw upon and refashion information's mixed semiotics. While it does not claim to offer universally applicable political solutions, this chapter proceeds in the hope that some exploration and explanation of the current conjuncture's contours might assist those struggling to navigate them.

After adumbrating Guattari's mixed semiotics as a schema for plotting these struggles, this chapter explores the problems and possibilities such a semiotics discloses for the politics of information in each of its expressive modalities. Struggles in each of these expressive registers adopt and harbor their own particular notions of *agency*, which get articulated in and to activities organized *around* information. Moreover, then, parsing information's mixed semiotics assists in discerning the various modalities of agency that appear through struggles in which "information" seems to play a decisive role. Each of information's semiotic modes discloses a certain *figure* of agency (a certain agential imaginary or articulation of *agency as a problem*), each with its own

dynamics that frame (guide or even prefigure) discussions of information politics in particular ways. In other words, *what* agency "means" (that is, what the term articulates, what *problems* it encompasses) shifts in each of these modalities. This chapter concludes by examining those important shifts.

Semiotization Without Signification

In *The Philosophy of Information*, Luciano Floridi (2011) identifies what he calls "the elementary problem" for any sustained, formal analysis of information: "What is information?" (p. 30, emphasis added). He writes:

Information is still an elusive concept. This is a scandal not by itself, but because so much theoretical work relies on a clear analysis and explanation of information and of its cognate concepts. (p. 30).

Perhaps just as scandalously, Floridi effectively skirts the question by turning its potential answers into matters of positionality; what information *is* is a matter of its relationship to particular conditions of existence. In this sense, then, "information can be viewed from three perspectives" (p. 30). These are:

- information *as* reality
- information *for* reality
- information *about* reality

Floridi's "information *as* reality" is an attempt to describe information as something "*environmental*," "a pattern of physical signals, which are neither true nor false" (p. 30, emphasis in original). This is a view of information as an ostensibly "natural" entity, something *isomorphic* with material conditions and capable of *configuring* them. "Information *for* reality" is Floridi's term for

phenomena like "instructions," "orders," and "recipes" (p. 30, emphasis in original)—things that do not *represent* real conditions but actually (under certain conditions and with appropriate resources) *trigger* or *maintain* those conditions. Information in this case is not *isomorphic* with the material, but it does *intervene in* the material. Finally, Floridi's "information *about* reality" is information in its "semantic" mode (p. 30). Here information functions as something "alethically verifiable" (p. 30); it traffics in economies of verisimilitude to accurately or inaccurately re-present some object or state of affairs. Thus, for Floridi (2011), this type of information can be "veridical" (p. 50); it performs a kind of truth function predicated on some correspondence between information and material conditions. And information, in this sense, must *by its very nature* always correspond to a referent with the greatest degree of fidelity. Floridi insists that "false [semantic] information is not a genuine type of information" (p. 50). "One speaks of false information not as one speaks of a false sentence, which is a sentence that happens to be false, but in the same way as one qualifies someone as a false friend, i.e. not a friend at all" (p. 50). Such information is not isomorphic with the material and does not directly intervene in it. Instead, it stands *apart* from real conditions to *re-present* those conditions in certain ways.

But Floridi's perspectives on information are not "perspectives" at all (for the term implies that information's effectivities are solely the result of some observing entity); rather, they are various *modalities*—of the ways information *figures* in both popular accounts of informatic activity, and of such activities' articulation into various socio-technical assemblages, especially those

assemblages characteristic of late capitalism. As Chapter 3 explained, radical psychoanalyst Félix Guattari adopted cybernetic, machinic thinking to address the production of subjectivity in precisely this period of capitalism's development. Part and parcel of his concern with these processes of production was a keen interest in the very mechanisms of capital's operations, the concrete techniques and technologies through which forces of power shape the conditions in which subjects emerge today. In particular, Guattari scrutinized one type of technology: *information technology* (see Genosko, 2009). While he was perhaps more optimistic about the revolutionary potential of ever-shrinking electronics (such as radios and personal computers) than were some of his contemporaries, Guattari maintained that these technologies operated in ways quite unlike their antecedents—and were for this reason ripe for fresh analysis and critique.

Adequately grasping the complexity of these expressive ensembles requires, Guattari suggests, expanding semiotic vocabularies in order to account for the functions of an assemblage that tend to fall outside the domain of the semiological (Guattari used the term "semiology" to name that semiotics concerned exclusively with the dynamics of meaning and representation). The result of such an expansion, inspired by the work of Louis Hjelmslev, was Guattari's "mixed semiotics" (see Genosko 1998, 2002), which theorized multiple modes of semiotization beyond the work of signifying semiologies. Indeed, Guattari viewed signification as only *one mode* of semiotization, and a limited one at that, circulating as it does *already-formalized* signifier-signified relationships through universal chains of equivalence and subjective

interpretation (i.e., the semiologist's "readings"). For him, structuralist semiology was a tyrannical science, one "not interested in social origins underlying the formalization of significations" (Guattari, 1984, p. 169) and concerned more with producing universalizable interpretations of symbols that served institutions with the power to perpetuate them. Guattari sought to limit semiology's scope in order to account for the multiplicity of sign functions present in any given assemblage and expand the conceptual vocabulary with which analysts and critics might address that assemblage's particular regime of signs.

In his early work, Guattari schematized his Hjelmslevian mixed semiotics this way:

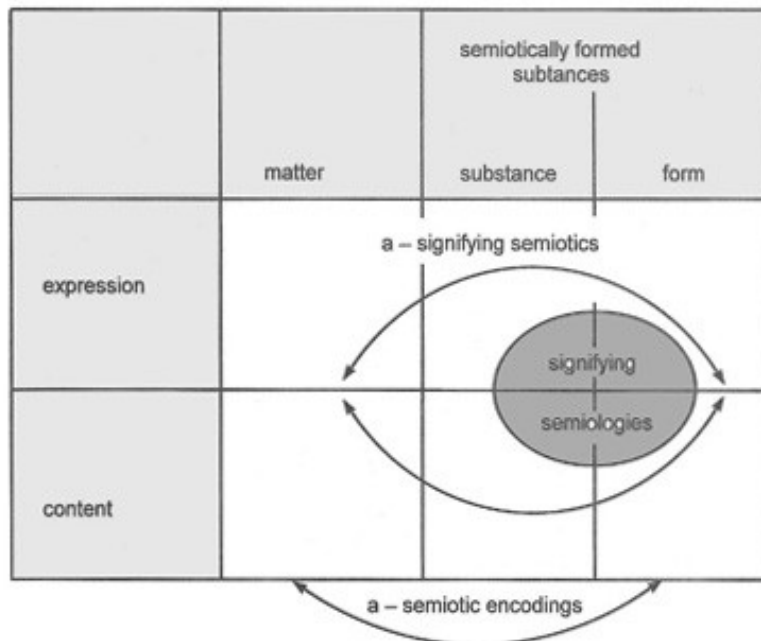


Illustration 3: Guattari's mixed semiotics, as conceived in 1973

Understanding Guattari's multiple modalities of sign activity is crucial for recognizing not only the force and scope of his intervention into semiotics in general but also the specific contribution he makes to the study of information and information technologies. Examples of each semiotic mode, specifically as each relates to the problem of information, follow these more general descriptions.

First (in order to specify the limits of his conceptual model), Guattari (1984) explains *a-semiotic encodings*, or activities that "do not involve a specific semiotic stratum" (p. 90). With appropriate scare quotes and other qualifiers, Guattari refers to these encodings as "'natural' chains of encoding" (Guattari, 1984, p. 90) or "so-called natural encoding which functions independently of the constitution of semiotic substance" (Guattari, 1996c, p. 149). Here, Guattari is attempting to theorize a kind of organization or formalization that functions *outside of* or *apart from* the *semiotic* activities that instantiate planes of expression and content. To theorize a-semiotic activity, Guattari mobilizes Hjelmslev's distinction between *matter* and *substance* (that is, "matter" refers to the field of un-actualized material intensities, while the "substance" refers to what those intensities *become* when actualized through a semiotic encounter). Here, then, is Guattari's attempt to describe a system of encoding that is not "properly" semiotic. He believed matter could take form in ways that could not be semiotically explained. "Indeed," he writes

the separation between non-semiotically formed matter and semiotically formed substance, insofar as it is established independently of the relations of expression and content, opens the way to the study of semiotics independent of signifying semiologies, that is to say, semiotics which, to be precise, would not be based on the bipolarity of signifier-signified. (Guattari, 1996c, p. 148)

"A-semiotic encodings" is perhaps the most abstract and least thoroughly explained of Guattari's categories (see Genosko, 2002, and Watson, 2009, for two excellent explications). Clearly, as the preceding quotation shows, Guattari wished for this category to counter semiological tendencies, including the tendency to view the world as a textual system, a system of *writing*. "Do not succumb to the semiotic illusion of projecting an *écriture* onto the natural field," he says. "There is no genetic writing" (Guattari, 1996c, p. 149). Indeed, genetic activity was a sort of a-semiotic touchstone for Guattari, as it apparently addressed the process by which organic matter organizes outside a system of signs. Importantly, however, Guattari states that nothing prohibits actors from *trying to represent* the processes and products of a-semiotic encodings. "The biologist who makes a model of the RNA and DNA chains is transposing these structures into a system of signs, thus producing an entirely new basis of expression" (p. 90). In much the same way, one might describe American information theorists' notational activities; Shannon and Wiener, for example, used mathematical symbols to depict the "natural" processes of organization they envisioned.

Second, Guattari describes the operations of *signifying semiologies*. As the above semiotic schema indicates, Guattari depicts signifying semiologies as *severed* from material flows, locked in circular and self-referential loopings

whereby signs refer to other signs *ad infinitum* as part of formal signifying chains. For Guattari, signifying semiologies tend to arrest and flatten the force of material fluxes, which are "doubly reduced: first to fit the signified contents, and then to fit the signifier, whose despotic ambition is to put everything that could represent it through a process of repetition that always brings it back to itself" (p. 92). This type of semiotic activity is, in other words, that which the structuralist semiologists prided themselves on elucidating. Guattari displays little sympathy with the structuralists, whom he accused (as previously indicated) of a kind of tyranny, for they "take control of the symbolic semiologies used by children, the mad and others to try and safeguard their economy of desire as best they can" (Guattari, 1984, p. 168). Structuralist psychoanalysis is, then, in the business of offering universal interpretations for the sign systems that structure the unconscious "like a language." Semiological signs relate to their referents via re-presentation; sign and thing never intersect directly, as signs stand apart from the "real" conditions of their ongoing circulation. This is to say that semiological signs work by *interposing* themselves between material conditions and consciousness; they always presuppose an already-formed subject who interprets them. The result, for Guattari (1984), is the trap of Kantian mediation: "a subject cut off from all direct access to reality, imprisoned in a signifying ghetto" (p. 92).

Third, Guattari elaborates a class of semiotic activity he calls *a-signifying semiotics*, which involve signs that do not necessarily partake in signifying economies. Indeed, they operate anterior to and only potentially in support of signifying semiologies; they modulate material fluxes that set the *conditions* for

signification. For this reason, they are not truly "signs," but rather what Guattari variously calls "particle-signs," "point-signs," or "part-signs," for they shuttle *between* the symbolic and the material—part sign, part matter. A-signifying particle-signs need not "pass through" consciousness or even subjectivity. As Genosko (2009) puts it, "part-signs engage machinic material processes beyond the problem of referentiality" (p. 99). Developing a theory of part-signs allows Guattari access to those *machinic* processes that are without recourse to signifying logics. It displaces the speaking subject from the center of analysis as the wellspring from which reality is ostensibly "socially constructed," and facilitates Guattari's contention that

Signs "work" things prior to representation. Signs and things combine with one another independently of the subjective "hold" that the agents of individuated enunciation claim to have over them. A collective assemblage of enunciation is, then, in a position to relieve speech of its role as the imaginary support of the cosmos. (Guattari, 1996c, p. 151)

In Guattari's terms, a-signifying particle-signs "can bring into play systems of signs that, though they may incidentally have a symbolic or signifying effect, have no connection with that symbolism or signification as far as their specific functioning is concerned" (Guattari, 1984, p. 171). They prefigure signifying signs but do not rely on them or the significations they produce. Ultimately, for Guattari, part-signs function without recourse to some *semantic* content. They do not open themselves up for *interpretations* as much as they work well within various *configurations*; that is they effectuate the material *conditions* for potential significations according to certain established parameters (parameters established, for example, in other semiotic registers, like a-

semiotic ones). Indeed, while semiological signs tend to loop and expand through seemingly infinite signifying semiosis, "an extremely precise and rigid syntax" (Guattari, 1984 p. 171) governs a-signifying part-signs. According to Guattari, part-signs

give up all the manifold values that can exist in symbolic systems of signifying systems: the sign becomes so refined that there are no longer thirty-six possible interpretations, but a single designation. (p. 171)

Unlike signs available for signifying semiosis (the becoming-conscious of the subject to the sign, the ongoing act of semiotic *mediation* that occurs in subject-sign encounter), particle-signs do not permit ongoing redefinition—they do not "slide" (Genosko, 2009, p. 97). Instead, according to Guattari (1995), part-signs' primary operation is *triggering*; enmeshed in complex relations of other bodies and signs arranged to facilitate their actions, these signs activate relationalities and police boundaries—they "give out stop and start orders" (p. 49). They initiate or terminate material operations. Rather than run isomorphic with "real" conditions or stand apart from and re-present those conditions, particle-signs operate "flush" with them. As Genosko (2002) puts it, a-signifying part-signs demonstrate "no recourse to representative structures. (p. 170).

Understanding the particular dynamic of Guattari's a-signifying part-signs can be difficult because Guattari's own semiotic schematic seems to misconstrue their relationship to material fluxes. Guattari offers a pictorial figure of his mixed semiotics that sees matter *always already bifurcated* into expression and content in advance of any kind of semiotic activity. A truly immanent semiotics, such as the one Guattari hoped to realize, would entail,

however, positing the existence of matter as a category of *true undifferentiation*. The material cannot "contain" categories, for these are a form of differentiation—and matter is (by Hjelmslev's definition) without differentiation. A more appropriate schematization of Guattari's mixed semiotics might look like this:

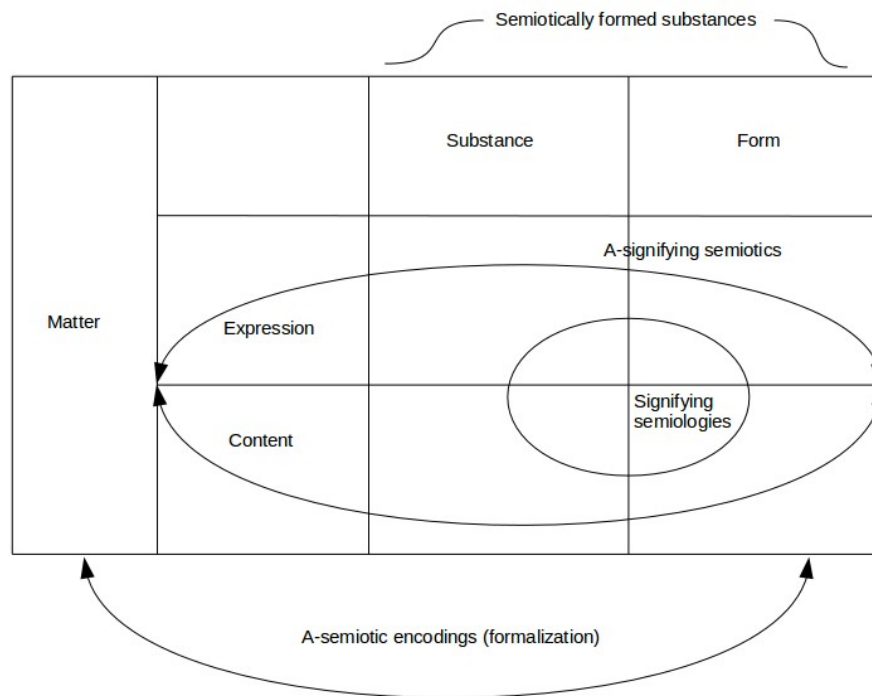


Illustration 4: Guattari's mixed semiotics revised

This revised figuration of Guattari's mixed semiotics more clearly depicts the role of a-signifying part-signs; it maintains their position on the planes of content and expression, but denies them the ability to immediately or

transparently actualize material flows (the province of a-semiotic encodings) while retaining their capacity to modulate the conditions of signifying structures.

Developing a mixed semiotics was Guattari's (1984) way of "re-defining the problem of meaning and signification" so that "meaning" names something *more* than the effects of semiological activities, something "resulting from the conjunction of semiotic systems in confrontation" (p. 164)—something, as Langlois (2014) suggests, that has more to do with establishing the conditions of *meaningfulness* than conveying already-meaningful contents. A mixed semiotic approach to the question of "meaning" stresses the multiple and overlapping regimes of signs that work to produce the conditions in which meaningful activity may occur, in which some "things" might be designated meaningful and others not. In short, thinking beyond signification refocuses critical attention on those non-semantic processes by which the material conditions of everyday life get organized to support various "meaningful" orientations in and to the world.

Information—

These conceptual tools from Guattari underscore the fact that Floridi's "perspectives" on information are not merely positions subjects *take* in relation to information, but rather *facets* of information's mixed semiotics, particular *modalities of sign activity* through which information might operate. As such, this approach to information discloses something about the popular terrain on which struggles over information occur; it indicates certain critical points of tension at which "information" gets variously articulated, animated, and

deployed toward particular ends. This is uneven terrain, to be sure. However, what remains of this dissertation presents a brief (and, admittedly, occasionally speculative) reading of this terrain as refracted through the multiple modes of information's mixed semiotics.

—*About Reality*

The Kumusha Takes Wiki project "aims at activating communities across Africa to create and contribute freely-licensed information, texts, images and media about their communities (villages, townships, suburbs, inner cities, etc.)," which anyone can eventually incorporate into Wikipedia (Wikimedia, para. 1). The project is important, blogger Francois-Xavier Ada (2014) explains, because the "digital divide means some African communities are underrepresented on the web," and "without a well-developed online presence, misinformation about them can spread relatively unchallenged" (para. 1). Indeed, Ada says, "much existing information available about local African communities can only be accessed within the confines of specific languages and dialects" (para. 5)—but "the Kumusha Takes Wiki Project wants to give those communities a voice" (para. 3) online. So the project encourages members of Sub-Saharan communities to work with designated "Wikipedians in Residence" (para. 7) to help produce "online content" (para. 6) better representative of their cultures. "The project will work to create information that benefits everyone," Ada says "not just those writing the articles" (para. 8). Kumusha Takes Wiki is part of the Africa Centre, which Ada explains is "involved in correcting the spread of incorrect information" about African communities. It

wants to "revitalize the information base" (para. 9) available to both those *seeking* knowledge about Sub-Saharan African communities and those *creating* it.

This is information in its signifying modality, whereby information functions according to the logic of semiological sign. Here, information *stands for* something or someone. It functions as a signifier of a world beyond or apart from it. It represents or misrepresents with greater or lesser fidelity. It is *about* reality.

This, of course, is the very semiotic modality early information theorists did *not* embrace, for their information was non-semantic (it did not traffic in economies of "meaning") and non-representational (see Chapter 2). And yet this is the semiotic function many contemporary, commonsense definitions of information tend to presuppose and espouse. Consider, for instance, various programs and practices aimed at protecting "personal information" (or "personally identifiable information" in juridical contexts), information deemed valuable precisely because it discloses something *about* a target; in its signifying modality, information is useful insofar as it ostensibly reflects something *about* a referent. Such information reveals certain conditions that orient subjects in the world. It can expose (information is "accurate" when it thoroughly re-presents target conditions), and it can obfuscate (as "misinformation" about Sub-Saharan African communities circulates online to the detriment of the people that comprise them).

Information functioning this way must first become an *object*, something disarticulated from the material conditions of its production, something one might *circulate*. As Guattari's semiotic schema indicates, signs that perform signifying functions operate at the nexus of fully-formed contents and expressions, articulating some identifiable form and substance; they form discrete units ready for appropriation by other mechanisms, which might subsequently *enclose them*. Capitalist and liberal democratic formations, for example, frequently—and seemingly with much success—articulate information *about* reality into something one might own, trade, protect, secure, and so forth. In this mode, information can become some kind of content for other assemblages.

Struggles over information in its signifying modality are therefore typically struggles over and with competing representations of the world. Indeed, though he never defines or specifies his use of the term "information" in his recent book *Infoglut*, Andrejevic (2013) assumes the primacy of this semiological modality in order to argue that "contemporary forms of information glut" (Andrejevic's term for the preponderance of irreconcilable accounts of the world in the data-saturated global West) spur "deadlocks of representation" (p. 14) that continually undermine anyone's ability to speak truthfully or authoritatively on matters of intense public debate. Such debate becomes less focused on proposing sound arguments and counter-narratives and more on how "to use the expanded media space to engulf any dominant narrative in possible alternatives, to highlight the indeterminacy of the evidence by promulgating endless narratives of debunkery and counter-debunkery" (p. 9).

Struggles over information are struggles not only to represent real conditions but also to demonstrate the utter futility of any sustained narrative about those conditions.

Documentational and political economic grammars of information frequently foreground this signifying function when they facilitate claims about information's ability to re-present certain properties or conditions. These grammars depend on a figure of information as not only something that re-presents reality but also does so *with accuracy*; they hinge on logics of fidelity and verisimilitude.

—*For Reality*

Pacing across the now-iconic, red-carpeted TED Talk stage, author Eli Pariser frets. "There is no standard Google anymore," he tells his audience. Quite simply, he says, two users submitting the same query will receive vastly different search results from the world's most-used search engine. Egalitarian rhetoric to the contrary, the World Wide Web has become a meshwork of "filter bubbles," says Pariser: "your own, personal, unique universe of information that you live in online," (TED, 2011), a kind of "personal ecosystem of information that's been catered by these algorithms to who they think you are" ("The Filter Bubble"). And Pariser worries about the effect these "algorithmic gatekeepers" might have on users' abilities to access, connect to, and retrieve material that enhances their lives. For Pariser, it's one of the most pressing ethical issues of our time: What's made relevant? What's drawn closer? What's pushed aside? What connects (and doesn't connect) to what? Or, in Pariser's (2011) words, what "controls the flows"?

Pariser's "information" is information in its a-signifying modality, or the modality in which information functions as a matter of orchestrating non-representational forces. In this mode, "information" pertains to those operations that attempt to actuate or facilitate the effects of certain arrangements; it regulates flows, modulates signals, distributes relationships. It decides *what* goes *where* (and in what proportions). It does not re-present a given state of affairs, but rather *intervenes directly in it*, helping to shape it: information *for* reality.

Recall that MacKay (1969) understood this modality rather well (see Chapter 2), as he distinguished between the "selective" (or syntactic) function of information (which Shannon's theory foregrounded) and the "descriptive" (or semantic) function that complemented it. MacKay maintained Shannon's insistence on a fundamentally non-semantic (or a-signifying) dimension of information processes. "By the theory of information," he writes, "we shall mean broadly the theory of *processes by which representations come into being*, together with the theory of those abstract features which are common to a representation and that which it represents" (p. 80, emphasis added). According to MacKay, a-signifying forces "justify" (p. 80) representational activity; they undergird it, establishing its concrete conditions. Indeed, this is why MacKay ultimately settled on a *pragmatic* theory of "meaning" for information theory and not a *semantic* one: because he imagined messages as "keys" with the ability to perpetuate or attenuate effects across complex constellations of heterogeneous elements and modulate their potentials (what MacKay called their various states of "conditional readiness" for action),

MacKay framed the problem of "meaning" as always first and foremost one of organizing an "information space" (p. 92) by activating some elements of a situation and not others. "The meaning of a message," he wrote, "may be defined as its selective function on a specified ensemble" (p. 92). "Selective" information theories like Shannon's address precisely how the processes through which the conditions for meaningfulness—not the "transfer" of meaning itself—become part of the communication process. These processes are primarily a-signifying.

Research regarding information's a-signifying modality has proliferated lately (see Langlois, 2011, 2012, 2014; Rieder, 2012; Terranova 2004b; Thomas, 2013), as theorists and critics have attempted to describe "how digital platforms reconfigure life in networked societies" (Thomas, 2013, p. 1), and specifically how emerging socio-technical ensembles ask us to attend to "the governance of the heterogeneous conditions within which specific meanings come to appear" (Langlois, 2011, p. 8). Such investigations foreground the non-representational and non-semantic operations of contemporary media technologies (and, in particular, what one might call "information technologies"). But perhaps one of the most popular critical investigations of information's a-signifying modality is Galloway's (2004) elucidation of "protocol," that "distributed management system" for 21st century power relations (p. 8). For Galloway, "protocol" names the set of concrete conditions for the actuation of relations, a "*proscription for structure*" that determines the ways entities connect and relate (p. 30, emphasis in original). A protocol "regulates flow" (p. 74); it outlines the material contours of specific relations,

the concrete possibilities for action in specific configurations. It names *what* is connected (or isn't), *what* transpires (or doesn't), and *how* (or not). And with a slight nod to Shannon and Wiener (though using an economic vocabulary they would not), Galloway calls information "the key commodity in the organizational logic of protocological control" (Galloway & Thacker, 2007, p. 57).

Struggles over information in its a-signifying modality typically concern efforts to establish, police, and rework the various (dis)connections that make certain activities (im)possible. Ruppert (2012, 2013) highlights such struggles, for example, in her research on management information system (MIS) practices as they relate to the administration of juvenile offenders and "at risk" populations in the UK. She explores the way certain information systems selectively arrange certain statistical parameters through ongoing acts of calculation and assessment in order to make particular bodies visible and actionable under particular conditions. For Ruppert, databasing techniques and technologies are ways of managing the various contingent linkages and couplings that make certain bodies available for forms of intervention. Similarly, Rieder's (2012) investigation of "evaluative metrics" (software like Google's PageRank) work to distribute indicators of "importance, quality, relevance, performance, and so on" (para. 1). Through an analysis that is both genealogical and textual (both diachronic and synchronic), Rieder demonstrates the ways certain algorithmic variables shape and regulate complex collections of heterogeneous materials (like websites, in the case of PageRank), drawing some together, associating some with others, and distancing others from one

another. Such algorithms, he writes, "encode ways of putting things into relation that (can) fundamentally reconfigure how power is constituted" (para. 48). For thinkers like Pariser, it is a form of power in desperate need of address.

This mode of information's expressivity is salient in documentational and cultural grammars of information. While *normative* discourses in this register tend to treat information as signifying or representational, *counter-discourses* often stress information's *a-signifying* modality. Arguments against certain "informatic" juridical-technical assemblages like DRM (digital rights/restrictions management) technologies, for example, to criticize the technologies for *the ways in which they organize conditions of possibility* (the ways they organize a repertoire of actions available to a subject)—not for their "representational" functions (see, e.g., Stallman, 2014).

—As Reality

"Ever since the elucidation of the molecular basis of living systems, we have known that all elementary processes of life are governed by information," writes Bern-Olaf Küppers of the Friedrich Schiller University of Jena (2014, p. 217). He is attempting to demonstrate information's cosmic fundamentality by insisting that it makes worlds hang together. "The processes of life would implode into a jumble of chaos if they were not perpetually stabilized by information and communication," he says (pp. 217-218). For Küppers, anything that organizes communicates, for communication is the very *process* of organization itself: "'Communication' means neither more nor less than the reciprocal harmonization and coordination of processes by means of chemical, acoustic, and optical signals" (p. 220). Communication is what patterns the

universe—gives is a basic, operational order. And anything that exhibits order might find its way under the aegis of "structural sciences," which endeavor to discern "the way in which reality is structured—expressed, investigated, and described in an abstract form [...] irrespective of whether these structures occur in a natural or an artificial, a living or a non-living, system" (p. 232-233). Küppers' "structural sciences" attend to *the fact of order itself*; they examine how the world gets *in-formed* and, as such, establishes the preconditions for all that is: information *as* reality.

This is information in its a-semiotic mode. It is, in other words, information as *a-semiotic encoding*, an ongoing process of (in)formalization that organizes "matter" (conceived broadly as Hjelmslev does—as potentiality). Here information is not *form* but *formalization* (an *encod-ing*); it is organization *qua* organization, and it operates outside the planes of content and expression. Information is the simple and sheer fact of repeatability or unrepeatability, *the* basic movement of organization or disorganization. It is the particular taking-form that occurs with greater or lesser probability.

Information as a-semiotic encoding is the *object of inquiry* early American information theorists described as part of their mathematical and engineering endeavors. It discloses some seemingly "fundamental" relationship between order and chaos (Wiener), predictability and unpredictability (Shannon). As Chapter 2 explained, these thinkers were responding to what they perceived to be a drastic reconfiguration of conjunctural dynamics, which rearticulated knowledge of the universe as a fundamentally probabilistic place. This shift prompted a flurry of activity aimed at comprehending and ultimately controlling

this contingency, but such activity—and the conceptual resources it spawned, including the notion of "information"—would have been inconceivable, even unnecessary, at a time when Newtonianism reigned. Using Deleuzean-Guattarian language, one might suggest that these thinkers crystallized a new *diagram*, a new organization of content and expression that stressed probability and, by extension, contingency, as the inescapable way of the world. Scientists and engineers like Wiener and Shannon *illuminated* this diagram by developing materials to cope with, or subsist in it. Building theories of information, that measurable quantity to which other researchers could apply various mathematical and scientific instruments, was one of the ways they did so.

They were not alone. A probabilistic imaginary animates even the Deleuzean-Guattarian vocabulary this dissertation mobilizes to make sense of this shift itself. This fact complicates deployment of the term "diagram" in this context, because Deleuze and Guattari are themselves indebted to the conceptual resources that emerged from this conjuncture, and their "diagram" is one result of this debt. This is to say that their ability to imagine the world as a kind of fluctuation between more-or-less chaotic states—or the very idea of a "fundamental" tension between order and chaos as a world-making mechanism in the first place—is part and parcel of the imaginary they mobilize in their philosophizing; the *concept* of a "diagram" names the idea that the world's contingency is organized according to non-necessary distributions, and the idea that the world is composed of non-necessary distributions is *itself* part of a contextually-specific diagram (more on this soon). As Chapters 3 and 4 illustrate, a specific conceptual genealogy links the notion of a probabilistic

universe with 20th century developments in metaphysics. Deleuze and Guattari developed their immanentist ontology under the direction of (and with conceptual resources from) this very non-Newtonian line of thought.

Contingency and immanentism do not imply one another (one might call Spinoza's metaphysics an immanentism without contingency, for example), but the particular combination these philosophers articulated resonates with the processes and problematics of their cybernetic forebearers.

Struggles over information in its a-semiotic modality tend to foreground this organizational (i.e., diagrammatic) mechanic: a dynamic between order and disorder, a tension between coherence and incoherence. Indeed, this is the primary "pivot" for *metaphysical* grammars of information, which stress information's capacity to configure the undifferentiated (i.e., the entropic). Accounts like Küppers' are becoming increasingly more common, for, as award-winning essayist and physicist Ken Wharton puts it, the force of their logic has become entrenched, "so strong that many physicists can't even articulate what other type of universe might be conceptually possible" ("Why the Universe," para. 3). Articulating new models of the universe—new *diagrams*—concerns addressing the deep-seated and commonsensical: what, in Deleuze's (1988) terms, is "seeable" and "sayable" as part of a certain configuration. Mounting resistance to diagrams would be akin to launching an attack on something as grand as "discipline" (one of Foucault's most famous diagrams) or "control" (one of Deleuze's). It would involve imagining a universe that resists description in terms of the more-or-less calculable, one in which the twin polarities of order

and chaos lose their ability to organize a world—a world in which the calculability of everything imaginable itself becomes difficult to imagine. In this way, other diagrams become possible.

On the Agency of the Informatic (Once More)

The *problem-space* of information discloses the *problematic* of agency, conceived here as some ability to influence the shape, valence, contours, or effectivity of a social formation. Because social formations are assemblages that help determine the capacities of the elements they assemble as part of their specific *agencements*, this ability to influence assemblages' compositions is an important object of inquiry for critical social and cultural theory. This chapter concludes by examining the figures of agency, the "agential imaginaries," that have become part and parcel of various grammars of information, which differentiate themselves precisely by foregrounding different modalities of information's mixed semiotics.

On the Agency of the Signifying

In information's signifying modality, "agency" typically refers to practices of (mis)appropriation and/or (mis)representation. It figures as a capacity to wield, protect, or otherwise utilize information object-commodities. In other words, agency pertains to a subject's relative ability to either *use* or *protect* information "about" something (often themselves); it refers to some faculty for controlling proliferations of representations. Recall that for Guattari signifying

semiologies operate on and with *fully formed* and *discrete* signs that traffic on the planes of content and expression. These signs have become bounded *objects* capable of being transported, circulated, controlled—and *possessed*.

In the context of (neo)liberal capitalism, this figure of agency frequently embraces an ethos that champions autonomous individuals' *responsibility* for their own information (in the face of entities, such as corporations, who may wish to mishandle or usurp it). This is precisely the agential imaginary at work, for instance, in various exhortations to protect one's "personal information". Such exhortations are in no short supply in places like the United States Federal Trade Commission's online "Consumer Information" guides, which implore citizens to "secure" their personal information, to "know who [sic] you share it with," to "store and dispose" of it diligently, to "ask questions before deciding to share" it, and to "maintain appropriate security" on portable electronic devices that carry it ("How to Keep," para. 1). Here is an agential imaginary that often aligns productively with discourses and apparatuses of responsabilization and individualization. It also underpins "data portability" discourses, which call for removing any and all constraints on individuals' abilities to "move" their information between various services (social networks, cloud storage lockers, and so forth). Google, for example, maintains its own "Data Liberation Blog," which keeps Google users abreast of ways "we're making it more convenient for you to retrieve your information however you want" (Lueck, 2012, para. 2).

In its signifying register, informatic agency is a matter of sovereign individuals' capacity for managing various forms of *possession*: their possessions, the informatic commodities they generate and acquire, as well as their self-possession, their relative ability to leverage those commodities in efforts to increase their own freedom, autonomy, and rational decision making. Information functions to the extent that it reveals the truth about some set of conditions (or, rather, it *can* do so should an actor simply acquire enough of it), and can therefore aid efforts at adequately grasping "real" conditions. Agency is the enactment of individual freedoms, an ability to overcome (or at least operate counter to) determinations. For decades, techno-utopians and social conservatives alike insisted that "information wants to be free." In activist Cory Doctorow's (2014) recent rebuke of the maxim is a more appropriate expression of informatic liberty:

[...] Thirty years on, the phrase has gone from a useful way of provoking discussion about the philosophy of information society to a trite slogan that obscures more than it illuminates. It's time to kill it. The "desires" of information are totally irrelevant to the destiny of the Internet, the creative industries, or equitable society. Information is an abstraction, and it doesn't "want" anything. Information doesn't want to be free—people do. (p. 94)

Whatever Doctorow's "philosophy of information society," information's own expressivity clearly has no place in it.

On the Agency of the A-signifying

In information's a-signifying modality, "agency" names an ability to actuate the possibilities certain arrangements afford, to manage collections of elements by triggering particular affordances according to established logics. It refers to a capacity for modulating connections that facilitate various actions and relations. Agency is an ability to enact some prescription *for* reality.

In its a-signifying mode, informatic agency pertains to something "dynamic and productive (capable of multiple articulations) but rigorously constrained" (Genosko, 2009, p. 103). As Genosko explains, "meaning is not essential in [a-signifying] activity, but specific codes, algorithms, materials, and standards are" (p. 103). This is to say, then, that the a-signifying dimension of agency involves not the subversion, contortion, or supersession of "structure" but rather the effective execution of established relationalities. Thus, to Genosko's list one might add "protocols," the non-semantic facilitators of informatic action outside the register of representation. Here, agency is the actuation or activation of proscriptions for relation—an ability to modulate a field of connectivities and/or breaks, to "give out stop and start orders" (recall Guattari, 1995, p. 49). Popular critics like Pariser tend to frame the question of informatic agency in non-signifying terms; with regard to "filter bubbles," for example, "agency" pertains to those actions that involve particular boundary conditions (what links to what, which relations become salient and significant, what gets displayed) according to particular established logics (in this case, the logics of the PageRank algorithm, which ensures "there is no standard Google any more" by shuffling connections according to past activities).

Likewise, much writing on the agency of "code" expresses this a-signifying modality of information's mixed semiotics. Consider MacKenzie (2005, 2006), who takes issue with those accounts that would attribute to software a kind of "secondary agency"—that is, the simple capacity of "supporting or extending the agency of some primary agent: the programmer, the corporation, the hacker, the artist, the government or the user." He argues for the essentially *agential* nature of code (p. 8). For him, code harbors agential capabilities because it helps determine the speed, direction, and valence of certain intensities or lines of force—certain abilities to *influence* some *arrangement*. "We recognize other people as agents (to a lesser or greater extent) because they have the capacity to act," he writes. "But in milieus populated with bodies, things, systems, conventions and signs (and this is virtually everywhere), agency distributes itself between people or events and ensembles that generate different attributions" (p. 10). In arguing for code as principally agential, then, MacKenzie implicitly recognizes code's non-semiological role in helping determine relationalities. This is to say that his "different attributions" materialize as differently-distributed capacities for acting (or acting *effectively*) and, by extension, for *agency*.

Interlude: Against the Resource Doctrine of Information

The resource doctrine of information makes use of those modalities of information's expressivity that treat information as a matter of *content*. Consequently, it straightjackets discussions of information—and of popular *struggles* over information—according to particular logics. For example, in his recent *Information Politics*, Tim Jordan details multiple forms of exploitation

central to struggles over information. He works to "locate the specificity of information as a form of exploitation and liberation in the twenty-first century" (Jordan, 2015, p. 3). Jordan is especially interested in identifying and (ultimately) avoiding political strategies that actually *reinforce* the very structures of power they seem designed to dismantle.

Many of these strategies, Jordan says, take two notions for granted: first, that information is property, and second, that struggles over information are therefore akin to other struggles over ownership and sovereignty. "Information about an individual [...] is fetishised as a quality of the individual, [sic] it may appear to the provider as their property because it derives from their self and their singularity" (p. 201). "However," he continues, "information about anyone or any thing is only made into property by certain social relations" (p. 201). Information-as-property is, in other words, a specific social, cultural, and economic *production*, one that, for Jordan, seriously misconstrues the *true* nature of information.

Using terminology from economics, Jordan describes information as a "non-rival good," something that fails the test of exclusivity and can belong to two parties simultaneously without significant depreciations in utility. And yet, Jordan says, contemporary struggles over information continue to treat information in a manner contrary to its essence: as a *rival* good, as something that can and should "belong" to some individuals and not others. In doing so, he says, they risk leaving unchallenged the particular set of incorporeal transformations that transform information into property *in the first place*:

Focusing on the rights of the network tempts us to base information liberation on a right to control information about one's self, which may have tactical efficacy or may be important in the connection to another political antagonism, but which pays for its efficacy by confirming the basis for privatisation of what could be collective information benefits. (p. 216)

Information "by nature" lends itself to what Jordan calls "simultaneous complete use" (p. 201), or non-exclusive relations in which social actors *share* and do not *exhaust* the value of a good. Treating information otherwise would be to act in discord with this nature—and to unwittingly support the very actors whose attempts at enclosure are the motor of information politics.

Jordan suggests, then, that completely realizing information's benefits means fighting for it to *remain* a non-rival good; he writes that "the enclosures of information platforms need then to be examined not so much in terms of the fact of enclosure" but rather in altogether new terms, "in terms of the benefits that are drawn from the enclosure of information that could potentially be available to many at once but which actually may only be available to the platform controller" (p. 204). Information should be available to all, Jordan implies; it should *remain common*, operate *outside of* or *beyond* private property relations. And we can ensure it does through the construction of "devices and network-protocols that prize information for its capacity for simultaneous complete use that delivers benefits through openness, access and making to all information citizens" (p. 217). Such would be a politics of information *in line* with information's essence as a non-rival good: an ability to

make use of information equitably, justly, and fairly in a world where "all [might] share simultaneously in any bit of information and [...] use that bit to its full extent" (p. 23).

Jordan's hand-wringing over political strategies that refuse to disrupt or displace an informational commonplace (that information is, or should be, a kind of private property) is certainly not unfounded. And yet while Jordan readily recognizes the *constructed* nature of information-as-property (its "fetishization" through the work of various overlapping social, political, and economic apparatuses) he seems less capable of recognizing the *very same fact* about information's "natural" status as a "non-rival good." For this, too, is an articulation, one with powerful and pervasive effects—effects so powerful and pervasive, in fact, that they often manage to successfully mask the conditions of their own artifice and operate as a set of taken-for-granted knowledges about information's "essence." For even as Jordan convincingly challenges the idea of *information-as-property*, he leaves untouched the notion of *information-as-resource*; he balks at the idea that information should be *enclosed*, but seems to take no issue with the notion that information remains something to be *stored*, *amassed*, *tapped*, etc.

Failing to question information's status as a resource limits the repertoire of effective political tactics available to actors attempting to resist informatic regimes of power. More specifically, conceiving information as a resource *orients* such tactics around questions of *use*. Jordan attempts to frame this question around a convenient bipolarity: that between the "rival" and the "non-rival." Neither status jettisons the assumption that information remains

something to be *tapped* or *used*; each simply names a different *approach* to such use. Moreover, Jordan's descriptions clearly grant each polarity a specific ethical and political valence: the "rival" is detrimental and undesirable, while the "non-rival" is beneficial and desirable.

Unfortunately, Jordan's argument for ensuring information's status as a "non-rival good" fails to achieve the kind of solution he seeks, in part because the question of *use* is more complicated than a rival/non-rival binary can express. Jordan's dichotomy is meant to frame a distinction between the enclosed and/or delimited (i.e., the "rival") and the *unencumbered* or *free* (i.e., the "non-rival"), but nothing about a particular good's status as "non-rival" prevents multiple parties from sharing it *while at the same time* preventing still others from doing so. Many open source and free software licenses, for example, strictly limit the ways actors may *share* the goods these licenses govern. The reality of the ways in which people *use* and *share* goods—informational or not—is more complex.

But more important than the conceptual limitations of Jordan's argument are the political ones. By dismissing the "rival" as categorically undesirable, Jordan risks ignoring one important way actors might struggle over information. In early October 2015, for instance, a European court invalidated 15-year-old "safe harbor" regulations, which permitted companies in the United States to treat data according to U.S. law (rather than European law, which is more strict) when shuttling it across the Atlantic. In light of reports that U.S. agencies were making regular use of mass surveillance techniques and technologies, European officials wanted to ensure that the U.S. government

"collect[s] personal information" only in ways that are in accordance with European data protection provisions (Levine, 2015, para. 6). Max Schrems, a 28-year-old law student at the University of Vienna, initiated the decision when he filed suit against Facebook, which he discovered was not in compliance with European data retention provisions (Facebook mailed him "a CD [...] with more than 1,200 pages of information," some of which he'd assumed were safely deleted [Levine, 2005, para. 7]). Facebook's terms of service did not violate U.S. laws—but they did not comply with Europe's. The case underscored critical differences between two vastly different legal traditions for addressing privacy (Scott, 2015). In this particular instance, however, U.S. corporations whose stock-in-trade is the accumulation and analysis of personal data for the purpose of selling targeted advertising appeared to champion Jordan's so-called "non-rival" position on informational goods. By insisting that information should move uninhibited across international boundaries, they reinforced the belief that "sharing" information does not *detract* from that information's "essential" value—in which other users remain welcome to partake. Schrems' case insists that U.S. firms comply with European data retention laws, which dictate that *only* agencies from countries in which personal data are generated may attempt to access those data; his suit initiates a counter-discourse predicated *precisely* on the notion of information as a rival good, something not everyone should share. It was for him a different *kind* of resource.

That resource, of course, is never without a subject that utilizes it. In Jordan's case, being a good "information citizen" means demonstrating "openness" with information-goods, demanding access to the information-stuff

that represents us (as did Schrems), and using information to make decisions as part of and for the betterment of the polity. This is the political imaginary that fits hand-in-glove with a resource view of information, a decidedly liberal one in which individual subjects draw on the informational assets at their disposal as part of their efforts at rational decision-making, all against a backdrop of institutional frameworks designed to either facilitate or hamper this practice. The resource doctrine's *political imaginary* therefore includes a specific *agential imaginary*, some shared belief in the status, role, and capacities of agents. It is a *dualistic* imaginary, one that pits agent-subject against structure-object in struggles that either hamper or enhance the subject's ability to act autonomously. Consequently, an information politics built on the resource doctrine of information is a politics of *appropriation* in which the question of informatic power is a question of use.

On the Agency of the A-semiotic

In information's a-semiotic modality, "agency" typically articulates and encapsulates the problem of (in)coherence or (in)stability. It figures as a capacity to make redundant (to shore up, to stabilize) or to make novel or divergent (to disperse, to scramble). Indeed, this figure of agency "works" precisely because it is predicated on the knowledge—or rather, the diagrammatic configurations that articulate *possibilities* for knowing—that aspects of this world might exist in greater or lesser states of organization or disorganization (recall, for example, Barad's "agency" as articulated in agential realism). "Agency," in short, *names something that operates on the ratio of order to disorder*.

Thus, "order" and "disorder" assume particular axiological valences depending on the contexts of their deployment and the proclivities or dispositions of those invoking them. For instance, some contemporary writing in critical social theory (especially that inspired by the work of Gilles Deleuze) depicts agency as a capacity to dislodge reified structures, to rupture established patterns—or, in Deleuze's (and sometimes Guattari's) words, to become minoritarian, to move from a state of molarity (of structure or rigidity or homogeneity) to molecularity (to chaos or unpredictability or heterogeneity). Indeed, in certain strands of critical social and political theory today, this view of agency has become somewhat *normative*; agency here looks something like the act of "overcoming [molar] perspectives and tapping into molecular desires" (Widder, 2012, p. 129), of deterritorializing the territorialized, of introducing confusion or irregularity into the otherwise smooth functioning of powerful forces that capture and reify flows of energy and desire (see also Grossberg, 2014). For a progressive politics born of these conceptualizations, order (or territorialization) is undesirable while disorder (or deterritorialization) is desirable.

These valences lead popular commentators like Hayles (1999), for example, to label American information theory a principally *conservative* enterprise, given its propensity for privileging stasis over change (*conservation* above all else). For in Wiener's universe—where fragmentation and dissolution are purportedly "natural," inevitable, and ongoing processes—to be agential is to *counter* entropy, to persist in light of forces that fracture and dissolve. To be agential is to *construct* and *maintain*. As contemporary formations of power

multiply and hone their inducements to metamorphosize (to change, to become-different, to become-singular), such acts of *maintenance* actually begin to assume some political purchase. Indeed, stability and maintenance might present some of the most incisive and strategic political possibilities imaginable in certain situations. American information theories demonstrate, then, ways in which "conservation" might occasionally be resistive or politically progressive. At any rate, their respective political valences are, as the theories themselves, contextually specific.

As previous chapters have demonstrated, an ability to imagine the world as a particular balance between order and disorder *is itself* part and parcel of a diagram that discloses this possibility, one that gives rise to the problem of information as a mathematical concern. In fact (as previously explained), the *concept* of "the diagram" (one of Deleuze and Guattari's principal ordering mechanisms) *is itself* possible because of the philosophers' *situation* in epistemic and material configurations that make the world "knowable" as an ongoing state of (dis)organization. Considering information's a-semiotic modality underscores the social and historical contingency of the very problem that animates information as a problem-space.

Agency Beyond Subjectivity (or, Some Entropy)

Understanding each of these agential modalities facilitates attempts to track and diagnose relations of power inherent to contemporary struggles over information. It also assists the formulation of strategies and tactics for intervening in these struggles. This chapter parses information's mixed

semiotics in order to illuminate the complexity of information's dynamics in contemporary contexts—in the hope, of course, that better understanding this complexity assists efforts to tell stories that engage with it.

Today these stories tend to assume that information is a resource for which individual subject can (or should) take responsibility. What American information theory during the wartime and postwar periods reminds us, however (and what this dissertation has endeavored to demonstrate), is that the problem of information need not necessarily, even primarily, be a problem *of or for* the subject. Indeed, reading mathematical theories of information recuperatively and unpacking the theoretical work they begat discloses a set of concerns much broader than a singular preoccupation with subjects and subjectivity will allow, for these mathematical theories of information arose at a time when the unity and self-assuredness of the euro-modern subject was less certain. Popular postwar theories of information (such as Shannon's and Wiener's) *do not concern subjects*, even if subsequent readers eventually read this work as doing so. These theories express a profound and compelling interest not in the ways subjects might *use* informational resource-objects, but rather with the ways *fields of influence and effectivity get organized*, the ways certain material arrangements might be modulated and controlled. Such an analytical focus shifts attention from the activities of individual (typically human) actors to the *broader processes of organization* that establish the conditions of possibilities for living and thriving under certain social conditions. In short, it opens onto the question of *agency beyond subjectivity*.

The question of what one might call "informatic agency" is therefore not simply a question of what one "does" with her or his "information." It is not merely a question how so-called "information technologies" inhibit, diminish, or otherwise usurp individual actors' relative autonomy. As a mixed semiotic approach to information demonstrates, information's problem-space addresses a number of concerns, including the ways "informatic" organizations take hold in particular social formations. The problem of information in its *signifying* modality concerns the ways subjects relate to (and cope with) what they come to "know" as informational objects—how they work to protect their "personal information" or sell "informational goods." But the problem of information in its *a-signifying* modality concerns precisely those processes that supersede or subtend individual subjects' actions, the *machinic* processes that *modulate the conditions* for action in accordance with certain aims or directives—how they manage and/or maintain various contingent relations, how they negotiate both their symbolic roles and embodied capacities in conjunction with various "information systems." And the problem of information in its *a-semiotic* modality addresses the very "fact" of a contingent universe itself, the pervasive and persistent tendency to conceive the world as a fluctuating probabilistic field, a nexus of order and disorder, certainty and uncertainty, in which particular positions, activities, and compartments become salient—how actors come to think "informationally" about their worlds, conceive them as unrelentingly contingent and binaristic milieus in desperate need of certain types of management.

Politics under the auspices of the resource doctrine of information too quickly elide all but those informatic problems operating in a signifying register. This dissertation aims to enhance both *discussions* of struggles involving an "informational" component and attempts to *intervene* in those struggles. Understanding the problem-space of information—the particular issues, knowledges, logics, and histories this concept betokens and articulates—can only enhance our engagement with it. For to understand information is, in part, to understand "what we are in the process of becoming" (Deleuze, 1992, p. 164).

REFERENCES

- Ada, F. (2014, July 17). Some communities in Sub-Saharan Africa have no online presence. 'Kumusha Takes Wiki' wants to help change that. *Global Voices*, n.p. Retrieved September 16, 2015, at <http://globalvoicesonline.org/2014/07/17/kumusha-takes-wiki-helps-africans-own-information-on-wikipedia/>
- Anderson, B., Kearnes, M., McFarlene, C., Swanton, D. (2012). On assemblages and geography. *Dialogues in Human Geography*, 2(2), 171-189.
- Andrejevic, M. (2013). *Infoglut: How too much information is changing the way we think and know*. New York, NY: Routledge.
- Ash, R. B. (1965). *Information theory*. New York, NY: Dover Publications.
- Ashby, W. R. (1956). *An introduction to cybernetics*. New York, NY: John Wiley & Sons.
- Aspray, W. (1985). The scientific conceptualization of information: A survey. *IEEE Annals of the History of Computing*, 7(2), 117-140.
- Assange, J. (2010). The Wikileaks manifesto. Retrieved February 04, 2015, from <https://littlealexinwonderland.wordpress.com/2010/08/01/the-wikileaks-manifesto/>
- Balnaves, M., & Willson, M. (2011). Information and its reality (definitions, disciplines and dichotomies). In *A new theory of information and the Internet: Public sphere meets protocol* (pp. 14-44). New York, NY: Peter Lang.
- Barad, K. (2003). Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs*, 28(3), 801-831.
- Barad, K. (2007). *Meeting the universe halfway: Quantum physics and the entanglement of matter and meaning*. Durham, NC: Duke University Press.

- Barlow, J. P. (2008). Foreword. In C. Doctorow, *Content: Selected essays on technology, creativity, copyright, and the future of the future* (pp. xv-xxii). San Francisco, CA: Tachyon Publications.
- Bateson, G. (1972a). Cybernetic explanation. In *Steps to an ecology of mind* (pp. 405-416). Chicago, IL: University of Chicago Press.
- Bateson, G. (1972b). Redundancy and coding. In *Steps to an ecology of mind* (pp. 417-431). Chicago, IL: University of Chicago Press.
- Beniger, J. R. (1986). *The control revolution: Technological and economic origins of the information society*. Cambridge, MA: Harvard University Press.
- Bennett, J. (2004). The force of things: Steps toward an ecology of matter. *Political Theory*, 32(3), 347-372.
- Bennett, J. (2010). *Vibrant matter: A political ecology of things*. Durham, NC: Duke University Press.
- Brophy, J. E. (2010). Developing a corporeal cyberfeminism: Beyond cyberutopia. *New Media & Society*, 12(6), 929-945.
- Bryant, L. (2013). The gravity of things: An introduction to onto-cartography. *Anarchist Developments in Cultural Studies*, 2, 10-30.
- Buckland, M. (1991). *Information and information systems*. New York, NY: Praeger.
- Byfield, T. (2008). Information. In M. Fuller (Ed.), *Software studies: A lexicon* (pp. 125-132). Cambridge, MA: MIT Press.

- Callon, M., & Latour, B. (1981). Unscrewing the big Leviathan: How actors macro-structure reality and how sociologists help them do so. In K. Knorr-Cetina and A. V. Cicourel (Eds.), *Advances in social theory and methodology: Toward an integration of micro- and macro-sociology* (pp. 277-303). London: Routledge.
- Casper, M. J. (1994). Reframing and grounding nonhuman agency: What makes a fetus an agent? *American Behavioral Scientist*, 37(6), 839-856.
- Chan, K. (2009, February 16). On Facebook, people own and control their information. *The Facebook Blog*. Retrieved February 04, 2015 from <http://blog.facebook.com/blog.php?post=54434097130>
- Cherry, E. C. (1951). A history of the theory of information. *Proceedings of the IEEE*, 98(55), 383-393.
- Clarke, B., & Hansen, M. B. N. (2009). Introduction: Neocybernetic emergence. In B. Clarke & M. B. N. Hansen (eds.), *Emergence and embodiment: New essays on second-order systems theory* (pp. 1-25). Durham, NC: Duke University Press.
- Colls, R. (2007). Materialising bodily matter: Intra-action and the embodiment of 'Fat.' *Geoforum*, 38, 353-365.
- Conway, F., & Siegelman, J. (2005). *Dark hero of the information age: In search of Norbert Wiener, the father of cybernetics*. New York, NY: Basic Books.
- Coole, D. (2005). Rethinking agency: A phenomenological approach to embodiment and agential capacities. *Political Studies*, 53, 124-142.
- Coole, D., & Frost, S. (2010). *New materialisms: Ontology, agency, and politics*. Durham, NC: Duke University Press.
- Davies, P. (2014). Universe from bit. In *Information and the nature of reality: From physics to metaphysics* (pp. 83-115). Cambridge: Cambridge University Press.

- Day, R. E. (2001). *The modern invention of information: Discourse, history, and power*. Carbondale, IL: Southern Illinois University Press.
- Day, R. E. (2011). Death of the user: Reconceptualizing subjects, objects, and their relations. *Journal of the American Society for Information Science and Technology*, 62(1), 78-88.
- Deleuze, G. (1988). *Foucault*. Minneapolis, MN: University of Minnesota Press.
- Deleuze, G. (1992). Postscript on the societies of control. *October*, 59, 3-7.
- Deleuze, G. (1992). What is a dispositif? In T. J. Armstrong (Ed.), *Michel Foucault: Philosopher* (pp. 159-168). New York, NY: Routledge.
- Deleuze, G., & Guattari, F. (1977). *Anti-Oedipus: Capitalism and schizophrenia*. New York, NY: Penguin Books.
- Deleuze, G., & Guattari, F. (1987). *A thousand plateaus: Capitalism and schizophrenia*. Minneapolis, MN: University of Minnesota Press.
- Doctorow, C. (2014). *Information doesn't want to be free: Laws for the Internet Age*. San Francisco, CA: McSweeney's.
- Edwards, P. N. (1996). *The closed world: Computers and the politics of discourse in Cold War America*. Cambridge, MA: MIT Press.
- Elliot, P. (2012). *Guattari reframed*. New York, NY: I. B. Tauris.
- Escobar, A. (2007). The 'ontological' turn in social theory. *Transactions of the Institute of British Geographers*, 32, 106-111.
- Faucher, K. X. (2013). *Metastasis and metastability: A Deleuzean approach to information*. Boston, MA: Sense Publishers.

- Floridi, L. (2010). *Information: A very short introduction*. Oxford: Oxford University Press.
- Floridi, L. (2011). *The philosophy of information*. Oxford: Oxford University Press.
- Foucault, M. (1972). *The archaeology of knowledge*. New York, NY: Vintage Books.
- Foucault, M. (1978). *The history of sexuality volume 1: An introduction*. New York, NY: Vintage Books.
- Foucault, M. (1983). The subject and power. In H. L. Dreyfus & P. Rabinow, *Michel Foucault: Beyond structuralism and hermeneutics* (2nd ed.) (pp. 208-226). Chicago, IL: University of Chicago Press.
- Foucault, M. (2004). *Security, territory, population: Lectures at the Collège de France 1977-1978*. New York, NY: Picador.
- Foucault, M. (2010). Nietzsche, genealogy, history. In P. Rabinow (ed.), *The Foucault reader* (pp. 76-100). New York, NY: Vintage Books.
- Galison, P. (1994). The ontology of the enemy: Norbert Wiener and the cybernetic vision. *Critical Inquiry*, 21, 228-266.
- Galloway, A. R. (2004). *Protocol: How control exists after decentralization*. Cambridge, MA: MIT Press.
- Galloway, A. R. (2014). The cybernetic hypothesis. *Differences*, 25(1), 107-131.
- Galloway, A. R., & Thacker, E. (2007). *The exploit: A theory of networks*. Minneapolis, MN: University of Minnesota Press.

- Genosko, G. (1998). Guattari's schizoanalytic semiotics: Mixing Hjelmslev and Pierce. In E. Kaufman and K. J. Heller (Eds.), *Deleuze and Guattari: New mappings in politics, philosophy and culture* (pp. 175-190). Minneapolis, MN: University of Minnesota Press.
- Genosko, G. (2002). Mixed semiotics. In *Felix Guattari: An aberrant introduction* (pp. 155-185). New York, NY: Continuum.
- Genosko, G. (2009). A-signifying semiotics. In *Felix Guattari: A critical introduction* (pp. 89-109). New York, NY: Pluto Press.
- Geoghegan, B. D. (2008a). The historiographic conceptualization of information: A critical survey. *IEEE Annals of the History of Computing*, 30(1), 66-81.
- Geoghegan, B. D. (2008b). Agents of history: Autonomous agents and crypto-intelligence. *Interaction Studies*, 9(3), 403-414.
- Geoghegan, B. D. (2011). From information theory to French theory: Jakobson, Levi-Strauss, and the cybernetic apparatus. *Critical Inquiry*, 38, 96-126.
- Gleick, J. (2001, December 30). The lives they lived: Claude Shannon, B. 1916; Bit player. *The New York Times*, n.p. Retrieved September 16, 2015, at <http://www.nytimes.com/2001/12/30/magazine/the-lives-they-lived-claude-shannon-b-1916-bit-player.html>
- Gleick, J. (2011). *The information: A history, a theory, a flood*. New York, NY: Pantheon.
- Grossberg, L. (1986). History, politics and postmodernism: Stuart Hall and cultural studies. *Journal of Communication Inquiry*, 10, 61-77.
- Grossberg, L. (1992). *We gotta get out of this place: Popular conservatism and postmodern culture*. New York, NY: Routledge.
- Grossberg, L. (1993). Cultural studies and/in new worlds. *Critical Studies in Media Communication*, 10(1), 1-22.

- Grossberg, L. (1998). The victory of culture, part I: Against the logic of mediation. *Angelaki*, 3(3), 3-29.
- Grossberg, L. (2010). *Cultural studies in the future tense*. Durham, NC: Duke University Press.
- Grossberg, L. (2014). Cultural studies and Deleuze-Guattari, part 1: A polemic on projects and possibilities. *Cultural Studies*, 28(1), 1-28.
- Guattari, F. (1984). *Molecular revolution: Psychiatry and politics*. New York, NY: Penguin Books.
- Guattari, F. (1995). *Chaosmosis: An ethico-aesthetic paradigm*. Bloomington, IN: Indiana University Press.
- Guattari, F. (1996a). Ritornellos and existential affects. In G. Genosko (Ed.), *The Guattari reader* (pp. 158-171). Cambridge, MA: Blackwell Publishers.
- Guattari, F. (1996b). Regimes, pathways, subjects. In G. Genosko (ed.), *The Guattari reader* (pp. 95-108). Oxford: Blackwell Publishing.
- Guattari, F. (1996c). The place of the signifier in the institution. In G. Genosko (ed.), *The Guattari reader* (pp. 148-157). Oxford: Blackwell Publishing.
- Guattari, F. (2011). *The machinic unconscious: Essays in schizoanalysis*. Los Angeles, CA: Semiotext(e).
- Guattari, F. (2008). *The three ecologies*. New York, NY: Continuum.
- Hacking, I. (1990). *The taming of chance*. Cambridge: Cambridge University Press.
- Hacking, I. (2006). *The emergence of probability: A philosophical study of early ideas about probability, induction and statistical inference*. Cambridge: Cambridge University Press.

- Hall, S. (1980). Cultural studies: Two paradigms. *Media, Culture and Society*, 2, 57-72.
- Hall, S. (1985). Signification, representation, ideology: Althusser and the post-structuralist debates. *Critical Studies in Media Communication*, 2, 91-114.
- Hall, S. (1986). On postmodernism and articulation: An interview with Stuart Hall. *Journal of Communication Inquiry* 10(2), 45-60.
- Halpern, O. (2005). Dreams of our perceptual present: Temporality, storage, and interactivity in cybernetics. *Configurations*, 13, 283-319.
- Hansen, M. B. (2004). *New philosophy for new media*. Cambridge, MA: MIT Press.
- Haraway, D. (1985). A manifesto for cyborgs: Science, technology, and socialist feminism in the 1980s. *Socialist Review*, 80, 65-107.
- Harman, G. (2009). *Prince of networks: Bruno Latour and metaphysics*. Melbourne: re.press.
- Harman, G. (2014). Entanglement and relation: A response to Bruno Latour and Ian Hodder. *New Literary History*, 45(1), 37-49.
- Hartley, R. V. L. (1928). Transmission of information. *Bell System Technical Journal*, 7(3), 535-563.
- Hayles, N. K. (1990a). Designs on the body: Norbert Wiener, cybernetics, and the play of metaphor. *History of the Human Sciences*, 3(2), 211-228.
- Hayles, N. K. (1990b). *Chaos unbound: Orderly disorder in contemporary literature and science*. Ithaca, NY: Cornell University Press.
- Hayles, N. K. (1999). *How we became posthuman: Virtual bodies in cybernetics, literature, and informatics*. Chicago, IL: University of Chicago Press.

- How to keep your personal information secure. (2012, July). Federal trade Commission. Retrieved September 16, 2015, at <http://www.consumer.ftc.gov/articles/0272-how-keep-your-personal-information-secure>
- Iliadis, A. (2013a). Informational ontology: The meaning of Gilbert Simondon's concept of individuation. *Communication +1*, 2, 1-19.
- Iliadis, A. (2013b). A new individuation: Deleuze's Simondon connection. *MediaTropes*, 4(1), 83-100.
- Johnston, J. (2008). *The allure of machinic life: Cybernetics, artificial life, and the new AI*. Cambridge, MA: MIT Press.
- Jordan, T. (2015). *Information politics: Liberation and exploitation in the digital society*. London: Pluto Press.
- Klir, H. J. (2006). *Uncertainty and information: Foundations of generalized information theory*. Hoboken, NJ: John Wiley & Sons.
- Wikimedia. (n.d.). Kumusha Takes Wiki/en. Retrieved September 12, 2015, at https://meta.wikimedia.org/wiki/Kumusha_Takes_Wiki/en
- Küppers, B. (2014). Information and communication in living matter. In P. Davies & N. H. Gregersen (Eds.), *Information and the nature of reality* (pp. 217-235). Cambridge: Cambridge University Press.
- Langlois, G. (2011). Meaning, semiotكنولوجies and participatory media. *Culture Machine*, 12, 1-27.
- Langlois, G. (2012). Participatory culture and the governance of communication: The paradox of participatory media. *Television & New Media*, 14(2), 91-105.
- Langlois, G. (2014). *Meaning in the age of social media*. New York, NY: Palgrave Macmillan.

- Lash, S. (2002). *Critique of information*. Thousand Oaks, CA: Sage.
- Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Cambridge, MA: Harvard University Press.
- Latour, B. (1988a). Irreductions. In *The Pasteurization of France* (pp. 151-236). Cambridge, MA: Harvard University Press.
- Latour, B. (as Johnson, J.) (1988b). Mixing humans and nonhumans together: The sociology of the door-closer. *Social Problems*, 35(3), 298-310.
- Latour, B. (1991). Technology is society made durable. In J. Law (Ed.), *A sociology of monsters* (pp. 103-131).
- Latour, B. (1993). *We have never been modern*. Cambridge, MA: Harvard University Press.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network theory*. Oxford: Oxford University Press.
- Levine, R. (2015, October 09). Behind the European privacy ruling that's confounding Silicon Valley. *The New York Times*, n.p. Retrieved November 02, 2015, from <http://www.nytimes.com/2015/10/11/business/international/behind-the-european-privacy-ruling-thats-confounding-silicon-valley.html>
- Lloyd, S. (2014). The computational universe. In *Information and the nature of reality: From physics to metaphysics* (pp. 118-133). Cambridge: Cambridge University Press.
- Losee, R. M. (1997). A discipline independent definition of information. *Journal of the American Society for Information Science*, 48(3), 254-269.

- Lueck, J. (2012). Now offering Docs for Takeout. *Google Data Liberation Blog*, n.p. Retrieved December 5, 2015 from <http://dataliberation.blogspot.com/2012/01/now-offering-docs-for-takeout.html>
- MacKay, D. M. (1969). *Information, mechanism and meaning*. Cambridge, MA: MIT Press.
- MacKay, D. M. (1983). The wider scope of information theory. In F. Machlup & U. Mansfield (Eds.), *The study of information: Interdisciplinary perspectives* (pp. 485-492).
- Mackenzie, A. (2005). The performativity of code: Software and cultures of circulation. *Theory, Culture & Society*, 22(1), 71-92.
- Mackenzie, A. (2006). *Cutting code: Software and society*. New York, NY: Peter Lang Publishing.
- Massumi, B. (1992). *A user's guide to Capitalism and Schizophrenia: Deviations from Deleuze and Guattari*. Minneapolis, MN: University of Minnesota Press.
- Masani, P., & Phillips, R. S. (1985). Antiaircraft fire-control and the emergence of cybernetics. In P. Masani (Ed.), *Norbert Wiener: Collected works, volume IV* (pp. 141-179). Cambridge, MA: MIT Press.
- Maturana, H. M., & Varela, F. J. (1972). *Autopoiesis and cognition: The realization of the living*. Boston, MA: D. Reidel Publishing.
- McCullagh, D. (2012). Verizon draws fire for monitoring app usage, browsing habits. *CNET*. Retrieved February 04, 2015 from http://news.cnet.com/8301-13578_3-57533001-38/verizon-draws-fire-for-monitoring-app-usage-browsing-habits/
- McMillan, B. (1989). Norbert Wiener and chaos. In P. L. Duren and U. C. Merzbach (Eds.) *A century of mathematics in America* (pp. 479-491). USA: American Mathematical Society.

- Mindell, D. A. (2002). *Between human and machine: Feedback, control, and computing before cybernetics*. Baltimore, MD: The Johns Hopkins University Press.
- Nahin, P. J. (2013). *The logician and the engineer: How George Boole and Claude Shannon created the information age*. Princeton, NJ: Princeton University Press.
- Obama, B. (2009). Freedom of Information Act. *Memorandum for the heads of executive departments and agencies*. Retrieved February 04, 2015 from <http://www.eff.org/files/filenode/foia/2009foia.mem.rel.pdf>
- Obama lashes out amid calls to free Assange. (2010, Deember 13). *The Sydney Morning Herald*, n.p. Retrieved February 04, 2015, from <http://www.smh.com.au/technology/technology-news/obama-lashes-out-amid-calls-to-free-assange-20101212-18u2c.html>
- Passoth, J., Peuker, B. M., & Schillmeier, M. W. J. (2012). *Agency without actors? New approaches to collective action*. New York, NY: Routledge.
- Pickering, A. (1995). *The mangle of practice: Time, agency, and science*. Chicago, IL: University of Chicago Press.
- Pickering, A. (2002). Cybernetics and the mangle: Ashby, Beer and Pask. *Social Studies of Science*, 32(3), 413-437.
- Pickering, A. (2010). *The cybernetic brain: Sketches of another future*. Chicago, IL: University of Chicago Press.
- Pickles, J. (2004). *A history of spaces: Cartographic reasoning, mapping and the geo-coded world*. New York, NY: Routledge.
- Pierce, J. R. (1973). The early days of information theory. *IEEE transactions on information theory*, 19(1), 3-8.

- Pierce, J. R. (1980). *An introduction to information theory: Symbols, signals and noise* (2nd ed.). New York, NY: Dover Publications.
- TED. (2011, March). Eli Pariser: Beware online "filter bubbles." Retrieved September 20, 2015, from http://www.ted.com/talks/eli_pariser_beware_online_filter_bubbles
- Price, R. (1985). A conversation with Claude Shannon: One man's approach to problem solving. *Cryptologia*, 9(2), 167-175.
- Protevi, J. (2009). Beyond autopoiesis: Inflections of emergence and politics in Francisco Varela. In B. Clarke & M. B. N. Hansen (eds.), *Emergence and embodiment: New essays on second-order systems theory* (pp. 94-112). Durham, NC: Duke University Press.
- Rasch, W. (2000). Injecting noise into the system. In Niklas Luhmann's *modernity: The paradoxes of differentiation* (pp. 52-69). Stanford, CA: Stanford University Press.
- Rieder, B. (2012). What is in PageRank? A historical and conceptual investigation of a recursive status index. *Computational Culture*, 2, n.p.
- Ritchie, D. (1986). Shannon and Weaver: Unravelling the paradox of information. *Communication Research*, 13(2), 278-298.
- Rogers, E. M., & Valente, T. W. (1993). A history of information theory in communication research. In J. R. Schement & B. D. Ruben (Eds.), *Between communication and information: Information and behavior, volume 4* (pp. 35-56). New Brunswick, NJ: Transaction Publishers.
- Rosenblueth, A., Wiener, N., & Bigelow, J. (1943). Behavior, purpose and teleology. *Philosophy of Science*, 10(1), 18-24.
- Rosenblueth, A., & Wiener, N. (1950). Purposeful and non-purposeful behavior. *Philosophy of Science*, 17(4), 318-326.

- Ruddick, S. (2012). Power and the problem of composition. *Dialogues in Human Geography*, 2(2), 207-211.
- Ruppert, E. (2012). The governmental topologies of database devices. *Theory, Culture & Society*, 29(4/5), 116-136.
- Ruppert, E. (2013). Not just another database: The transactions that enact young offenders. *Computational Culture*, 3, n.p.
- Sayes, E. (2014). Actor-network theory and methodology: Just what does it mean to say that nonhumans have agency? *Social Studies of Science*, 44(1), 134-149.
- Schiller, D. (2007). *How to think about information*. Chicago, IL: University of Illinois Press.
- Scott, M. (2015, October 07). In Europe-U.S. class on privacy, a longstanding schism. *The New York Times*, n.p. Retrieved November 02, from <http://www.nytimes.com/2015/10/08/technology/in-europe-us-clash-on-privacy-a-longstanding-schism.html>
- Shannon, C. E. (1948). A mathematical theory of communication. *The Bell System Technical Journal*, 27(3), 379-423.
- Shannon, C. E. (1949). Communication in the presence of noise. *Proceedings of the IEEE*, 37(1), 10-21.
- Shannon, C. E. (1950). The redundancy of English. In H. von Foerster (Ed.), *Cybernetics: Circular causal and feedback mechanisms in biological and social systems (Transactions of the seventh conference)* (pp. 123-158). New York, NY: Josiah Macy, Jr. Foundation.
- Shannon, C. E. (1993a). Communication theory—exposition of fundamentals. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 173-176). New York, NY: IEEE Press.

- Shannon, C. E. (1993b). Recent developments in communication theory. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 190-193). New York, NY: IEEE Press.
- Shannon, C. E. (1993c). The bandwagon. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 462-466). New York, NY: IEEE Press.
- Shannon, C. E. (1993d). General treatment of the problem of coding. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 177-179). New York, NY: IEEE Press.
- Shannon, C. E. (1993e). Letter to Vannevar Bush, February 16, 1939. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 455-456). New York, NY: IEEE Press.
- Shannon, C. E. (1993f). The lattice theory of information. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 180-183). New York, NY: IEEE Press.
- Shannon, C. E. (1993g). Communication theory of secrecy systems. In N. J. A. Sloane & A. D. Wyner (Eds.), *Claude Elwood Shannon: Collected papers* (pp. 84-143). New York, NY: IEEE Press.
- Shannon, C.E., & Weaver, W. (1963). *The mathematical theory of communication*. Chicago, IL: University of Illinois Press.
- Stallman, R. (2014, November 18). Opposing digital rights mismanagement (or digital restrictions management, as we now call it). Retrieved November 04, 2015, from <http://www.gnu.org/philosophy/opposing-drm.en.html>
- Slack, J. D. (1984). *Communication technologies and society: Conception of causality and the politics of technical intervention*. Norwood, NJ: Ablex Publishing.

- Slack, J. D. (1996). The theory and method of articulation in cultural studies. In D. Morley and K. Chen (Eds.), *Stuart Hall: Critical dialogues in cultural studies* (pp. 113-129). New York, NY: Routledge.
- Slack, J. D., & Wise, J. M. (2005). *Culture + technology: A primer*. New York, NY: Peter Lang.
- Slack, J. D. (2011). Beyond transmission, modes, and media. In J. Packer and S. B. Crofts Wiley (Eds.), *Communication matters: Materialist approaches to media, mobility, and networks* (pp. 143-158). London: Routledge.
- Sterne, J. (2012). *MP3: The meaning of a format*. Durham, NC: Duke University Press.
- Stormer, N. (2010). Mediating biopower and the case of prenatal space. *Critical Studies in Media Communication*, 27(1), 8-23.
- Sumner, T. (2014, Feb). How to hide your genome. *Science*. Retrieved March 8, 2015 from <http://news.sciencemag.org/biology/2014/02/how-hide-your-genome>
- Swartz, A. (2008). Guerilla open access manifesto. Retrieved February 04, 2015 at <http://archive.org/details/GuerillaOpenAccessManifesto>
- Taylor, M. C. (2001). Noise in formation. In *The moment of complexity: Emerging network culture* (pp. 99-123). Chicago, IL: University of Chicago Press.
- Taylor, R. (1950a). Comments on a mechanistic conception of purposefulness. *Philosophy of Science*, 17(4), 310-317.
- Taylor, R. (1950b). Purposeful and non-purposeful behavior: A rejoinder. *Philosophy of Science*, 17(4). 327-332).
- Terranova, T. (2004a). *Network culture: Politics for the information age*. London: Pluto Press.

- Terranova, T. (2004b). Communication beyond meaning: On the cultural politics of information. *Social Text*, 22(3), 51-73.
- The filter bubble. (2010, October). *The Atlantic*. Retrieved September 20, 2015, from <http://www.theatlantic.com/daily-dish/archive/2010/10/the-filter-bubble/181427/>
- Thomas, N. (2013). Social computing as a platform for memory. *Culture Machine*, 14, 1-16.
- Tukey, J. W. (1952). The Extrapolation, Interpretation and Smoothing of Stationary Time Series with Engineering Applications, by Norbert Wiener. *Journal of the American Statistical Association*, 47(258), 319-321.
- Tweeddale, J. W. Jain, L. C., Watada, J., & Howlett, R. J. (Eds.) (2014). *Knowledge-based information systems in practice*. New York, NY: Springer.
- von Foerster, H. (2003a). Cybernetics of cybernetics. In *Understanding understanding: Essays on cybernetics and cognition* (pp. 283-286). New York, NY: Springer.
- von Foerster, H. (2003b). On constructing a reality. In *Understanding understanding: Essays on cybernetics and cognition* (pp. 211-227). New York, NY: Springer.
- von Foerster, H. (2003c). Cybernetics of epistemology. In *Understanding understanding: Essays on cybernetics and cognition* (pp. 229-246). New York, NY: Springer.
- Waldrop, M. (2001, July 1). Claude Shannon: Reluctant father of the digital age. *MIT Technology Review*, n.p. Retrieved September 16, 2015, at <http://www.technologyreview.com/featuredstory/401112/claude-shannon-reluctant-father-of-the-digital-age/>
- Ward, K. (2014). God as the ultimate informational principle. In *Information and the nature of reality: From physics to metaphysics* (pp. 357-381). Cambridge: Cambridge University Press.

- Watson, J. (2009). *Guattari's diagrammatic thought: Writing between Lacan and Deleuze*. New York, NY: Continuum.
- Webster, F. (2006). *Theories of the information society* (3rd ed.). New York, NY: Routledge.
- Whatmore, S. (2002). *Hybrid geographies: Natures, cultures, spaces*. Thousand Oaks, CA: Sage.
- Why the universe is not a computer after all. (2012, December 4). *MIT Technology Review*, n.p. Retrieved September 12, 2015, at <http://www.technologyreview.com/view/508246/why-the-universe-is-not-a-computer-after-all/>
- Wicken, J. S. (1987). Entropy and information: Suggestions for common language. *Philosophy of Science*, 54, 176-193.
- Widder, N. (2012). *Political theory after Deleuze*. New York, NY: Continuum.
- Wiener, N. (1938). The homogeneous chaos. *American Journal of Mathematics*, 60(4), 897-936.
- Wiener, N. (1949a). The machine age. *The New York Times*. Unpublished.
- Wiener, N. (1949b). *Extrapolation, interpolation, and smoothing of stationary time series with engineering applications*. Cambridge, MA: MIT Press.
- Wiener, N. (1954). *The human use of human beings: Cybernetics and society* (2nd ed.). Garden City, NY: Doubleday Anchor Books.
- Wiener, N. (1956). *I am a mathematician: The later life of a prodigy*. Garden City, NY: Doubleday & Co.
- Wiener, N. (1961). *Cybernetics: Or control and communication in the animal and the machine* (2nd ed.). Cambridge, MA: MIT Press.

- Wiener, N. (1964). Problems of sensory prosthesis. In *Selected papers of Norbert Wiener* (pp. 431-439). Cambridge, MA: MIT Press.
- Wiener, N. (1966). *God & golem, inc.: A comment on certain points where cybernetics impinges on religion*. Cambridge, MA: MIT Press.
- Wiener, N. (1985a). A new concept of communication engineering. In P. Masani (Ed.), *Norbert Wiener: Collected works, volume IV* (pp. 197-199). Cambridge, MA: MIT Press.
- Wiener, N. (1985b). Thermodynamics of the message. In P. Masani (Ed.), *Norbert Wiener: Collected works, volume IV* (pp. 206-211). Cambridge, MA: MIT Press.
- Wiener, N. (1985c). Letter covering the memorandum on the scope, etc., of a suggested computing machine. In P. Masani (Ed.), *Norbert Wiener: Collected works, volume IV* (pp. 122-124). Cambridge, MA: MIT Press.
- Wiener, N. (1985d). Cybernetics. In P. Masani (Ed.), *Norbert Wiener: Collected works, volume IV* (pp. 203-205). Cambridge, MA: MIT Press.
- Williams, R. (1976). *Keywords: A vocabulary of culture and society*. New York, NY: Oxford University Press.
- Williams, R. (1977). *Marxism and literature*. New York, NY: Oxford University Press.
- Williams, R. (1983). *Culture and society: 1780-1950*. New York, NY: Columbia University Press.
- Wise, J. M. (1998). Intelligent agency. *Cultural Studies*, 12(3), 410-428.
- Wise, J. M. (2005). Assemblage. In C. J. Stivale (Ed.), *Gilles Deleuze: Key concepts* (pp. 77-87). Montreal: McGill-Queen's University Press.

Wiley, S. B. C. (2005). Spatial materialism: Grossberg's Deleuzean cultural studies. *Cultural Studies*, 19(1), 63-99.

Wolfe, C. (1995). In search of post-humanist theory: The second-order cybernetics of Maturana and Varela. *Cultural Critique*, 30, 33-70.