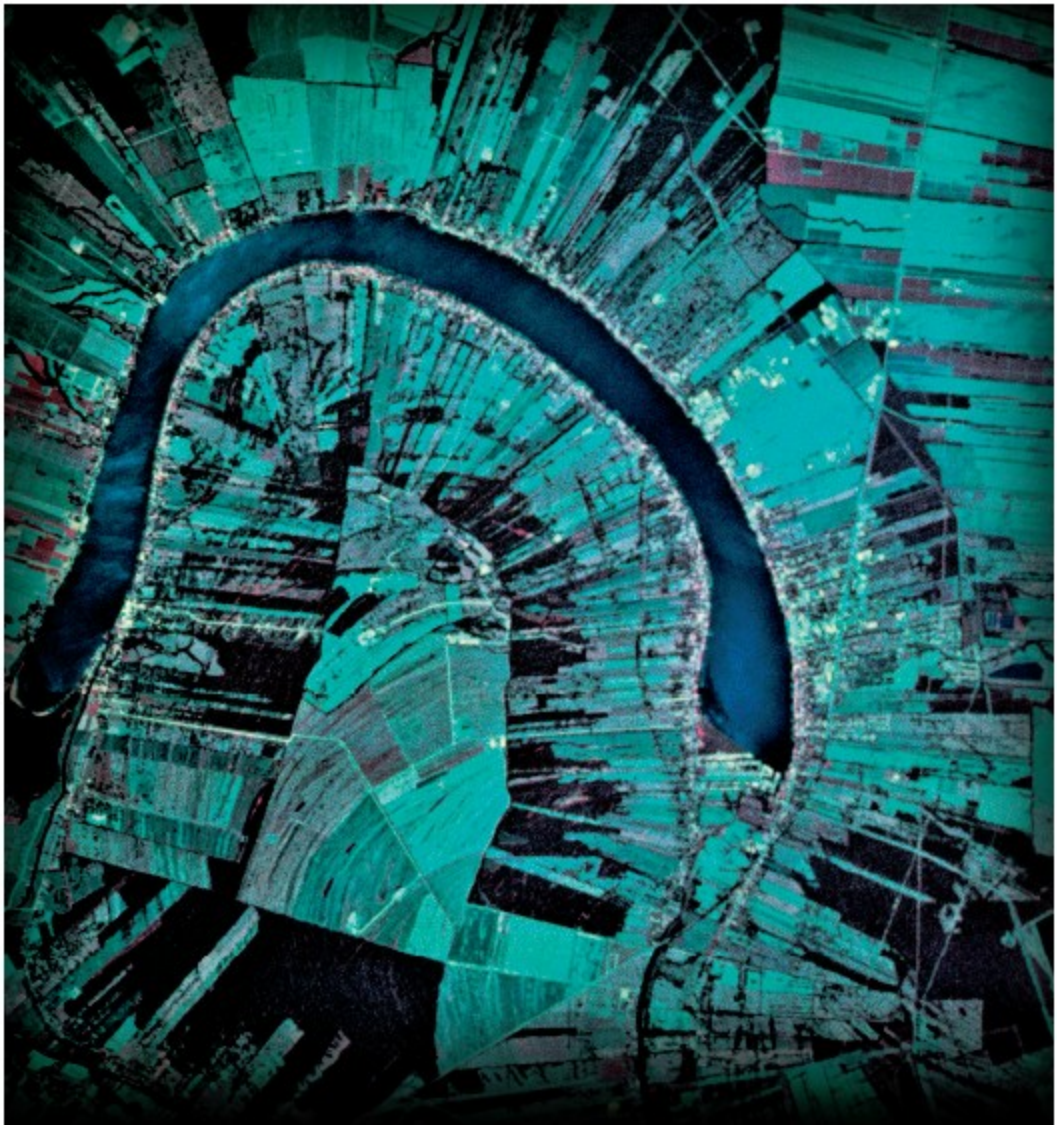

THE MANGLE IN PRACTICE

Science, Society, and Becoming

ANDREW PICKERING

and KEITH GUZIK, editors

The Mangle in Practice

Science and Cultural Theory

A Series Edited by BARBARA HERRNSTEIN SMITH *and* E. ROY WEINTRAUB

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Preface

This book contains a set of essays written from a variety of perspectives and concerns in a wide range of fields and areas including history, philosophy, sociology, geography, literary theory, biophysics, and software engineering. The chapters are unified by their connection to the analysis of scientific practice I set out in my book *The Mangle of Practice: Time, Agency, and Science* (1995), and their cumulative impact is to show that the notion of the mangle is not simply an analysis of paradigmatic natural sciences. Instead, it suggests a coherent and productive approach across the humanities, social sciences, and beyond that is interestingly different from more mainstream and familiar perspectives.

The first chapter in the collection, my "New Ontologies," aims to sketch out the contours of the mangle and some of its implications in as accessible a fashion as possible. Here, however, it might be fruitful to follow a different path, starting with observation that I found *The Mangle* a difficult book to write. My difficulty with the book, and my interest in it, lay in the unfamiliarity of the analysis of scientific practice that I was developing, an unfamiliarity that condensed around two key ideas: that the analysis should be a *posthumanist* one, as I called it, and that it needed to come to grips with *temporal emergence.* The first idea stemmed from my conviction that any convincing analysis of scientific practice had to be *decentered*, relative to both human actors (scientists and engineers) and nonhuman ones (material instruments and machines). We need, I argued, to think of scientific practice as an open-ended, reciprocally structured interplay of human and nonhuman agency, *a dance of agency*, in the process that I called *mangling.* The second concept—temporal emergence—signaled my conviction that mangling has a truly *evolutionary* character, rather than a causal one. Just as it is impossible to predict what sparrows will become in the future, so it is impossible to predict or explain fully what the contours of human or nonhuman agency will turn out to be in scientific practice.[1]

I arrived at these points in my efforts to understand empirical case studies, and in *The Mangle* I tried to convey my ideas about posthumanism and emergence through detailed analyses of four case studies, including Donald Glaser's invention of the bubble chamber, Giacomo Morpurgo's experimental searches for free quarks, William Rowan Hamilton's construction of the quaternion system in mathematics, and the introduction of numerically controlled machine tools in production at General Electric. By the time I finished the book I was convinced that I was right—that my analysis was fully general and applicable everywhere, not only to human practice and cultural evolution but also to the nonhuman world. This idea was central to the book's second postscript in which I described the mangle as a "theory of everything"—and this gets us back to the present book.

I recognize that a handful of case studies is not really enough to sustain a theory of everything, so I was very pleased when other people found inspiration in the mangle in their own research. My ground-zero reading of this book is thus that it provides reason to think that I was not so far wrong when I described the mangle as a theory of everything.[2] The chapters in this book exemplify insights that can be gained in topics in science studies that I had never before thought about, such as pig farming and software development, and in topics that lie outside the usual purview of science studies, such as domestic violence and Australian national identity—the territory of the mainstream social sciences. This, of course, makes me happy, but it also encourages me to enter a qualification.

After writing *The Mangle* I realized that there are two possible senses of "a theory of everything." One comes, like the phrase itself, from contemporary physics. There it evokes a dream of finding the fundamental equations of matter from which all of the visible world can be derived. This sense is *not* the one I needed. My claim was not that *The Mangle* solved all problems. My idea, instead, was that there is something visibly and demonstrably wrong with the hegemonic mainstream interpretive frameworks in the humanities and social sciences, precisely in that they obscure the posthuman coupling between people and things and the omnipresence of temporal emergence and becoming. *The Mangle* was, then, not a claim to have found the fundamental equations of culture and practice (which everyone should now spend the rest of their lives solving), but rather an argument for a shift in interpretive sensibilities, an argument that scholars should take an interest in decentered and emergent

processes rather than recycling implausible devices to obscure their existence.[3] This shift to a different gestalt from the mainstream social sciences and humanities was what I sought to advocate by describing the mangle as a theory of everything. And what many of the chapters in this book show, I feel, is the viability, coherence, and promise of making such a shift, not only in science and technology studies but in the social sciences and humanities more generally. The possibility of this sort of open-ended extension of a mangle-ish approach beyond science studies is an important argument of this book as a whole.

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Each of the chapters that follow stands on its own, but we have sought to impose a loose structure on the book as a whole. The first chapter is my "New Ontologies," which provides an introduction to the mangle that does not require of the reader a detailed familiarity with my earlier book. In this chapter I seek to evoke the sensibilities discussed above by appealing to examples drawn not from the history of science but from the history of painting and of struggles with the Mississippi River.[4] Hopefully, these examples serve immediately to indicate the broad viability of a mangle-ish analysis. Beyond that, the chapter also aims to open another topic for reflection: *ontology*—questions of what the world is like and of our place in it. This is a topic that has come to be of great concern to me. After writing *The Mangle* I realized that my analysis entailed, in effect, reading sciences such as modern physics *against the grain*. The ontological vision at which I had arrived, of the world as a place of open-ended emergence and becoming, was one that was constitutively denied by the sciences I was analyzing. This is not, of course, an argument against the modern sciences, whatever that might mean—one cannot fail to be awed by their achievements. At the same time, however, this recognition implies an active curiosity about the possibility of knowledges and practices that *explicitly adopt* rather than deny a mangle-ish ontology. "New Ontologies" points to a range of approaches in art, philosophy, spirituality, engineering, and science that are reflexive to the mangle, and it suggests why we might be interested in them, politically as well as intellectually.[5]

The rest of the book has been divided, in a rudimentary fashion, into three parts. Part I consists of empirical studies, though none of these are merely—that egregious word—empirical. Adrian Franklin's "A Choreography of Fire" continues and extends the concerns of "New Ontologies," though the

nonhuman partner in the dance of agency here is not water (the Mississippi) but fire—burning gum trees in Australia. Franklin extends the story of mangling to the material world itself and to the prehuman evolution and becoming of eucalypts and their distinctive performances. He also makes valuable connections to other literatures in the humanities and social sciences, notably those in geography, urban studies, studies of national identity, governance, interspecies relations, and other critiques of humanism (such as those by Donna Haraway and Katherine Hayles). One fascinating theme in Franklin's chapter is the emergence of novel human *desires* within posthuman assemblages. In this case it is a desire for fire: bush fires in Australia are often started by the people who volunteer to put them out.

The unglamorous topic of Dawn Coppin's fascinating chapter is that of mega-hog farms, and her detailed description of the use of the crate in intensive-confinement pork production again brings to life the story of nonhuman agency—here of animals. In response to the efforts by pig farmers to move sows indoors in order to maximize their farrowing capacity, the sows have continued to express their agency in novel ways, eliciting in turn a variety of emergent accommodations on the part of the farmers. Exemplifying the continual becoming of "natureculture" (Haraway's term), this dance of human and nonhuman agency has served to transform the architecture of the farm and the very bodies of the animals as the pig farmers have refashioned themselves as professional pork producers. In the chapter that follows that by Coppin, Keith Guzik goes off in another direction entirely, reporting on one aspect of his research on the U.S. criminal justice system's implementation of aggressive measures for fighting domestic violence. Focusing on pro-arrest policing, Guzik describes how law enforcement officers adapt their performances to transform the material and interpersonal relations of power that sustain the violent agency of batterers. His sinister notion of the police as the "collectors" of batterers' "souls" extends the Foucauldian analysis of power by highlighting a distinctive phase in projects for disciplining the world.

Esther-Mirjam's Sent's chapter returns us to the history of science, as she traces the various trajectories in the career of the "rational expectations" economist Thomas Sargent. In countering the rational reconstructions of economic history endemic to her field, Sent refines my idea of the mangle as a dialectic of resistance and accommodation to describe how Sargent's "free

moves" to establish symmetry between economists and individual agents have continually come up against the "disciplinary agency" of economic theory and econometrics. In doing this, she offers a forceful demonstration of how facts and knowledge in rational expectations economics represent, in her words, "tenuous assemblages of human and disciplinary agency, which can fall apart as disciplinary winds change and new currents of thought come into fashion." The chapter by Volker Scheid addresses his ongoing inquiries into traditional medicine in China. In his book *Chinese Medicine in Contemporary China: Plurality and Synthesis* (2002), Scheid argued that a mangle-ish ontology is more appropriate to an analysis of traditional medicine than are ontological presuppositions deriving from the modern sciences; in this chapter, he addresses the topic of historical continuity rather than change. Interestingly, he concludes by discussing senses in which the ontology of Chinese medicine is and is not itself mangle-ish, thus complicating the crude dichotomy advanced in my chapter. In the final chapter of part 1, Casper Bruun Jensen and Randi Markussen connect to the ontological discussion running through different chapters in this book (Pickering, Scheid, Asplen, Marick, and Steiner) by reviewing the controversy over the fate of Mårup Church in Denmark: namely, should it be allowed to fall into the sea? In countering the discourse of nature management, which presents the relation between culture and nature as one of human choice, the authors trace the multiple "ontological configurations" on top of which such policy debates and choices happen. Arguing that the open-endedness of the world undermines the ability of humans to effectively realize their choices, Jensen and Markussen offer an interesting alternative take on the suggestion (which they ascribe to me) that we posthumanists should embrace becoming.

The chapters in part 2 are also empirical, but they are grouped together as reflexive to the mangle—that is, as interested in real-world practices that themselves display mangle-ish sensitivities, or, we might say, instances of the mangle in action. Lisa Asplen contrasts two approaches to environmental management (thus intersecting with my chapter and with those by Coppin, Franklin, and Jensen and Markussen, as well as further reflecting a heightened interest in the environment in science and technology studies). The first method is the classical "command and control" approach that seeks to dictate to rivers how they should behave. Asplen concentrates, however, on the second, mangle-ish, approach, which in its more symmetric and open-ended

stance favors an experimental exploration of the possibilities for environmental intervention rather than the pursuit of predetermined outcomes. Asplen's chapter thus offers an image of a real-world practice that takes seriously a mangle-ish ontology, and she shows how it differs from more conventional approaches. The same can be said of Brian Marick's chapter, which contrasts two approaches to writing computer software. The traditional approach can again be described as "command and control," organized as it is around top-down advance planning. Marick focuses instead on Agile software development, a bottom-up, deliberately short-sighted approach that refuses to try to see into the future beyond the immediate task at hand. His experience is, amazingly, that Agile programming can produce desirable code even in long-term development projects, and he foregrounds the topic of temporal emergence in his analysis of the production of a new software "object" whose existence and utility could not have been seen in advance, even by the software's users—for them, too, it was a new and useful object. The last chapter in part 2, Yiannis Koutalos's "The Docile Body of the Scientist" is reflexive to the mangle in a different way. The modern sciences are organized around a kind of "practical dualism"—they aim at material systems and bodies of knowledge that sever the connection to their human producers and users. This is why a mangle-ish analysis has to read the sciences against the grain: it has to explore the posthuman connections that they seek to efface. Koutalos, in turn, is concerned with the practical effects of practical dualism, especially in scientific fields like his own, that depend upon animal "sacrifice." Ironically, there is an enormous discourse on the "humane" treatment of animals at the same time that there is an enormous silence on the human end of this relation. Koutalos wants to break the silence and to discuss the implications of practical dualism for the human scientist, as an open-ended intervention into the science itself.

The two chapters that form part 3 focus principally on issues in philosophy and social theory. In *The Mangle* (chapter 1) I tried to draw a contrast between posthumanist approaches to science and technology studies and approaches using semiotics. Both entail a form of decentering, but in different directions: my approach emphasizes a decentering of the human in relation to the material powers and performances of machines, while semiotics decenters human agency in relation to language. Semiotics thus remains humanist in my terms. Maxim Waldstein elaborates and complicates this discussion in interesting and important ways in his sustained confrontation between semiotics, the

mangle, and the all-important writings of Bruno Latour. Going further, Waldstein examines the relatively unknown work (in the West) of Iurii Lotman and the Tartu School of Semiotics, in which he finds many resonances with the mangle (and some differences as well), even extending to a shared interest in cybernetics ("New Ontologies" again). Waldstein's aim is thus to open up productive conversations and exchanges between two literatures that we might think of as existing in different—humanist and posthumanist—worlds.

Carol Steiner has the last word by staging a conversation between Martin Heidegger and me. Heidegger's argument is that the mangle might be on the way to becoming a theory of everything, but it should not be. The mangle might be a good analysis of the practice of modern science, but that sort of practice should not be allowed to invade the lifeworld. If this had been a real conversation, I would have argued more forcefully against that line of thought (and who knows what Heidegger would have said? Would he really have given me the time of day?), but Steiner's chapter is constructively provocative, and at minimum it serves to reinforce connections that can be made between the mangle and Continental philosophy (I invoke Heidegger, too, in "New Ontologies").

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The original impetus for this book came from graduate students at the University of Illinois, who felt—rightly, I believe—that synergistic intersections between their research projects on very different topics could come to the surface in a book like this one. Along the way, several of these students have been pulled in other directions and are not represented here, but Keith Guzik and I want to thank Peter Asaro, Jongyoung Kim, Diana Mincyte, Anya Pantuyeva, Amit Prasad, and John Wedge as intellectual fellow travelers. We also want to thank the "outsiders" who allowed themselves to be enrolled: Adrian Franklin, Casper Bruun Jensen, Randi Markussen, Brian Marick (who also played an important part in the genesis and development of the book), Volker Scheid, Esther-Mirjam Sent, and Carol Steiner. The contributions from these writers encourages the thought that the mangle is not solely a product of the midwestern imagination. Finally, I personally want to thank my coeditor, Keith Guzik, for his intellectual companionship on this trip and for his part in the endless labor of producing an edited volume.

ANDREW PICKERING

NOTES

1. The theme of posthumanist decentering runs through one wing of science and technology studies (in sharp contrast to the "humanism" of the other wing)—see, for example, the canonical works of actor-network theory and Donna Haraway's thoughts on cyborgs. My conviction that this decentering needs to be understood as a temporalized dance of agency is not so widely shared or expressed. But our concern in this book is not to make a sharp distinction between mangle-ish approaches and others; instead, we wish to demonstrate that the analyses of *The Mangle* can indeed be extended further into a wide range of studies and arguments.
2. My own post-*Mangle* research has included macrohistorical studies (of science, technology, and the military in the Second World War, and of the intersection of science and industry in the nineteenth century), various theoretical inquiries, and, most recently, the history of cybernetics (Pickering forthcoming). All of these, too, constitute extensions of the reach of the mangle.
3. Turner (1994) remains the *locus classicus* on the implausibility of traditional approaches to understanding practice.
4. These examples are intended to be evocative rather than compelling. For full scholarly documentation and analysis, see *The Mangle.*
5. Thus one sense of the "new" in the term "new ontologies" is "new to me since writing *The Mangle*," but the ignorance might not be exclusively mine. It might exemplify a centrality of nonmangle-ish approaches that is taken for granted within the academic institutions in Britain and the United States that I have long inhabited.

New Ontologies

ANDREW PICKERING

In *The Mangle of Practice* (1995) I offered an ontological vision of the world and our place in it, a vision in which both the human and the nonhuman are recognized as open-endedly becoming, taking on emergent forms in an intrinsically temporal "dance of agency." In this chapter I seek to enrich and extend that vision (see also Pickering 2003). To see what is at stake, I find it useful to begin with a contrast between the work of two twentieth-century Dutch painters, Piet Mondrian and Willem de Kooning, and to read their paintings as "philosophical objects" that point toward rather different conceptions of being in the world.

Mondrian's later geometrical abstracts—a vertical and horizontal grid of solid black lines filled in by patches of primary color—are very well known and instantly recognizable.[1] How do such paintings encourage us to think about being in the world? They speak to me first of a certain dualism of people and things, a clean split between the painter and his work. We can understand this as a *detachment* of the painter from the world. Even the usual tenuous connection of *looking* at the world—the artist gazing at a landscape and somehow representing it in paint—is missing. Looking at these paintings, we have to imagine them as products of Mondrian's *mind*; that is, as abstract representations first planned out mentally—the black lines will go here and here on the white background laid out on a Cartesian grid and then the patches of primary color will go there and there—and then imposed on paint and canvas. A Mondrian thus encourages us to think of ourselves not so much in relation to the world but rather as both detached from it and *dominating* it from outside as freestanding human agents in a passive material world. This is one ontological vision.

De Kooning's paintings often owe little to seeing the world and translating it into paint—they are just as "abstract," in this sense, as those by Mondrian. Yet his smeary canvasses speak powerfully of a dense, embodied, material *engagement* with the world. One cannot imagine a de Kooning as the translation of a preconceived mental image into paint on canvas. One has to think of them along the lines in which they were, in fact, executed. De Kooning may have had some initial idea of where he was going in a given work, but he never held to it. Applying the paint thickly, he would look for emergent aesthetic effects—swirls, vortices of color, chance juxtapositions. Then he would allow himself to be *carried away* (Gomart and Hennion 1999) by these effects, adding more paint, smudging it around, and so on. His painting was a continual back-and-forth movement between perceptions of emergent effects and attempts to heighten them, leading in an open-ended fashion to canvasses that no one, including the artist himself, could ever have planned or anticipated in advance. It has been said that a work by de Kooning was only ever finished when someone took the canvas from him; otherwise he was always liable to find some new effect in the painting and then go back to work on it.

As philosophical objects, then, de Kooning's paintings conjure up a different ontology from those by Mondrian. If Mondrian's works evoke a dualist movement of human detachment from the world, then de Kooning's speak of a constitutive engagement with it. And if Mondrian's works couple this detachment with the asymmetric human domination of passive matter, then de Kooning's emphasize a much more symmetric interplay of the human and the nonhuman. That is, a de Kooning painting is somehow irrevocably *a joint product of the human and the nonhuman*; of de Kooning, the paint and the canvas—a decentered production of which de Kooning was at once the author and the discoverer, both active and passive in turn. This is the first key contrast I want to emphasize between the two painters and their works. The second contrast has to do with *temporality*. Mondrian's paintings do not thematize time. One can imagine a Mondrian as the materialization of an almost timeless Platonic image, an image one can hold clearly in one's mind and unleash in the world whenever one is so disposed. In contrast, one can only imagine a de Kooning painting appearing in the real time of embodied practice: *this* had to happen—the application of this quantity of this color, there on some already-laden surface—then *that* had to happen, and so on, on a unique trajectory that led up to *this* image. Fur-

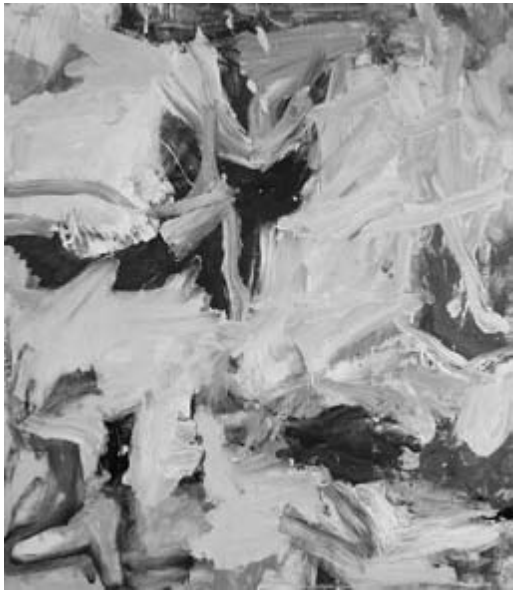

FIGURE 1 Willem de Kooning, "Untitled VI," 1977. (The Menil Collection, Houston. Copyright 2007 by the Willem de Kooning Foundation / Artist Rights Society (ARS), New York)

thermore, as I said, the endpoint of this trajectory was by no means given in advance—not in de Kooning's brain, nor in the tubes of paint, nor anywhere else. De Kooning's paintings thus show us how *genuine novelty can genuinely emerge in time* in the thick of things, in the intersection of the human and the nonhuman, in a trial-and-error search process that is open ended and forward looking. De Kooning thematizes, as I would say, an *ontology of becoming*.

The works of these two painters thus can stand for two different ontologies. One entails a dualism of the human and the nonhuman, a detachment from and domination of the latter by the former, and an erasure of time; the other entails an immediate symmetrical engagement between the human and the nonhuman and an intrinsically temporal becoming in that engagement. Mondrian's ontology is, I think, very familiar to most of us. Over the past few centuries it has become, to borrow Arthur Fine's phrase, *the natural ontological attitude*.

But I also want to say something stronger than that. My suggestion is not, in fact, that here we have two ontological understandings that are somehow on a par with one another, or are equally matched rivals that we can choose between. To get beyond this idea one has only to recognize that Mondrian did not always paint in the form of the geometrical abstracts for which he is now best known. Some of his earlier paintings look rather like those by de Kooning (though the historical influence went the other way). My point here is that Mondrian's style of painting itself changed in time and became in relation to his struggles with paint, brushes, and canvas (and, no doubt, with various artistic and philosophical traditions, his own evolving aesthetic experience and personal biography, and so on). Viewed over time, then, the trajectory of Mondrian's work itself conjures up an ontology in the manner of de Kooning. *Both* painters, then, lived in the thick of things, symmetrically engaged with the material world in processes of open-ended becoming; it is simply that later works by Mondrian (the Cartesian paintings I began with) do not themselves thematize this notion. In evoking a world of timeless dualist detachment, Mondrian's works *draw a veil* over the basic ontological situation from which they themselves emerged, while de Kooning's works thematize those ontological conditions of existence.

My fundamental thought, therefore, is that the ontology I associate with de Kooning is, let me say it, a true ontology—one that reminds us of how being in the world always has been and always will be; while Mondrian has to be seen as thematizing *a certain stance* in the flow of becoming, a particular tactic of being in that flow that resists a recognition of the flow by attempting to step outside it, and that can be associated with dualist projects of the domination of matter and the denial of time. And a general point I want to make here is that we have been dazzled by Mondrian. Instead of seeing dualist detachment and domination as a move, a tactic, a ploy, and a very specific way of living in the flow of becoming, we tend to mistake it for the world itself.[2]

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So much for art; what about philosophy? The line of thought sketched out above is reminiscent of Martin Heidegger (1977a; see also Steiner, this volume). In his well-known essay "The Question Concerning Technology" Heidegger took the de Kooning line: the contours of the material world endlessly emerge and become; likewise the contours of humanity; and, in fact, these two be-

comings are irrevocably entangled with one another. However, according to Heidegger "modernity" is marked precisely by the taking up of Mondrian's stance in this flow of becoming. In the mode of "enframing" we humans seek to step outside nature, dominating and controlling it, challenging it forth as "standing reserve" for circuits of production and consumption. At the same time we challenge ourselves as specific kinds of beings, as standing reserve for those same circuits. Heidegger saw enframing as a tremendous danger to humanity, and at the least we can say that it is obsessive. It would be nice if we had other ways to go on in the world more readily available. This is where my ontological remarks are leading. But a discussion of two painters is not sufficient to ground them, so now I turn to a real-world example.

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I want to talk about the Mississippi River; to do so I draw my inspiration from John McPhee's wonderful book *The Control of Nature* (1989). The Mississippi is one of the world's great rivers. All of the rain that falls in the midwestern region of the United States drains through it into the Gulf of Mexico. Prior to European settlement, the lower reaches of the Mississippi were marked by levees formed by natural embankments of sediment deposited on either side of the waterway. The levees, averaging about three feet in height, usually served to contain the river, though sometimes the river would overflow and inundate an enormous floodplain. It appears that the region's human inhabitants during this period in history were able to live with the periodic flooding. But then came the European settlers, who began to establish fixed towns—most notably New Orleans as the river's major seaport. With the growth of these towns, the containment of the river became a matter of increasing importance, thereby giving rise to one of the world's great projects of the domination of nature—nothing less than the control of the Mississippi itself. One aspect of this project was the artificial raising of the levees to confine the river within its banks. What interests me most about this strategy is that it never worked. As the levees rose, the river rose as well, and when the flooding continued the levees had to be raised further, and so on, back and forth, right up to the present. As a result New Orleans became a walled city, surrounded by a ring of earthworks thirty feet high. McPhee compares New Orleans to the walled cities of the Middle Ages, except that the enemy is water and not the humans beyond the walls. Further, relative to the streets of New Orleans, massive cargo

boats on the river now pass *overhead.* As McPhee says, if the levees weren't in the way, the water traffic would present a surreal spectacle reminiscent of an elevated railway.

Who should we think of here? I think of de Kooning first, inasmuch as the basic story, here of the engineering architecture of the river and New Orleans, is one of open-ended becoming. Nobody intended that the upshot of struggles with the river should be boats passing overhead. Instead it just turned out that way in a decentered interplay of the river and the people, an interplay isomorphous with de Kooning's relation to his paints. But added onto this decentered emergent process, and structuring it, we also find a dualist Mondrian-style impulse to impose on the river a detached and timeless human conception of how it should be. This, I think, is how Heidegger understood enframing.

For the past century and a half, the responsibility for controlling the Mississippi has been assigned to the U.S. Army Corps of Engineers, which describes its work as a battle with the river—a battle in which the levees are central and whose outcome is far from certain. It turns out that the Mississippi wants to move. It is now thirty feet above one of the lesser rivers it feeds into, the Atchafalaya. Left to itself, the entire Mississippi would spill into the Atchafalaya; in so doing it would reach the Gulf a couple of hundred miles west of its present destination and thus leave the existing lower reaches of the Mississippi a mere trickle. This would be a catastrophe for cities like New Orleans that rely on the river water in all sorts of ways, and the Army Corps of Engineers has accordingly been fighting the Atchafalaya for decades by reengineering its intersection with the Mississippi.

In 1963 a massive 250,000-ton sill or weir was set in place to control the runoff from the Mississippi into the Atchafalaya and to prevent it exceeding its prior rate of around 30 percent. In the floods of 1972 and 1973, the control structure held—but just barely. If it had failed, the Mississippi would have changed course irrevocably. After the flood, inspections revealed that the structure had suffered massive damage. Part of it washed away: turbulent flows had excavated holes as big as football stadiums around it. Despite massive repairs, the structure would never again meet its design specifications. The original control project had cost $86 million; after 1973, a new auxiliary structure consisting of six gates, each 62 feet wide and together weighing

2,600 tons, was added at a cost of $300 million. McPhee quotes an engineer on the new project as saying at the time, "'I hope it works'" (52).

Here, then, we have a continuation of a human-centered, atemporal, detached, control project—trying to keep the Mississippi to its historic course. The Army Corps of Engineers actually speaks of "'stopp[ing] time in terms of the distribution of flows'" (21). But this project has always itself been embedded in a decentered and open-ended becoming of the human and the nonhuman, a "dance of agency," as I would call it, between the engineers and the river. The human agents, the engineers, try something—raising the levees, say—and then the nonhuman agent takes its turn by rising still higher and flooding New Orleans. In response the humans do something else—building the weir between the Mississippi and the Atchafalaya—to which the river does something else—ripping and tearing away at it. And so on, forever. Again we find Mondrianesque control situated as a tactic of being in de Kooning's world.

This is one of the main points I want to make by discussing the Mississippi. I am not talking just about painting but rather *how the world is* in general—and the Mississippi is perhaps a big enough example to sustain the argument.

A second point can be made more briefly. The Army Corps of Engineers has not acted blindly in its struggles with the river. Plenty of *science* has entered into its strategies. The Corps of Engineers would like to get out of the thick of things by finding the timeless hidden essence of the river and hence dominate it, first conceptually and then materially. For example, throughout the nineteenth century and up until 1928, the management of the Mississippi was based on the principle of "levees only" (41). The idea, supported by the best contemporary scientific hydrology, was that cutting off outflows from the Mississippi would speed up the flow of water within the river, thus encouraging it to dig into the riverbed and lower the overall level—and thus bringing to an end the continual raising of the levees. The idea seems plausible, but, as I said before, it failed to work. Now the science of hydrology is different, and now the Corps of Engineers has a fifteen-acre scale model of the entire Mississippi drainage area on which to test its ideas. But even this model cannot solve the problems of practice. The best material for the realistic simulation of riverbeds seems to be walnut shells, and yet because they rot underwater nuggets of coal are used instead.

The moral of this part of the story is twofold. First, *science is itself caught up in the flow of becoming*; the contents of science change emergently. And, second, like one of Mondrian's paintings, scientific knowledge helps to conceal becoming from us. It portrays and draws our attention to a timeless and constant world—here invariant representations of water flows—somehow subsisting behind the visible world of change and becoming. From the ontological perspective I am developing here, *science itself thus appears as a veil*, clouding our perception of how things actually are. As Heidegger put it, science is at best in the domain of the "correct" rather than the "true."

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So where are we now? My argument is that we live in the thick of things, in a symmetric, decentered process of the becoming of the human and the nonhuman. But this is veiled from us by a particular tactic of dualist detachment and domination that is backed up and intensified, as I have just added, by science as our certified way of knowing. The questions I want to address in the remainder of this chapter are thus as follows: Is it possible to draw back the veil and to live in the presence of decentered becoming? If so, what difference might it make? The answer to the first question is, obviously, yes—we can draw back the veil, de Kooning did it; and the answer to the second question is that doing so would make a big difference, de Kooning's paintings look very different from Mondrian's. All we need to do once we have seen that is to think how this painterly contrast might echo through other aspects of being.

But how would that go? At this point, I have to say something about my second example, the Mississippi, and one line of thought seems inexorable. The Corps of Engineers should stop fighting the river and let New Orleans go. The inhabitants of New Orleans might not like to hear this, but, in fact, the idea is not as crazy as it sounds. It seems unlikely that even the Corps of Engineers can stop time forever. The Mississippi is going to flow into the Atchafalaya sooner or later. It can either do it amid death and destruction in the so-called hundred-year flood (one estimate [Nordheimer 2002] was 45,000 people killed, 400,000 trapped on roofs and 700,000 homeless evacuees), or we could let it happen at a time of our own choosing—a time of drought, say, when the water level is low, and when the inhabitants of the region have prepared themselves for it. We could do it gracefully; we could go with the flow; we could start afresh with a new geography. This would be a different and, I

think, better way to live in nature than to do so through the use of grim and desperate projects of domination and control.

Even imagining letting the Mississippi go its own way is, as far as I know, a completely radical proposal in the history of U.S. environmental thought (Nordheimer 2002, for example, does not even entertain the possibility), and I take this as evidence that the shift to an ontology in the manner of de Kooning, stripped of the Mondrianesque veil, can make an enormous difference in the world.[3] But now I want to take a different tack.

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Heidegger wrote as if "enframing" is a unitary and all-encompassing mode of being, which is why it is both so dangerous and so hard to escape from. But Heidegger was wrong. Dualist detachment has certainly run rampant since the scientific revolution and the Enlightenment. It permeates all sorts of practices and their products. This, no doubt, is why it now comes naturally for us to mistake the correct for the true, and why we find it hard to latch onto the world in any other way. But Mondrian has never been more than hegemonic. In the shadows of Mondrian we can always find de Kooning. And if we want to resist the ontology of dualism and domination, it seems to me that we have only one option: we have to throw in our lot with the de Koonings—the strands of our culture that have in one way or another sought to live in the presence of becoming. We should not do so uncritically—these traditions, above all, should move and become in time—but we should seek to unite them in a *counterhegemonic formation*. The ambition should be not to eradicate Mondrian—no one wants to dispense entirely with rational planning or modern science. But we should aim to bolster de Kooning to the extent that the world becomes sufficiently full of explicitly and self-consciously decentered practices and their products that an ontology of becoming becomes the natural ontological attitude, exposing dualist detachment for what it is: just one tactic of being in the world that we have at our disposal.

But, then, I should give some instances of these marginal traditions that I want to unite in the cultural foreground. Again, I could start with art. I am not an art historian, but I know that de Kooning was not an absolute historical singularity. We might think, for example, of the tradition of "abstract expressionism" in which Jackson Pollock loomed very large. I am sure we could multiply instances indefinitely here. I think of the surrealist Max Ernst

producing haunting images by tracing out the knots in the floorboards of his hotel room—another angle on the decentered and emergent production of artworks. And, of course, we don't have to confine ourselves to Western traditions. We could think, for instance, of images of the Indian god Shiva, who dances the world into and out of existence, reminding us directly that we live in a symmetric and open-ended relation with nature.

To move in this direction also immediately reminds us that in an ontology of becoming art shades very directly into religion and spirituality. We could think of Hinduism as operating a different dualism from that of Mondrian—a dualism between gods and men—which at the same time dissolves any detached dualism between men and nature. Or we could think of Shiva as immanent in nature, and of becoming as that which itself is to be worshipped and wondered at. Either way, we are in an enormous artistic and spiritual field that immediately evokes an ontology of becoming without any Mondrianesque superstructure. Buddhism comes to mind, too, as an exploration of how to navigate the flows of becoming. The trick is to let go of attachments and to be as fluid as the flow. This brings us back to New Orleans.

In terms of philosophy, Heidegger was no more alone than de Kooning. He was a representative of what the English and Americans call "Continental philosophy," a marginalized tradition running from Hegel through Alfred North Whitehead (an honorary "continental") and on up to Gilles Deleuze. More accessible to noncontinentals, there is the North American tradition of pragmatist philosophy, and William James above all, with its insistence that we should not mistake our detached representations for the world itself; that representing is instead a navigational device in a world that is always "boiling over."

I could go on with this list at length. I could mention, for example, the philosophical-spiritual-social-medical tradition that runs from premodern alchemy and Paracelsianism through Jean-Jacques Rousseau and his "noble savage" (Giedion 1948) up to the contemporary New Age movement. But it might be more important here to pay attention to developments closer to the heartland of enframing, in science and in engineering. Heidegger thought that there was just one kind of science, which intrinsically backed up the conversion of the world to standing reserve. He was wrong about that, too. One could write a big history of science in the manner of de Kooning, but here I will give just a couple of examples.

First engineering, and we can stay with water (see also Asplen, this volume). In 2002 an article in the *New York Times*, entitled "Dams and Politics Channel Mighty River," stated the following: "Scientists know what is ailing the great rivers of America. They also know how to cure it. From the Columbia . . . to the Everglades . . . they have been empowered . . . to take control of ecologically imperilled rivers that have been harnessed for decades to stop floods, irrigate farms and generate power. Instead of demolishing dams, they are using them to manipulate river flows in a way that mimics the seasonal heartbeat of a natural waterway. Scientists have discovered that a spring rise and a summer ebb can give endangered fish, birds and vegetation a chance to survive in a mechanized river."[4]

Here, then, we have a recognition within science and engineering that a detached domination of nature is not the one best way of proceeding in the world; that it can indeed be better to go with the flow—of water, time, and the seasons. Closer to home for me, much of the midwestern region of the United States was under water a hundred years ago. It was drained and converted to farmland by straightening the rivers and digging drainage ditches to feed them. Now, to quote my local newspaper, there is a "movement afoot to undo some of draining's damage"—damage that includes destroying entire ecosystems and wiping out enormous populations of fish and birds. As one University of Illinois geography professor is quoted as saying, "Even letting a short section of a ditch or channelized stream 'do what occurs naturally' and not maintain it can be very beneficial to fish and other wildlife. . . . This is science in its infancy. It's a mixture of science and trial-and-error. We're good in ways we can command and control a stream. We're not good at figuring out ways to make it a complex system in which nature can function."[5] It is clear, then, that even water scientists and engineers can act, in the real world, like de Kooning instead of Mondrian. We don't need to endorse Heidegger's totalizing fears of science and technology. But we should pay attention and latch onto this other kind of water engineering in the thick of things, if we want to disturb the hegemony of dualist ontology.

Gilles Deleuze and Félix Guattari (1987) sketch out a history of sciences in the de Kooning style rather than that of Mondrian, which they refer to as "nomad" or "minor sciences" to distinguish them from the "royal sciences" that underpin the stable and enduring state-form of social organization.

I will mention here one more example of a nomad science, my favorite one—namely, the weird science of cybernetics that flourished for twenty years or so after the Second World War. There are many ways of describing cybernetics. The most insightful for present purposes follows the conception of one of the leading English cyberneticians, Stafford Beer. Beer's basic starting point was explicitly ontological. He insisted that the world was what he called "an exceedingly complex system"—one that was impossible to know and control fully (Beer 1959, 12). So cybernetics began from de Kooning rather than Mondrian, acknowledging from the start that human detachment from and domination of the world is, at best, a fallible strategy. What was left for cybernetics, then, was a kind of engineering in the thick of things—the development of technologies that would be light on their feet; a form of adaptive engineering based upon open-ended, forward-looking searches through spaces of possibility that could not be exhaustively foreseen.

I cannot here go into the details of the weird and wonderful material technologies of cybernetics (see Pickering forthcoming; see also Pickering 2002a, 2004a, 2005a, 2007), but I do want to emphasize the social range of the field. The distinctive ontology of cybernetics fed into distinctive approaches in areas of human endeavor as various as brain science and artificial intelligence, robotics, information theory, and theoretical biology, on the one side, and psychiatry, management, politics, arts, and spirituality on the other. Cybernetics thus showed that bringing to consciousness a decentered and temporalized ontology can make a big difference in the world, restructuring and reconfiguring great swathes of culture and practice—it was a nomad science. If we want to challenge the hegemony of Mondrian, beginning with science and engineering and extending ourselves outward over diverse regimes of culture, I think a critical recovery of cybernetics might be an important part of the process and a source of inspiration that goes beyond the New Age movement and water engineering.

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What kind of politics might go with a decentered ontology of becoming? Actually, the political message as far as I can understand it has already been given. We should strive to elaborate, articulate, and assemble these de Kooning-esque traditions that presently live in the margins of our culture, with the goal of contesting the hold of Mondrian on our imaginations. Such a gestalt

shift in our ontological awareness would inevitably lead to shifts in our ways of conducting ourselves in the world, and I have tried to show how this goes via specific examples, from painting, philosophy, and engineering to the New Age movement, non-Western spiritualities, and cybernetics. My expectation is that if Mondrian's spell could be broken, the world in general would then strike us in our everyday lives as what it is—a place of decentered human and nonhuman becoming—and we would surely live very differently were that to be the case, self-consciously in the flow of becoming rather than denying it. Here a second sense of the politics of ontology surfaces. If we succeeded in breaking the spell of Mondrian, it seems to me that we would be left with a *politics of experiment.* The cyberneticians were right; there would be nothing left to do but imaginatively and critically explore the open-ended spaces of the world's possibility. The experimentalism of the 1960s is where I would look for inspiration, though I will not go into that now (see Pickering 2003).

One last remark. The politics I have in mind is not a matter just for theory, talk, and social organization. If dualist detachment and domination is still our natural ontological attitude, it is because since the Industrial Revolution we have remade the material world to make it so. Wolfgang Schivelbusch's (1986) beautiful history of the railways dissects the imposition of a Cartesian grid of straight lines and of a standardized Newtonian time on the landscape and our cities and our lives in the nineteenth century. In such a technologically reconfigured and geometrized world, we very easily fall into a perception of space and time in themselves as abstract categories, detached from the flux of experiences and ready to hand for the construction of yet more detached representations. To renew our ontological faculties, we need to remake the world again, *materially* as well as representationally (Pickering 2005b). This material transformation truly is a big job. I am glad the river engineers are already doing the politics of ontology for us.

NOTES

1. Copyright restrictions prevent us from reproducing Mondrian's work here; representative works can be viewed at the Artchive Web site: www.artchive.com/artchive/M/mondrian.html.

2. Barbara Herrnstein Smith notes an irony here and throughout, in that I seek to undermine one dualism (of people and things) by constructing another (a modern ontology that is dualist; a nonmodern ontology that denies that duality). This does seem to be my style, I must admit, but I have no interest in maintaining the purity of the latter dualism. No doubt one can find examples of all sorts of stances in the flow of becoming; one can muddy the waters endlessly. My aim is to challenge a taken-for-granted dualism of people and things by going to the opposite extreme and pointing to what I hope are striking, memorable, and important examples of their reciprocally transformative coupling and intertwining.
3. This chapter evolved in a series of conference presentations beginning in 2000, and this section on the Mississippi was overtaken by events while in the hands of the Duke University Press readers, though in 2005 it was Hurricane Katrina coming in from the Gulf of Mexico rather than floodwaters descending from the Midwest that devastated New Orleans. I still feel like saying I told you so. I also note that the immediate focus in the United States was on returning the displaced population to New Orleans as quickly as possible. If I were to rewrite this chapter I would lay more emphasis on catastrophic disaster as a corollary of enframing, and I would contrast this with the robustness of, for example, the adaptive approaches to the civil engineering of water discussed below.
4. B. Harden, "Dams and Politics Channel Mighty River," *New York Times*, May 5, 2002, A1.
5. K. Pringle, "Movement Afoot to Undo Some of Draining's Damage," *Champaign Urbana News Gazette*, March 3, 2002, E1, 7.

PART ONE STUDIES

A Choreography of Fire

A Posthumanist Account of Australians and Eucalypts

ADRIAN FRANKLIN

In this chapter I ask whether there is anything to be gained by taking seriously a posthumanist analysis of the relationship between humanity and the natural world, one that in fact extinguishes dualism and produces only natucultures (Haraway 2003b, 5). I will examine this question through an analysis of the relationship between eucalyptus (gum) trees and Australia. Most humanist accounts, such as those developed in "traditional" social anthropology and sociology, privilege the activity, agency, and representations of humans, and in so doing render the natural world and its individual species as passive and of interest only insofar as they provide a palette of meanings for essentially *human* symbolism, dreamings, imaginaries (see Rival 1998; Douglas 1975, 1996). Such an approach has an impeccable track record ranging from Emile Durkheim to Mary Douglas, and it is not one I want to challenge here per se. What I do want to challenge is the implicit assumption that this approach is all there is to the relationship between nature and humanity, or all we can say about it. Rather than only inquire about the meaning of nature (or gum trees in this case), I also want to inquire about what it is they *do*, and, importantly, what implications those actions have for the world, themselves, humans, and "the social."

Following Andrew Pickering's advice in *The Mangle of Practice* (1995) that we place ourselves in the action—*in medias res* or "in the thick of things" where the play or dance of agency takes place—my analysis never assumes that eucalyptus trees and humans exist in separate worlds but rather that what happens

to both is emergent and co-constitutive. If we allow that gum trees are neither purely natural nor purely social but both (what we might call a *relational* entity, after John Law [1994, 1999]), then what does this say about environmental discourses that endorse and seek to reproduce (or restore) so-called primordial natures in light of the claim by Tim Low (2003) for a *New Nature* (in Australia)? In this chapter I suggest that wilderness and environmental policy in general need to be mangled. I also support those who argue that agency needs to be understood always as an artifact of time—of social, ecological, and glacial times (Macnaghten and Urry 1998; Jones and Cloke 2002).

As Stephen Pyne notes, "*Eucalyptus* is not only the Universal Australian, it is the ideal Australian—versatile, tough, sardonic, contrary, self-mocking, with a deceptive complexity amid the appearance of massive homogeneity; an occupier of disturbed environments; a fire creature" (1992, 25). Here Pyne is using gum trees as representations of Australia. This notion, along with similar material from art, literature, and the media, provide considerable mileage for the sociology of Australian nature. For example, narratives about gum trees tell us a great deal about Australian processes of nation formation; it was *against* the gum tree that a viable Australia was wrought (the motif of the so-called Heidelberg school of art is "the now relaxed" pioneer with his axe [see Allen 1997]); it was *with* the gum tree and *against* the oak and the plane tree that a distinctive modern Australia was asserted (introduced species were to be chased out while natives were to be embraced, and enthusiastically planted); and it was under and for gum forests that an econationalism was forged against global capitalism (gum trees hereby enter a final phase as sacred intensities of Australianness with its back against the wall). How they have changed as objects in the Australian imaginary makes perfect sociological material by describing so well the colonial and postcolonial connection between an emerging Australia and its totemic nature. But Pyne is surely also being ironic: How can we be so much like a tree and yet remain so unlike one—so outstandingly human against the woodenness of a mere tree? Pyne is not making much of a humanist point, but the point is the humanism of the writing slips in with little or no thought required. After its human representations there is little or no sociological content left to a gum tree. Or is there?

Pickering (2000) reminds us of C. P. Snow's description of the "two cultures" of the humanists and the scientists of British society in the 1950s and

the yawning gap they produced. But whereas in the 1950s the two cultures barely knew about each other and had little need to do so, in recent years this congenial polarity is short-circuited by inconvenient new phenomena, such as biopolitics, environment, and natureculture. Where does the science of biopolitics end and the humanity begin? Similarly, what is a "proper" nature, or a "proper" environment? Who can tell us, science or the humanities? What is the expertise we need to have in order to think through issues raised by genetic modification? What is a genetically modified organism—nature or culture? No matter what we consider we seem to encounter agency that slides backward and forward across this once-stable boundary and across "inscription devices" and "enactments" with multiple implications culminating in what Donna Haraway terms "states of disorder" (Law 2004).

Pickering defines the humanities as humanist "inasmuch as they study and theorise a world of humans amongst themselves." The sciences are "antihumanist" precisely inasmuch as they study and theorize a material world from which humans are absent. Only in science and technology studies, he argues, has an attempt been made to close the gap, but this simply produces new tensions: "So, 'bridging the gap' between the two cultures creates a different gap. Now the mainstream scientists and humanists appear as a monolithic bloc, united in their dualism, against which Science and Technology Studies [STS] . . . appears as a strangely nondualist formation, or, as I am inclined to say a *posthumanist* one—where the word 'posthumanist' denotes a decentred perspective in which humanity and the material world appear as symmetrically intertwined, with neither constituting a controlling centre" (2000, 3). The significance of this observation and its implications for a much-strengthened sociology has been demonstrated only too well in Pickering's analysis of New Orleans and the agency of the Mississippi River (this volume). Showing how both the river and the city were entwined in an emergent becoming, the city from this perspective (i.e., in the thick of things) seemed less of an impregnable blue-printed design of humanity than the delicate and endangered artifact of an experimental choreography between nature and culture. From this perspective the events directly surrounding Hurricane Katrina were interesting: the failure to grasp what had happened stemmed in part from a false belief in the city as a supreme humanist triumph over nature. At the same time the extent of the damage to the social fabric of the city illustrated just how much the river was involved in the city's life and shape.

One of the striking things about Pickering's chapter in this book is both its simplicity and its profound implications. It is simple because a place like New Orleans is, of course, intimately bound up with the specific waters of the Mississippi; it is so obvious it hardly needs to be stated. Yet it is also profound because most academic writing on the city supposes it to be a binary opposite of nature—its antithesis or defeat. It is a space devoid of nature, sanitized by human technologies and governed by civic orderings. Sarah Whatmore and Sarah Hinchliffe (2003, 4) argue that urban theory and planning practice exemplify what Tim Ingold (2000, 181) characterizes as a "building perspective" where "the organization of space cognitively precedes its material expression; built environments are thought before they are built." In a manner similar to Pickering's depiction of the artist Mondrian, Whatmore and Hinchliffe argue that the "thoroughly humanist commitments of this perspective are evident both in the genius of the architects/planners whose visions materialise into the city and in the strictly human terms in which its fabrication and inhabitation are conceived" (4).

But Pickering is not alone in noticing the necessity of a symmetrical, monist view of the city, nor the fantasy of humanist order. Nigel Clark (2003), building on Mike Davis's claim that California is "configured by waves of dynamic instability," goes one step further in claiming that most cities (and by implication the experiences of most people) are characterized by their location in sites of "turbulence" and by turbulences that they themselves set in motion. He argues that while social scientists have "been obliged to take into account the human impact on the biophysical environment, this is not the same as engaging with ecological processes and events that impact on social worlds." Clark considers the themes of extreme weather, seismic unrest, plague, and predation, and he reminds social scientists that, ironically and perversely, humanity has tended to look to nature for a sense of order and equilibrium. More than this, in modern societies this Edenic fantasy has been responsible for garden cities and for rural or hillside suburban developments built in such spectacularly dangerous places as the Australian bush or the Californian chaparral. As Davis writes of California, "Statewide some seven million inhabitants—the whitest and wealthiest segment of the population—now live in the suburban-chaparral border zone where the wildfire is king." The consequences are staggering: "Two-thirds of all homes and dwellings . . . destroyed by wildfire since statewide record keeping began in 1923 have been

burnt since 1980. Individual fires there can cost between $1 and $2 billion on assured items alone" (1999, 145). According to Clark, though, this is not exceptional: order and balance are the exception not the rule. If this is so we would expect turbulence and tensions between nature and society to be both normative and constitutive of both. As things stand this is not how most sociologists conceive their subject matter, but what happens when one places oneself *in medias res?* What is at stake? And what advantages derive from posthumanist approaches?

The first and most obvious advantage is that such approaches open up a world of research possibilities that were precluded by the very nature of the Great Divide. Relationships that were once unthinkable can now be thought; relationships that were once understood as structured can now be thought of as fluid and open. This makes a huge difference. A good example is the recent research by Haraway (2003) and Franklin et al. (2005) on the relationship between humans and companion dogs. Truly symmetrical investigations into this relationship were unthinkable until quite recently. Dogs were held to have little or no communicative competence and humans were held to be conscious of the world only through their own social symbolism. The simultaneous denial of communicative competence to animals and the assertion of human tendencies toward anthropomorphism descends from George Mead and has remained very influential in scientific and psychological discourse. But as Clinton Sanders remarks, Mead was also influential in those rare moments when sociologists considered the human-animal relationship: "Since animals were not fully fledged social actors from the Meadian point of view, their encounters with humans were one-way exchanges, lacking the intersubjectivity at the heart of true social interaction. People interacted with animals-as-objects. The dog owner's babbling endearments to his or her canine companion is engaged in a form of happy self-delusion; he or she is simply taking the role of the animals and projecting human-like attributes into it" (1999, 118–19). This thesis also rules out the need to look closely at the relationship itself. After all, it is a fantasy creation of the human, and what the dog is thinking or doing matters very little. The asymmetrical nature of this exchange is mirrored in other follow-up studies that try to focus on the cause of health benefits resulting from companion animals. One of the more common is to measure blood pressure before and after a human interacts with (looks at, strokes, accompanies) an animal, as if only human agency and human thoughtfulness are at play and need to be understood.

While we can agree that human agency, thought, semiotics, and imagination are critical to understand our relations with animals, and inevitably play an important role in explaining them, we do not have to agree that this is all we need to attend to nor where the whole answer lies. The most obvious posthumanist thesis is that there are two other objects that demand to be investigated: the companion animals themselves and the relationship itself. Again, the statistical studies of companion species and human health suggest that human self-delusion may be less important than the type of relationship and the species in question. Cats are equally the objects of human projection, but statistical studies show that they offer less health benefit than dogs (Freidmann, Thomas, and Eddy 2000). Research might show the relationship to be both a hybrid cultural form and one built on agency rather than on imagination. If this is so, then we would be in a position to be able to refine, direct, train, and target the effect more easily. Policies could be directed to maximize the health benefits, which in Australia alone are estimated to be worth $988 million and represent 2.7 percent of the nation's health expenditure (Headey 1998). More specifically we could then ask: How do dogs and humans shape each other in species-specific ways? This is an entirely new kind of question with pragmatic, practical, and ontologically new dimensions.

However, the posthumanist ontology is also concerned with the nature of conscious agency and the limits of control that it can attain. Posthumanists dispute the very possibility of the humanist project as an ordering of the world, and they argue that "the very illusion of control speaks a fundamental ignorance about the nature of emergent processes through which consciousness, the organism and the environment are constituted" (Katherine Hayles 1999, 288). As Jeff Malpas and Gary Wickham (1995) argue, *failure* and instability are built into human ordering attempts just as much as success and stability. This is because ordering attempts that push into the world are always incomplete and are frequently the subject of other orderings that may not be compatible. Malpas and Wickham identify the problem in the relation between governance and "known objects": "Governance is thus predicated on the resistance of object, not only in terms of the being of the object as something recalcitrant, but also in terms of the object as in some sense separate from that which governs. Moreover since every project is always enmeshed with other projective activities, there can be no guarantee that such projects,

though connected, will even be wholly consistent with one another" (46). However well we research social orderings, our labors will be for nothing unless we pay equal attention to the objects they order, their social life, and their relationships.

Both Katherine Hayles and Donna Haraway have consistently pointed out the deceit of humanism. "Mastery through the exercise of autonomous will is merely the story," Hayles argues, "consciousness tells itself to explain results that actually come about through chaotic dynamics and emergent structures. If . . . there is a relation among the desire for mastery, an objectivist account of science, and the imperialist project of subduing nature, then the posthuman offers resources for the construction of another account" (1999, 288). In this account emergence replaces teleology; reflexive epistemology replaces objectivism; distributed cognition replaces autonomous will; embodiment replaces a body seen as a support system for the mind; and dynamic partnership between humans and intelligent machines replaces the liberal humanist subject's manifest destiny to dominate and control nature.

In the remainder of this chapter I sketch a posthumanist account of the relationship between gum trees and Australians. I show how they are mutually constitutive of each other; how the different fire regimes that they constitute together have structured social life in important ways and enrolled individuals into fiery relations; and how both the gum trees and the humans are affected by each other in embodied or physical terms. Most important of all I demonstrate a practical value. At present firefighting is conceived in abstract terms, literally fighting fire. Yet fire is merely the artifact of a more material struggle between gum trees and humans, and the attention given to fire prevention obscures this true relation. If the alternative posthumanist account were to be operationalized, then greater focus would be on human relations with the trees and forests themselves, and greater care might be taken in human management through more extensive monitoring and removal of debris. As we shall see this was and is how Aborigines tended to view their relations with the gum tree forests—that is, expressed not in terms of the risk of human life but rather the health of the country as a whole, they referred to burning forests and scrub as "cleaning up the country." Equally, we shall see how this perspective provides a better account of the rising numbers of deliberately lit fires and thereby the means to address the problem more effectively.

In medias res Australis

Eucalypts are a relatively late arrival within the Mytaceae family. Around the time Australia had pulled away from Gondwana and was heading out into the Pacific and northward, the eucalypts were a very minor genus existing on the margins of rainforest where they exploited disturbance and openings in the canopy. As Australia itself became a more disturbed, drier landscape, the eucalypts expanded and began to reshape the environment around them, producing along with some other species a scleroforest that was adapted to natural lightning fire. The epoch that Pyne calls the eucalypt revolution took place only in the last twenty thousand years. As Australia drifted northward it experienced greater aridity, disturbance, and increasingly impoverished soils. As this happened the eucalypts mastered this newness, but then became attuned themselves to newness.

According to Pyne the takeover by eucalypts was staggering and unrivaled by any species on any other continent. By the time of the continent's first settlement, approximately 25 percent of the Australian landmass was covered in forest, and of that 70 percent was eucalyptus forest: "Across Old Australia, eucalypts comprised some 95 percent of the constituent tree species" (1992, 16). They were remarkably adaptive to almost all environments and were "incredibly plastic and unstable"; "hybrids are common within the subgenera, juvenile habits persist into adulthood, and even phantom species (apparently hybrid populations that now exist in the vicinity of only one parent) have been identified. As they expanded, more and more of the plant and animal population had to adapt to them, and they became a vital focus for insects, mammals, and birds: occupying 25 percent of the landmass they harbored 50 percent of Australian birds, for example" (1992, 18). However, it was their relationship with humanity that was critical to their own incredible spread across Australia, since the fire hardiness of the eucalypts also made them fire dependent. Until humanity arrived, fire was limited by natural lightning strikes. After humanity arrived and started to use the torch the spread of fire was rapid and extensive.

However the issue was not just the blanket increase in fire, even though it was extremely extensive and unremitting for upward of sixty thousand years. Human interventions in the landscape was patterned by a technology of fire use, which sought to achieve different goals at different times of the year and in different parts of the country. Ultimately this technology produced not a

monolithic biotic structure but a mosaic of patches, thereby increasing biodiversity and ecosystemic variation. Increased ignition and the routinization of the practice of fire technology changed the way fires burned and, in so doing, affected new selection pressures on many species including the eucalypts themselves. Regular burning was a less catastrophic affair, and if it were confined to cooler times it could preserve islands of persisting rainforest. Most especially the burning produced over the course of millennia the grassland-eucalypt parklands and savannahs that are, ironically, so attractive to the European eye.

Here we can identify the start of a dance of agency. Eucalypts began as a rare specialist exploiter of disturbance. As disturbance, aridity, and fire became generalized conditions in Australia, the eucalypts began to take over from former rainforest species, but their spread was limited by natural ignition. Once humans arrived, probably bringing fire technology with them, ignition was more frequent and more extensive and fires were of different types with each seeking different effects. This altered the way forests grew, notably in the relationship between grassland, dry forest, and rainforest and in the distribution of animals and other plants. The Aborigines used fire to concentrate game, torch their enemies, and keep the forest from becoming impenetrable. Over time, fire-sensitive plants were killed off while the more tolerant began to undergo evolutionary transformations and adapt to fire. Most reached the point in this evolution of being so adapted to fire that they became dependent upon it and would die out in any one region if regular burning were to stop. As a result, gum trees have produced an impressive battery of pyrotechnic adaptations and, even more remarkably, individual species have adapted and in a sense need the precise type of fire they grew to expect from human fire technology.

This rapid evolutionary adaptation that occurred in response to the dramatic difference that hunters and gatherers made to the landscape must be seen not merely as something that happened to gum trees but also as something that they *did*. Further, we must not think of such adaptations as ecological fait accompli, but rather as works in progress or organisms that are never finalized. This is because we can only understand any given organism in relation to the shifting networks of objects and other organisms that define it, and although these may best be thought of as bundles or rhizomes, even these metaphors may be too foreclosing of the essentially open and fluid nature of its ecological

being. This shift in emphasis undermines our tendency to see organisms like trees as mechanisms, suggesting instead that they respond to events and changes in their world. These changing responses result in new patterns of behavior that we can describe in terms of acts that of course have profound (if not knowable or intended) effects on the world around them. Trees by their very nature act, and they act both upon others and in relation to others; this is why dance and choreography are fitting metaphors for the agency we need to describe. We need, as Law (1994) suggests, a sociology (or a natureculture) of verbs and not nouns. In botany the agency of trees is downgraded to the noun *habit*, but this is only so from the social time of the gardener or forester. Sociologists interested in social and natural change need to take a longer-term view, but at the same time they need to place analysis in the thick of things in order to see who is doing what and why that matters. In this respect it is important to see in round terms what gum trees are doing and why that matters to contemporary Australians.

First, let's look at how the eucalypts act in relation to fire. The characteristic most emphasized by science is that without fire eucalypts cannot reproduce. The seed cases or gum nuts are very tough and the seeds are very long-lived. A waxy barrier through which only a hot fire can break protects the seeds. In order to survive bush fires the seeds must be protected by producing this tough barrier, but once it is in place the trees require fire in order to release the seeds. Thus we can say that other forms of agency focus on creating and enhancing a fiery landscape around them. This involves fueling and fire spreading.

Fueling is achieved by the somewhat dramatic shedding of wood and other materials in conjunction with the production and distribution of volatile oils. The eucalyptus oil is in the leaves and bark of the tree, and when it is combusted it produces an explosive hot flame that is propelled through the canopy in a fast-moving fire, or through the lower stories in the slower-moving ground-level fires. But this is not the end of the story. Over even short periods of time, a few months or so, gum trees very quickly amass large quantities of combustible materials around their base. The tree's leaves trickle down at all seasons of the year, and twigs and small branches that seem unreasonably sensitive to even moderate winds form a deadly carpet of fire-priming materials. Many gum trees also shed their bark, pieces of which hang down from branches, boughs, and trunks and in so doing trap all manner of other flammable material. Further, perfectly healthy gum tree boughs that produce strong and

healthy growth are prone to sudden shedding. This feature produces an impenetrable mass of materials that make access and transit exceedingly slow for most large species of land animals including humans, but the main purpose of the debris accumulation is to create a strong, evenly distributed and sustained blaze. Finally, most gum trees create extremely dry soil conditions around their base, thus preventing the buildup of fire-suppressing understories or footholds for rainforest species. Even after good rains the soils in gum forests remain very dry.

Gum trees are also active in spreading fire. This is achieved not only through the chain of combustion through the canopy and the litter but also through spotting fires downwind from the fire front. Caught in the updraft of forest fires, the asymmetric gum tree leaves spin and sail with the updraft very high into the upper atmosphere. With their rich concentrations of oil, they are typically still smoldering even after a very long flight. Eventually the leaves fall away from the influence of the updraft and are caught in the more lateral northerly winds that usually propel bush fires at great speed. In relation to these winds the leaves begin a shallow descent landing up to ten kilometers away from the fire front. However, under the dry conditions of the summer and the baking heat of a northerly blow a smoldering leaf can set off a spot fire, thus making sure that the fire is reproduced across any natural fire breaks such as mountains, rivers, and marshy valleys, and across man-made barriers as well.

Posing the idea that trees act is typically hampered by the nature of human perception of them, in addition to the humanist tradition that reduces agency to a capability that humanity alone possesses (Latour 1993, 138). Because trees move very slowly and their activities are spread out over relatively long periods of time, trees appear, like slowly moving clocks, to be essentially passive. But, as Owen Jones and Paul Cloke note, "trees produce action not only through their overall growth and development but also in their seasonal and longer term cycles. A wood or city park, say, are deeply different places in winter, spring, summer and autumn" (2002, 69). Gum trees produce cycles of debris or "fuel" accumulation that are followed by fire and then by regeneration; if gum trees are not subjected to fire every two hundred years or so they will naturally die and be replaced by rainforest species more or less completely. Over the course of such cycles they may destroy parts of a modern city, wipe out longstanding farms, reconfigure natural wildlife systems, and change

insurance premiums or transform the aesthetic appeal of a given place. As Murray Bail says, "It is trees which compose a landscape" (1999, 16), but they do so in their own time—a time that humans find hard to recognize. Therefore it is vital that hybrid collectivities are not simply defined in terms of social time, for fear that our understanding of agency relations will in this way simply revert to the study of those networks that center on human agency (Jones and Cloke 2002, 69).

We know trees grow but even this growth can only be perceived over long periods of time. Some trees are used by humans to trace and represent the slow time of seasonal change, hence in deciduous higher latitudes autumn is *fall* and spring can be *bud burst* or *blossom time.* However, we do not acknowledge these as acts but as events without agency. More recently the constitution of agency has been enlarged by Actor-Network Theory (ANT) writers, a new group of geographers lead by Nigel Thrift and David Harvey and feminists such as Haraway. For them an actor is defined by its ability to create effects and to be responsive to the world around it. Or as Whatmore, following the ANT tradition, elaborates it, agency should be seen as a "relational achievement, involving the creative presence of organic beings, technological devices and discursive codes" (1999, 29). These analysts also speak of agency as having a distributed quality. For obvious reasons intentionality, language, and consciousness are unnecessary to this definition of agency as it has been redefined in recent years: if these elements were to be included, much human action would be ruled out (since so much of our action and activity is unconscious or noncognitive) and unintended consequences could be wrongly regarded as without agency (see Thrift 2000a; Law and Hassard 1999). Cloke and Jones (2001) show how fruit trees act in the Somerset orchard they studied, and how eucalypts in Australia can be shown to act not only in response to new conditions but in their habits and character and interface with humanity.

Humans certainly feel "the push" from gum trees. Over a relatively short period humans are only too aware of one of the trees' main activities: by shedding large quantities of boughs, branches, twigs, leaves, and bark they build up a massive pyre underneath themselves. If eucalypts are left without any management of this buildup, even for one or two years, they become a fire hazard, human passage through the forest becomes closed off, and new undergrowth is suppressed and game less common. Rather like the flower that attracts the bee, the eucalypt prompted aboriginal people to torch this debris—hence the

use of the term "to clean up" the country through this activity. To keep "country" clean, accessible, and productive of game, forests had to be burned frequently.[1] The fire that this regular burning produced was low in intensity. It was sufficient to release new seeds from their protective pods and to release nutrients into the ground but not sufficient to damage the trees themselves. Trees burned normally would bounce back through specially adapted lignotubers just beneath the soil line.

It is clear then that the eucalyptus evolved first in relation to the disturbance of natural fire and then to the more systematic fire technologies of aboriginal people, which expanded the trees' range and grip on the landscape. The range of effects that they *might* have, however, is never stable: the trees depend on the nature of subsequent human interventions—or lack thereof—on those landscapes. In other words, when white settlers arrived the effects, or agency, of eucalyptus trees was very likely to change in ways that the settlers and even subsequent generations of settlers could not predict. Two very important things can be said about the new relationship of the trees with the new humans. First, the fire regime they were used to ceased. Regular and systematic burning was not a feature of colonial Australia, rather the opposite was the case. This meant that the trees now created even more intensely fueled forest areas. Second, the new humans could not anticipate the singularity of risk from gum trees. Although they cut down millions of hectares of gum tree forest they also left many hectares standing, often very close to settlements. It was to take a very long time before the precise nature of the risk was known and an effective response formulated. However, as with the U.S. Army Corps of Engineers and the Mississippi River (Pickering, this volume) the emergence of theories about the situation did not solve the problem and return the world to equilibrium so much as simply change the nature of the dance steps.

I do not want to go into too much detail on the ontology of fire itself, except to say that it can be regarded as a form of *decomposition*, albeit a very rapid form, that releases locked-up nutrients for use by trees and other plants. Bush fires in Australia are where basic life processes converge for both humans and trees. Both use fire in producing their essential food, simultaneously and symbiotically. However, I do want to say that fire is not a separate agent but always a specific artifact (fire is never just fire) of the relationship not only between gum trees and humans but also other agents (weather systems, ploughs and other metal implements that cause unintended ignition, cigarettes, cars, discarded glass

bottles, etc.). Fire, of course, is not a separate element and its nature is directly related to human and plant actants. This is always the case no matter what the agents that cause it are. If we were to consider house fires instead, especially those caused by electrical faults, we would say that the key agents involved would be those technologies that degrade or fail, such as wiring, switchboards, or electrical appliances in conjunction with human agents (e.g., residents who fail to maintain or safeguard; workers who fail to fit appliances properly; errors in construction at the factory). We would not say that a house fire was caused by fire, we would say instead that the fire was caused by a responsible agent (faulty wiring, a failed appliance, or a careless householder).

Here I want say a few things about the aboriginal accommodation to and agency within this *fiery environment.* From the records and logs of the first ships to sail the length of the eastern coast of Tasmania in the eighteenth century, we know that early explorers were struck by the sheer extent of fires. The log of James Cook in the *Resolution* records the continuous presence of bush fires in the forests from the northern cape as far as his journey's end at Hobart, a distance of some three hundred kilometers. Another example comes from an entry dated March 10, 1773, in the log of the explorer Tobias Furneaux in the *Adventure*: "The trees are mostly burnt or scorched, near the ground, occasioned by the natives setting fire to the under-wood in the most frequented places; and by these means they had rendered it easy walking."[2] Fires were very well understood by Aborigines and they knew how to control and direct them. Recorded observations by some Europeans mention the sight of fires over vast areas: these may have been set unintentionally or had burned out of control (indeed, perhaps the gum trees were ultimately impossible to control owing to their ability to raise spot-fires), or maybe they were left out of control intentionally in order to burn a very large area. Subsequent research has shown how aboriginal fires targeted specific tracts of country impacting differently on a range of vegetations. Over time this created a mosaic pattern of vegetation geography. Despite aboriginal ability to control fire, fiery environments require specific forms of mobility and nomadism. In the case of Tasmania, with the presence of large fires and with Tasmania's notoriously unpredictable shifting winds, the Aborigines' ability to move at short notice was also necessary at times. This ability to predict weather, especially shifts in winds as well as a keen sense of knowing when and where to move, was recorded in Tasmania by Augustus Robinson (1971 [1829]).

Becoming Europeanized Gum Trees

This dance of agency and the relationship in Australia between gum trees and humans offered possibly the most difficult conditions and challenges to European settlers and their sedentary way of life. In seeking to establish scattered permanent settlements and permanent field systems of agriculture, the Europeans had no choice but to clear trees in an extensive manner. Fire could not do this, and for many decades large numbers of Chinese ring-barker gangs made their way through millions of hectares of forest improving its value as they went. However, even though it was economical for land developers and farmers to clear forest for agriculture, there remained millions of hectares of forest that was unsuitable for agriculture. These forests lay in scattered patches across the entire continent, notably in the zones of greatest white settlement, along the coastal strips and hinterlands of the east coast. Unlike the savannah parklands produced by constant aboriginal burning, a landscape that so pleased the first European colonists and made possible the long pony-and-trap journeys through the bush, the forest that arose subsequent to the removal of Aborigines was very different as well as highly dangerous to have close to settlements.

As Phil Cheyney notes: "As soon as Aboriginal burning ceased, the regrowth of the vegetation was extremely rapid and within a few years the grass was 'choked by underwood' and by the regeneration of young trees. Major Mitchell describes 'the omission of the annual periodical burning by natives, of the grass and young saplings has already produced in the open forest lands nearest to Sydney, thick forests of young trees, where, formerly, a man might gallop without impediment and see whole miles before him.' This regeneration of forests around Sydney was repeated in other parts of Australia and is still happening today in areas of north Queensland" (2003, 22). Further, the issue is not just the denser growth of the trees themselves but also the rapid buildup of leaves, twigs, branches, and boughs. As Richard McDonald notes: "A well-grown forest unburned for years was an explosion waiting to happen. Three centimetres of leaf litter was equivalent to one centimetre of refined gasoline lying on the forest floor" (2002, 70).

After the removal of Aborigines, bush fires became more explosive and dangerous and a litany of major disasters were experienced: Black Thursday, 1851 (Victoria); Black Sunday, 1926 (East Melbourne); Black Friday, 1939 (widespread in eastern Australia); Black Tuesday, 1967 (Tasmania); and the

Canberra Holocaust, 2003. It was only after the major 1939 fire that policies and strategies for systematic burning off were widely used, but the risk around Sydney and Canberra continues to persist. Indeed, the fires seem to be getting worse in scale and more frequent.

The fiery dance of agency between white settlers and the gum tree takes on an altogether different form. At one level it places the gum tree and dry sclerophyll forest in an ambiguous relationship with modern urban humans, but on another level the dance is one of a series of nondualistic defining features of Australia as a nation. In terms of the latter point, white Australia is and always was an essentially urban social formation, so why worry about trees and bush fires? The answer is that urban development in Australia is not the building of great cities of apartments but the sprawl of great suburbs. As in the United Kingdom, the best sorts of suburb are those that combine proximity to urban amenity with proximity to nature, which in Australia means forest or bush through most of the southeastern portion of the country (including Melbourne, Sydney, Canberra, Adelaide, Hobart, and all of the country towns in between). These suburbs have been spreading out since they were founded in the nineteenth century, and in this way each generation creates itself in the same manner by seeking to build a new home on the rural fringe. This is still true today. In Hobart where there are many older homes for sale in the city, new couples tend to favor building their own house on the (cheaper) city fringes, which are extremely close to the bush. From the 1960s onward some suburbs changed their character and aimed to be permanently "in the bush"—in the unlikely and dangerous hybrid called "the bush suburb." Canberra fulfilled the more extreme aim of a "bush city" with results in 2003 that few could have imagined.

Black Tuesday, Hobart 1967

In my backyard in Hobart I have about thirty gum trees and several stumps. Almost all of them are blackened from the fire of February 7, 1967. On that day, many small fires that had been burning flared up around 11:00 AM, and in a period of just over five hours burned an area of some 264,270 hectares, caused the death of sixty-two people, and resulted in the loss of 1,300 houses and cottages within fourteen municipalities along with 128 nonresidential buildings including factories, churches, halls, post offices, hotels, service

stations, and schools. The fire cost the state of Tasmania, with its population of 500,000, around $40 million.

Despite a long history of bush fires in Tasmania, including a particularly nasty fire in 1934, it took the disaster conditions of the 1967 fire for new steps to be added to the fire dance. Up until then, rural fires were allowed to burn themselves out in the belief that a city such as Hobart could not be torched. Such wisdom, however, was largely based on the conditions of the city before it had started to build up the gullies and foothills of Mt. Wellington and into fairly densely forested areas.

The Rural Fires Board *Annual Report, 1953* states that 256 firefighting units existed throughout Tasmania. Ten years later in 1963 the board reported that voluntary fire protection covered approximately 12,500 square miles or 46 percent of the state. In many instances these brigades were "on paper only" and thus not equipped to fight fires. In many communities the citizens' lack of interest undermined attempts to form brigades. In addition, there was no overall coordination of firefighting but rather a formal difference existed between the professional urban brigade and the rural volunteer brigades. The lack of coordination was marked by the fact that only a few professional urban machines were in radio contact and such contact itself was restricted. On the rural fringe the brigades consisted of motley crews equipped only with hand implements and doing no back burning. At this time, there were provisions requiring landowners to dispose of combustible materials, including gum tree debris, but these rules were not enforced because the authorities (councils) in question did not possess landowner records and "had better things to do" (Wettenhall 1975, 71). Fighting fires thus was hardly an attractive proposition in local communities and quite clearly of low priority to the authorities. It is little wonder that Hobart was nearly lost in 1967.

The Social Life of Modern Bush Fires

Following the devastating fires of February 1967 in Tasmania, the Rural Fires Act was amended to ensure that the organization of volunteer fire brigades was maintained at the community level. Local fire committees were formed that approved the development of brigades in municipalities and recommended policy to local councils in matters such as fire hazards, equipment, planning, and related matters. Reorganization came in 1977 after a review of

the fire protection arrangements in Tasmania. The result of this inquiry was that all brigades—urban and country, career and volunteer—were, beginning on November 1, 1979, brought together under the umbrella of the Tasmania Fire Service. From this point on the funding of volunteer brigades was improved and brigades were provided with standardized facilities, equipment, and training. At the time of this writing, approximately 5,000 volunteers from 236 stations are members of the Tasmania Fire Service, and the increased status of the role of the firefighter is enhanced via a more state-of-the-art technical operation. As a result, the relationship between communities, firefighters, and gum trees has changed in interesting ways.

The move of the suburbs into the bush has created an interesting homogeneity of experience for Australians of all ages, namely the experience of semirural life in the city. As such, this life has involved everyone in the fiery dance with gum trees—a situation that is serious in a country that favors wooden homes. Although humans still start most fires, these fires are now also related to the exigencies of suburban life (weekend barbeques or campfires; a cigarette tossed out of a car window; teenagers playing with lighters) or to contemporary farming practices where machinery sparks can easily start a blaze. However, there are also more complex and intriguing causes of ignition that point toward the more interpellative qualities that fire has within a fire landscape. In eastern Australia, people seem to be drawn into fire's self-perpetuating regime. While most Australians might admit to enjoying fire around camps or a log fire at home, there is no doubt that some people are attracted to fire itself or, more properly, bush fires, and when fires fail to occur naturally or by accident on days of extreme fire risk, it is thought that many are now helped on their way by arson. In a documentary that aired on ABC in February 2003 it was revealed that between 1993 and 2003 the number of fires started by arson grew from 30 percent to 50–60 percent of all bush fires. According to Matthew Willis (2004) deliberately lit fires are the cause of 25–50 percent of all bush fires. Whereas in the late 1980s there were approximately 60 deliberately lit fires per 100,000 people, by the 1990s there were 170 per 100,000 people. Further, in the 1980s there were around 300 bush fires per annum, but by the 1990s this number had grown to 4,400. The ABC documentary also suggested that the voluntary firefighting brigades either attracted or produced "firebugs," because the starting of fires produced huge thrills along with feelings of accomplishment, power, and, in the Australian

semibush and bush context, enhanced status from a nervous but appreciative community.

The social life of bush fires was first noticed in 1939 by H. G. Wells during his visit to Canberra for the annual meeting of the Association for the Advancement of Science. The 1939 bush fires disrupted the meeting with smoke, and eventually the delegates could do little other than go to the fire front to help out. Later H. G. Wells advised Australians to fight wars like they fought fires: "The thing to note, in a war-threatened world, is that for Australians, as for people at home, this sort of thing exhilarates. Everyone we met [during the fire] was dirty, hungry, thirsty, fraternal and *quickened*" (Wells quoted in Griffiths 2001, 146; my emphasis). In short, bush fires that threaten communities produce great excitement and a sense of teamwork, and they have a certain deadly appeal that is not dissimilar to war or mimetic contests such as sport (see Elias and Dunning 1986). However, I want to underline the fact that firefighting is not a mimetic contest but rather a true fight with great stakes in winning each bout. It is this factor combined with the largely embodied nature of the fight that contributes to its gravitas and elevates its fighters above even sports celebrities, if only briefly and less remuneratively. The point is Australians really do fight trees, not a separate element, that is, fire. Once experienced, the thrill of firefighting often leads to further thrill seeking. Seventeen volunteer firefighters have been convicted of starting bush fires in the past five years, which is a startling number given the extreme difficulties of proving a crime in which the chief characteristic is the destruction of its own evidence. In November 2002 the *Sydney Morning Herald* ran an article about Richard Kocsis, a criminal profiler, and his study of serial bush-fire arson. As the article states: "Most of the serial bushfire arsonists in the sample fell into the 'thrill' category, which Kocsis describes as 'the most malignant.' 'Thrill' arsonists associate random destruction with gratification of some kind—not sexual in nature, and not to do with personalised anger or resentment. The thrill seems to be centred on the power the fire gives them, or the attention they gain."[3]

In referring to this phenomenon I use the term interpellation because the factors that are so obviously at play are neither human nor natural but both. The complex intertwining of trees constantly acting in such a way as to create fire, with a settlement and forest management pattern that exacerbates the risk of disaster, creates in rural areas and suburbs alike a powerful tension that speaks directly to people and pulls them into its gravity. One firefighter,

Peter Burgess, was convicted of starting fifteen bush fires across New South Wales. He had pinned his life project on being a respected and superior fireman. He told police that he was excited by fire and that he got emotional satisfaction from the praise heaped on volunteer firefighters. Fire gave him a feeling of accomplishment. The excitement induced by experiencing a bush fire close to home is life altering, and despite their danger they are thrilling affairs in the relatively eventless suburban life. Indeed, the arsonists are not the only people who are drawn into the fiery dance of agency of the Australian bush. The approved method of fighting fire advancing on properties is to stand one's ground and fight them, and in the awful fire of 1996 this is what happened in Hobart, albeit without the massive destruction of 1967. All residents want to prevent their homes from any type of damage, let alone seeing them razed to the ground. Thus in Australia part of the dance is a series of routines, some domestic and some communitarian, that are called forth by gum trees.

Andrew Pickering has alerted us to an important idea. Elsewhere in accounts of the relationship between nature and nationalism the gum tree has figured first as an aesthetically unpleasing blot on the landscape and then as the vanquished and lonely (but romantic) figure standing isolated and alone in the middle of a meadow, offering shade to grazing cattle. By these accounts the gum tree symbolizes the victory of modernity over nature: once controlled it can stand as an attractive symbol of nationhood. At the same time it stood as a passive object beside the only active agency in the world, humanity. This romantic construction was a perfect dualist example of humanity and nature. But the account I have given here is very different. Although it is no less attentive to the true facts of the matter, it goes into the thick of things; from here, where most Australians live or have lived, the gum tree is a different thing, but so too are the humans. Gum tree forests are different active agents in the country and city. They are dangerous and unpredictable and require constant attention, training, and vigilance both before and during actual fires. They are constantly doing things: dropping boughs and other fuels, spreading into uncultivated areas; renewing their presence after fires; serving as the host for fires that burn vast areas of bush and settlement. Australian suburban life has also been shaped by the trees. The specific form of protection needed through volunteer groups provides the means of a local solidarity that is as meaningful and significant as any other agency of defense or health.

This solidarity extends beyond the immediate locality of one's own suburb, because more than one fire unit is required for big fires. Indeed, Tasmanian firefighters regularly travel to New South Wales, Victoria, and Western Australia where major fires threaten crops, animals, forests, and cities. In this way a big bush fire, like any attack on a city, is a major national incident and mobilizes a strange but unmistakable sense of nationalism. Such a fire tells and retells the story of Australia—a land of great opportunity and pleasure but also a land where nature is not and cannot be properly tamed. It tells this story in terms of social organizations that are made in relation to their dance with nonhumans. In this very precise way Australian nationalism is not just about finding symbols to unify, but instead is an effort in *practicing, sensing, and battling* against a familiar nature that has done as much shaping as it has been shaped itself. Somehow nature in this view seems to define very precisely who Australians are as dance partners. Is this a monist view of the relationship between the natural world and humanity? Are modern Australians made as much *by* nature as they are *with* nature? Are we glimpsing monist aspects of nationalism? I think we are.

The intertwining of the so-called natural and social that is necessary to tell such a tale is starkly different from the dualist way it is normally told. So, for example, scientists are quite happy to describe the nature of gum trees as pyrophytic, fire loving, and fire dependent, and even for fire itself to be attributable to and distributed by the biology of the eucalyptus. Eucalyptus trees were an artifact of natural fire in the first instance and then of human fire regimes. First they adapted to surviving fire and then they adapted further to spreading fire, for there is no doubting their genetic and morphic design in this direction, nor their practice of laying down fuel and causing ignition for up to five miles downwind of themselves. However, in the humanities, in the many books on bush fires, fire is abstracted from its natural agents and is given an independent elemental quality. In accounts of major bush fire disasters it is as if fire is a natural phenomenon independent of the gum trees that cause it. The account of Black Tuesday by the political scientist Roger Wettenhall (1975) is an excellent example: whereas there is continuous reference to fire, gum trees do not even register as an item in the index. Worse still, the force and agency of gum trees is hidden behind simple lapses of humanity in taking the necessary fire precautions. This is a typical humanist delusion because until humans were pushed into it by

the agency of gum trees, the plans and policies from which a *lapse* could be identified did not exist.

Black Tuesday illustrates how gum trees are formative of community and national life, and how they are not, ironically, merely symbolic of the human domination of Australian nature as dictated by the Heidelberg school (or Drysdale). The gum tree in my account here has become a ubiquitous and powerful actor in Australian society by forcing profound changes in the landscape and on the social structure. The gum tree also provides, in performative terms, an answer to the paradox of why an essentially urban society would construct itself in terms of a rural society, a society seemingly close to nature. Intuitively we might think of the Gellnerian story of a nation in need of a primordial origin myth. But now I am not so sure. If I have learned anything about the gum tree it is that it won't allow urban Australians to get away from it; in the dance the gum tree is a femme fatale—she leads. Are Australians willing partners? Although it is frightening, it is curiously exciting to be stalked in the hot summer weather. Bush fire disasters evoke communitas, those incredible moments of social solidarity unparalleled even by sport. In terms of the aftermath of fire, Wettenhall speaks of the "communal egotism" where, in the case of Tasmania in 1967, "for several weeks it was hard for Southern Tasmanians to put their minds to any question unrelated to their own collective predicament" (1975, 84).

Note also that in accounting for the social life of gum trees we find ourselves revisiting Durkheim's social effervescence, and we see that it is still dancing around fires. More tangible social becomings resulted from the dance with gum trees. The new social arrangements for dealing with bush fires also included managing the gum trees. It involved watching them and keeping an eye on their pyrocentric buildup. It involved fuel reduction through burning off, maintaining fire breaks, educating the community, and fund-raising. After 1967 new institutional and organizational structures came into being that kept a tight coordinating watch over the entire state but devolved immediate control to the community level. The number of voluntary firefighter brigades increased and had less trouble recruiting with a centrally funded, well-equipped, and effectively paid working environment. As the distinction between volunteer and professional firefighters diminished, especially after the mixed Tasmanian taskforce was sent to New South Wales to assist in fighting the bush fires of 1996, and local brigades took over the

broader accident, chemical hazard, and road incident work of professional firefighters, to be a volunteer firefighter took on new meaning and significance. Despite all the science and technology, the training and the risk minimalization, bush fires in Australia, like the waters of the Mississippi River at New Orleans, are on the rise and are becoming a more fixed aspect of our life.

Australia and California Compared

This fixed aspect of bush fires in Australian life is quite specific to the social and natural actors involved. The natureculture of bush fires in Australia is not the same as the natureculture of wildfires in California. To begin, in each case the anthropology of those who live among or near trees is very different. The rural fringes of Australian cities are typically and historically lower-status areas and the rural small towns are frequently characterized as socially problematic. In most cities it is the central suburbs that command the most prestige. In California, Davis reminds us that "the suburbanisation of Southern California's remaining wild landscapes has accelerated in the face of a perceived deterioration of the metropolitan core. As middle- and upper-class families flee Los Angeles (especially its older 'urbanized suburbs' like the San Fernando Valley), they seek sanctuaries ever deeper in the rugged contours of the chaparral firebelt" (1999, 142). Whereas the Australian bush cultures have developed a strong self-help ethos, and where their own fire brigades are a focal point of community life and prestige, in the case of California the wealthy hill-dwellers expect the state fire services to protect them absolutely and completely, regardless of the cost and without any input from themselves. The Australian residents are organizationally and personally related to the forests around them, while the American residents are divorced and insulated. In the two areas these social and cultural factors lie behind two completely different policies on fire prevention. In California the policy is for a complete ban on fire in the most dangerous areas. While this might well succeed in reducing ignition among responsible middle-class residents, it fails to do anything about fuel levels; as each year passes the fuel accumulates, which results in much hotter and more destructive fires than was ever the case in the past. In Australia by comparison, the local nature of firefighting and responsibility for prevention means that in cooler times of the year a great deal of back

burning takes place to reduce the fuel loads around residential areas. However, because the local brigades rely on fighting fires to maintain their status and income, individuals are now more prone to deliberately light fires. In Australia the number of homes lost to bush fires has declined sharply, while in California the number has grown exponentially.

Ironically, the wildfires of California are something of a misnomer in that the trees responsible for most of their ferocity are not wild native trees but rather introduced Australian eucalypts. For example, in the hills around Oakland and Berkeley the dominant trees historically were native oaks, but these were all logged in the 1880s and were replaced by plantations of eucalypts that then seeded easily across the entire region. Eucalypts now comprise 70 percent of the vegetation fueling contemporary wildfires.[4] Again we see eucalypts with yet another dance partner and yet another fire regime—one that Davis (1999, 143) has called the " 'postsuburban' fire regime." In this dance the trees are subject to no regime of regular burning, and the pattern of dispersed settlement makes it highly difficult to back burn safely. The dance of firefighting in the Malibu area comprises a house-by-house defense strategy that now involves the use of new technologies: the CL-415 "Super Scooper" is a huge amphibious aircraft that per fire drop can load up to 14,000 gallons of seawater. It is perhaps only fitting that in such exclusive areas firefighting has become such an expensive, elaborate affair. In the October 1993 fire the cost of mobilizing the 15,000 firefighters alone was $100 million.

More Dance Steps, Other Politics

There is yet another dance with gum trees in Australia that has significant social and economic ramifications. By removing the trees from so much of the land so completely and thus changing their mosaic patchwork presence on the land, Australian farmers and town planners have inadvertently raised the water table. This change has across a vast area of Australia created the specter of salination that affects roads and buildings as well as soils and wildlife. This dance involves *replacing* trees and experimenting with new variations on their primordial mosaic presence, as well as new forms of engineering and agricultural practice. This experimental maneuvering mirrors the dance of agency on the Mississippi described by Pickering, and in a sense it gives a much firmer footing to some of the more ethereal statements that Tim

Flannery makes in relation to the destiny of Australia as tied to Australian nature.

In this light, what is it that environmentalists and econationalists are seeking to protect from humanity? This is a thorny question. If gum trees and the entire Australian biota are created and modified by humanity principally through the medium of fire technology, can there be such a thing as a proper Australian nature that is not "managed" after the manner, if not exactly, of aboriginal technology? The fires that threaten Australians today are not the same fires burned by Aborigines, nor are national parks managed in a similar way. It seems unlikely that there will ever be the economy to reproduce aboriginal fire regimes in Australia, and in any case the knowledge of these regimes largely has been lost with the passing of the aboriginal presence in so many areas. So how do we choose what is a proper or appropriate nature given that so-called ecosystems (another invariant of science) are similarly contaminated by a lost humanity? Given that almost everywhere Australian nature is also dancing with a large number of introduced species that, quite frankly, can never be eradicated, and that an equally large number of Australian plant and animal species have made opportunistic moves out of their hitherto "natural ranges," how are we to determine the course of environmental policy? This is Tim Low's (2002) idea of "the new nature"—an idea that is not yet accepted by science, environmentalists, or of course the nation in whose name these elements of high culture now act. One thing is for sure: it is not possible for that nature to be conceived of as created or living separately from humanity. Equally, when doing sociology in Australia we must remember to apply the same symmetrical logic to our work and not conceive of sociology as humans merely "living among themselves."

Conclusions

This sketch of a posthuman account of Australian nature and society has quite radical implications for the way we do sociology and the way we conceive of nature. By this account nature is not separable from the social, but rather both are inextricably intertwined in a "becoming." Standard enlightenment orthodoxies have sought not a science of assemblage and becoming but one of separability and solid-state existence. Other approaches that seem to posit activity to the natural world that are not posthumanist often stray

far from the mark. So-called critical realism, a variant of neo-Marxism, attributes activity to natural phenomena through their internal "causal properties" but in doing so they are made to have a separate existence with potential connections or affordances rather than being embedded in already-existing connections or assemblages (see Martell 1994). These can become active or not and causal or not through their interaction with others although the great prime mover of the realist ontology is humanity. In this scheme both humanity and the natural preserve their separable ontologies from which vantage points they can enter into *dialectical* relations, thereby creating only new configurations from their robust parts and not, critically, "deterritorializiations" and "lines of flight" as Deleuze and Guattari would put it (1999, 88–89, 142–45, 510). In this way nature can be championed and environments preserved against the depredations of humanity (in the guise of capitalism) because in the realist ontology they are in theory (and ideally) separable. Because their scheme follows the notion of a world of "completed" and "created" individual forms and things, in a classificatory hierarchy nature and humanity do appear to be different and separable. But that appearance is merely the artifact of the classification and not the other way around. Nature can be deemed to be something that is clearly not human or social. However, I have shown in this chapter that this is decidedly not the case. Aborigines, gum trees, and modern Australians have been involved in mutual becomings.

There are, of course, practical benefits arising from the posthumanist account traced here. To begin, we can start to understand the complexity of the aetiology of the firebug. To date these individuals confound most attempts to understand them based on models of the rational, sane individual or the psychopathological personality. The normative ways in which ordinary Australian firefighters are so easily interpellated by the fire landscape needs to be understood and ameliorated through training and management. Further, gum trees do not merely drop combustible material but on hot dry days they create in the minds of those called upon to fight fires a tension and anticipated excitement. This is an embodied rather than a cognitive experience or relation, and the more nuanced sociology of Norbert Elias or Jose Gil is called for but seldom seen in environmental sociology. The arsonists are not setting fires in a detached, abstract manner but as knowledgeable connoisseurs of the fiery landscape in *their* world. As Gil writes, "relations to a tree, a prey, a star, an enemy, a loved object or desired nourishment set into motion certain privileged

organs including precise spaces of the body. Exfoliation is the essential way the body 'turns onto' things, onto objective space, onto living things" (1998, 127).

Equally, attention given only to fire risk rather than the management of the trees and forests themselves is an understandable humanist move but not one that acknowledges the complexity and distribution of agency or one that optimizes the human practice of dwelling among gum trees. Aborigines seldom created episodic dangerous fires because they created weak, low-intensity fires by paying attention to when the landscape needed "cleaning." The massive costs of contemporary bush or wildfires could easily be reduced by this sort of care of the land. But if the problem continues to be perceived as one of fire rather than one of trees, and if risk capital continues to be placed in firefighting units rather than in tree and forest management and care, then fires will continue to threaten our cities and suburbs. By paying more attention to the agency of gum trees—in other words, taking notice of what they are doing and have done—Australians will always be in a better position to assess the risk they pose at any one time. Perhaps this is best not placed in the hands of a volunteer organization of firefighters with their very limited resources, but rather in another form of local organization such as an inspectorate or a more nationally coordinated organization.

More generally, perhaps, modern settler society should realize that to be more effective they need to learn from aboriginal people and maintain a greater presence in forested areas and in the "country" generally; that good environmentalism is keeping people on the land and not off it. At the moment, many forest reserves are either in private land where owners are unable to prevent them from becoming hazardous (because they are either absent or are unprepared to spend money on management) or in national parks or state reserves where in recent times policy has been influenced by "human hands-off" values. Maybe this is not the best strategy. In order to be able to respond more effectively to the agency of gum trees perhaps we need to reorganize ourselves, and such a transformation might herald a radical change in the eco-politics of the twenty-first century.

Finally, my posthumanist analysis suggests that we need to take account of the different times over which the agency of eucalypts becomes manifest (to humans). It seems clear that the social times of specific forest policies, management plans, fire events, and resource use are often out of kilter with

the longer-term ecological and glacial times over which the trees and forests are active and influential. For example, I have shown in this chapter how, over the glacial time of the emergence of eucalypts, the species experienced such dramatic changes that they became adapted to change itself and that, compared to other species, they are by nature rather unstable and incomplete. However, we tend to imagine them as the opposite—as ancient, stable, fixed, and central (as in the notion of climax vegetation) to the environments in which they occur. Perhaps we need to realize that their nature is nothing more than a response to the fiery technology that to a great extent was man made; that while they are very effective in enrolling modern humans into the fiery landscape they are not really committed to maintaining it. Obviously by our own actions, in absenting ourselves from the landscape and refusing to maintain the regular aboriginal burning, we are creating different types of fire that are much hotter, larger, and more destructive, and we are thus setting gum trees off on yet another evolutionary trajectory. Is this what we want to leave as a legacy of our custodianship for the human generations that follow us? It seems that over the longer term most Australians would prefer that the exponential rise in the number and destructiveness of these fires would be reversed. Maybe the inhabitants of Malibu would agree. Perhaps this suggests that we should intervene once again in the essentially plastic nature of these species and produce, through different technologies, new genetic versions more in keeping with the contemporary landscape: gum trees, for example, that produce less volatile oil and shed bark, limbs, and branches less frequently, and that do not burn easily, produce spot fires downwind so effectively, or need fire to reproduce. Such an intervention would be contested, but the debate it would create is a perhaps one we need to have.

Returning to Pickering's metaphor of the dance of agency (or *ontological choreography* to use Charis Cussins's term), what can we say about the nature of the dance? There seems to be a contradiction between the emphasis given by Deleuze and Guattari to always-already-intertwined, inseparable, and mutual becomings and lines of flight, and Pickering's dance-step metaphor for reactive agency; his is a tango rather than the locked-together assemblage of the kiss. This can be resolved, perhaps, both through the consideration of time and the position of the observer. What look to be nonseparable steps (in-step choreography) are instead the artifact of ecological time, a view of the past from the present rather than *in medias res*, where nonhuman agency is

often impossible to perceive. And what look to be separate steps *in medias res* are often the artifact of *social time*, of socio-ecological narratives and perspectives where if one is openminded and strictly symmetrical the agency of nonhumans is only too apparent.

I think Haraway captures it well when she remarks that she is pursuing "a concept of agency that opens up possibilities for figuring relationality in social worlds, where actors fit oddly at best, into previous taxa of the human, the natural or the constructed" (1991, 3). We always confront others on the basis of an odd fit. Our gum trees act as if their aboriginal part-creators were still here, and modern settler Australians act as if gum tree forests can be lived in as one would among the deciduous trees of the north. We can't see the trees for the smoke.

NOTES

1. "Country" is an aboriginal term for the landscape—a term that does not distinguish between a separable nature and humanity but rather indicates the Aborgines' moral as well as practical obligation and attachment to the land and their dwelling in it.
2. T. Furneaux, *Log at Adventure Bay, Tasmania, 1783*. Available at the Web site of the Knowledge Representation Laboratory, Asian Institute of Technology.
3. Margaret Simons, "Burning Desire," *Sydney Morning Herald*, November 30, 2002.
4. Web site of the Firewise Communities Program (visited February 16, 2005).

Crate and Mangle

Questions of Agency in Confinement Livestock Facilities

DAWN COPPIN

She stands on a metal rectangular grid completely enclosed by thick metal bars. The light is dim where it enters the building through windows covered with opaque white plastic. The sound of her neighbors groaning, grunting, and squealing is constant and punctuated by clangs of feet against metal. The stench overwhelms all other senses. A fetid smell of decomposing manure and urine rises from pits beneath the grid, where it collects after being trampled through the holes by the body above. The ammonia sharpness quickly cuts off most of the olfactory receptors, although moving bodies and mechanical fans stir the air, alternately relieving and renewing the assault. The smell is enough to bring a grown man to tears and make him retch. Certainly the caretakers of this place do not linger to engage in idle chitchat, but rather do their work and leave as quickly as possible. Those in the crates have no such recourse; they are left behind without respite until their day comes to die. Then they are moved and, for a little while, they gasp cleaner air as they walk from their confinement building to the vehicle that transports them to their slaughter.

The life of swine in today's large-scale confinement facilities is, to paraphrase Thomas Hobbes, nasty, brutish, and short. This condition is the temporary result of ten thousand years of companionship with human beings. It is the outcome of many beings and things acting together over the course of many years, but it is only one snapshot picture of the evolutionary path that humans and swine have sauntered along together. It did not have to be this

way, in many places on earth it is not this way, and it definitely does not have to continue this way. Nevertheless, these are the conditions with which we currently live and to which we must attend.[1]

Complicating our understanding is the historical trend for the social sciences to be humanist—that is, solely about human beings among themselves—with matters relating to the rest of the earth left to other scholars. Fortunately, academics are realizing how this approach leaves their analyses incomplete; within the area of science and technology studies, for example, authors such as Donna Haraway, Andrew Pickering, and Bruno Latour have put questions about the relations between humans and nonhumans on the agenda. This chapter addresses an important subset of these relations, namely how human and nonhuman animals associate with one another in the realm of food. The often-cited essay by Michel Callon (1986) on St. Brieuc scallops is a model for starting to think about this association, particularly relating to his emphasis that a material infrastructure is the key for intensifying the domestication of both scallops and fishermen. In the following pages I elaborate on this point in a study of hog farming in Illinois; specifically, I examine the multiple agencies in the evolution of the crates used to confine sows from the time of conception until the weaning of their young. This site is filled with human and nonhuman animals and nonanimal social and material agents each associating with and responding to the other in a temporally emergent fashion. In this way agriculture is a liminal site of continual becoming of nature and culture and, therefore, it may be one of the clearest arenas in which to see the relations among heterogeneous agents creating another entity that is irreducible to any of its constituent parts.

The image presented at the opening of this chapter indicates that there is an undeniable element of ethics and power—otherwise known as politics—that is involved in all human-nonhuman animal relations. Perhaps such politics are strongest in confinement livestock agriculture where Michel Foucault's "micro-physics of power" are fully expressed to the degree that all movement, food, medicine, reproduction, physiology, and even psychology are controlled as strictly as possible (Coppin 2003). While I argue that sows, and all other swine by extension, are active participants in hog farming and assist in the reshaping of several social agents, it nevertheless remains that in the system of intensive confinement livestock agriculture the primary relation between humans and swine is one of domination. The emergence of large-scale intensive

confinement swine facilities is in part due to farmers seeking complete control over swine by means of depriving them of their agency. While this goal is not entirely achieved, and modern factory farms are as much a story of human adaptation to the emergent properties of swine and the infrastructure as they are of domination, a handful of intensely capitalist farmers and agricultural businesses are effective enough to make the effort worth pursuing.

Multiple Agencies

In E. B. White's children's classic *Charlotte's Web*, the old sheep declares to the pig Wilbur, "They're fattening you up because they're going to kill you [and] turn you into smoked bacon and ham." In response, Wilbur screams, "'I don't want to be killed. I don't want to die' . . . 'I don't *want* to die,' he moaned. 'I want to stay alive, right here in my comfortable manure pile with all my friends. I want to breathe the beautiful air and lie in the beautiful sun'" (1993 [1952], 185–87). For the majority of swine in the United States today, however, Wilbur's desires are impossible to realize, no matter how many advertising images run to the contrary. While Wilbur had the ability to run, frolic, and build a comfortable bed in his pigpen, today's pigs have had their ability to engage in such actions curtailed. This raises the question of whether animals kept in tight confinement can be said to have any form of agency when their space for expression is so utterly restricted.

Agency is a central concept in Pickering's *The Mangle of Practice* (1995), but it makes no sense to approach the question of agency as though it were an attribute that an entity either inherently possesses or does not. For Pickering, "agency" is a shorthand way of pointing to the things that are done in the world. Our world is an active place in which things are continually happening. It is unremarkable to say that human beings do things (human agency), and Pickering shows the banal, everyday ways in which nonhumans also do things (material agency). With his attention to the temporal emergence of material and human agency and the ways in which they interactively stabilize each other, Pickering foreshadows Jacques Derrida's (2003) belated foray into animal studies in which Derrida asks why humans say *they* have agency rather than addressing the arguments that nonhumans do not. It is perhaps more useful to examine the ways in which agency is expressed through relating to one another. Karen Barad proposes the notion of "intra-action" whereby it takes

two or more things to create action, and it is not possible to subtract one thing that will retain its agency outside the relationship. She argues that "according to agential realism, agency is a matter of intra-acting; it is an enactment, not something someone or something has," and she adds, furthermore, that "agential realism theorizes agency in a way that acknowledges that there is a sense in which 'the world kicks back'" (1999, 7, 2). Intra-action also ties to Haraway's (2004, 315–17) image of the game of cat's cradle that calls into question the ontological status of the collaborators but demands the involvement of at least two participants in its creation.

In Haraway's most recent examination of dog-human relations, she argues that the animal worlds, both "human and non-human alike, ought to be central concerns of technoscience studies . . . [and that] the differences between even the most politically correct cyborg and an ordinary dog matter" (2003a, 3–4). In addition, there are important differences to attend to between species and contexts. Haraway's analysis of dog-human relations cannot stand in for all other animal dyads, and inasmuch as the term "the animal" unforgivably elides the specificities of animals, so the generic "nonhuman animal" glosses over the particularities of species, environment, and development. Unfortunately, much of the animal studies literature that emphasizes the agency of animals focuses on those situations where there conceivably is some choice in the matter and physical space for those choices to be exercised (Haraway 2003a; Patton 2003; Smuts 2001). Those species that humans have domesticated and raised as livestock do not have the kinds of choice enjoyed by companion animals or undomesticated animals. In the following pages I explore an area where choice and the ability to act have been severely curtailed, and I question the role of agency in such a context.

This chapter illustrates how, for each time frame and material-social configuration, specific agents—be they swine, humans, construction materials, diseases, technologies, or legislation—relate to each other in a particular manner. In each case the participants attend to each other in a significant way, but the parameters of their interaction change. For example, when farmers moved sows indoors to farrow (give birth), manure disposal became an issue because disease organisms thrived in the accumulated waste and the odor was offensive to humans. In response, farmers put in slotted floors to separate the hog from its excrement, but this tactic precluded the use of the bedding material that is beneficial for the young swine and the adults. In turn, the different

materials used as flooring interacted in specific ways with the porcine physiology, bacteria, and farmer's capital. Wood was cheap, readily available, and easy to install; it was warm and provided traction for the hogs, but it was also impermanent and porous and thus provided a good home for diseases.

In this scheme it does not matter which one acted first with intention. Intentions are not at issue and action cannot occur in a vacuum—it is simply that all parties respond to changing conditions in ways specific to their own characteristics; in confinement buildings, for example, wood responds in a different manner than does concrete. At first glance it appears that sows do not have much room to express their agency in large-scale intensive pork production facilities. An examination of the historical evolution of these facilities illustrates the gradual limiting of swine action through physical confinement. However, when "agency" is thought of as an emergent product of two or more things interacting, then it is easier to see the ways in which the heterogeneous agents demand attention and force the other agent(s) to respond. Because sows cannot move more than one step forward or back when they are confined to farrowing crates, pork producers are forced to attend to many of the sow's needs—thus human behavior changes in response to porcine actions.

One way we can examine agency is by looking at the places in which it is expressed. If we accept the notion that agency is a temporally emergent phenomenon rather than a property inherent in some beings and not in others, then possibly the *only* way we can meaningfully discuss agency is through also discussing the specifics of its expression—who, when, where. With this in mind, I now turn to the evolution of the crate in pork production, and I argue that its development is caught up with human, hog, and material agency from whose interactions emerged today's form of intensive confinement factory farms.

Early Confinement

Many of the architectural developments in swine shelter were initially undertaken to improve the human experience by minimizing the time spent outside in the snow and cold mud, or doing undesirable activities such as shoveling manure from the hog pens. Before the onset of contemporary hog-farming methods, adult swine were quite hardy and able to thrive outside with

minimal attention from humans. Nevertheless, the architectural modifications beneficial to humans also were part of attempts to improve the productivity of swine in terms of both the number of pigs per litter that survived to weaning and reduction in the amount of feed necessary to reach market weight. The gestation period for swine is three months, three weeks, and three days. When the swine were constantly kept outside, farrowing in the United States was limited in most places to once a year in the spring months. While the sow[2] would build a cozy nest in which to give birth, her pigs would stand a much better chance of survival if the weather was warmer. Farmers who were interested in rearing as many pigs as possible built covered farrowing units close to the farmhouse so that the sow could farrow a second litter in the winter months. With the additional protection provided by building her nest indoors, most of a sow's pigs would survive to weaning and be strong enough to go outside just as winter gave way to spring.

Other organisms also appreciated the swine's new housing conditions, and many harmful bacteria and viruses built up in the bedding and construction materials. At the beginning of the twentieth century, one of the ways that farmers answered the resistance offered by disease was to enroll the killing properties of sunlight. John Evvard and J. B. Davidson go so far as to say that "without sunlight we cannot have a profitable swine husbandry. It is the great and universal germ destroyer and kills disease-causing organisms" (1916, 4). However, it was not easy to incorporate sunlight into the swine housing assemblage. The main difficulty was to design a farrowing unit that let direct sunlight reach all of the interior surfaces at some point during the day, while still providing enough shelter to protect the swine from the weather. Many farmers had to physically try out different designs, materials, and aspect (which direction the unit faced) in order to figure out which arrangement worked best, and even after all of these trials one design was not always superior. The local topography and climate, together with the farmer's financial and engineering abilities, ensured that the best farrowing unit structure for one farm in northern Illinois might not be the same as the best unit in northern Iowa.

Swine farmers realized the potential benefits of confinement in the early 1900s, but it took many years and a variety of trials before intensive confinement systems worked. The initial forms of confinement during the period of farrowing to weaning were designed to protect the newly born swine from

the weather. One of the early structures was a movable A-shaped hog house large enough for one sow and her litter. Unfortunately, while these A-shaped designs successfully sheltered swine from inclement weather, they also increased the likelihood of pig death. Of the pigs who died before weaning, many of them were killed when the lack of space within A-houses resulted in the sow lying on top of a pig who was caught against a wall—a situation that generally did not occur in the larger outdoor farrowing nests. In response to these deaths, the human architect, usually the farmer, added guardrails around the walls of the unit to give the pigs space to scurry out of the way of their mother.

Within A-houses the intra-action of sows, pigs, and space initially resulted in an unintended rise in pig mortality—a state of affairs to which farmers had to adapt by either demolishing the houses or installing devices that protected the pigs from a situation that had not been dangerous up to now. That is, human accommodation to inclement weather provided a new environment in which porcine agency expressed itself (through new interactions with confined space) that allowed for the temporal emergence of another way for pigs to die. Understandably, the farmers, and most likely the sows and pigs, were not happy with this arrangement, and so began one more round of human-porcine-material interactions.

Permanent central farrowing units were an alternative to A-houses and were the first widespread set of buildings to facilitate the shift to year-round farrowing (Jensen 1981, 6). The most popular arrangement of space within these buildings consisted of farrowing pens set on either side of a central aisle. The average size was twenty pens in each farrowing unit with each pen measuring roughly six feet in width and ten feet in length. The flooring was solid concrete with two-thirds of the length sloping gently to an outside gutter into which the manure was washed (Muehling 1979). One of the disadvantages of this arrangement was the quick buildup of manure in the pens that the farmer had to manually clean and dispose of either in a liquid or solid form (Jedele 1959, 10). Some scholars have argued that many of the problems in this time period emerged because, as I. Ekesbo notes, the "design of the animal environment was no longer a product of co-operation between farmer and sow, it was often created at the drawing-board where technical demands were given a higher priority than the animals' basic needs. One consequence of this revolution was that sows in many herds no longer had free choice

within the area available for bedding, dunging and feeding. The confinement system forced sows to dung in their bedding area. . . . For those of us who were in close contact with numerous commercial farms during these years, one thing was very obvious: the sows in the new confined systems were much dirtier than the sows in the previous system" (1981, 253).

Removing all feed and water from the confinement pens and instead turning out the sows for an hour in the morning and evening to a communal area to feed, drink, and defecate overcame this particular problem (Mueller and Muehling 1964). Swine can be house-trained in much the same way as dogs, and the general consensus was that with a regular schedule most sows would keep their own pens clean. However, in order for this arrangement to work both swine and farmer had to coordinate their schedules. While manure handling was not as easy for the farmers in semiconfinement as it was when the hogs were spreading the manure themselves in the pasture, it was not as bad as in some operations that did not allow their sows any access to an outdoor area. These initial versions of swine confinement were unsatisfactory for both of the primary agents, and "it became increasingly obvious that housing for confinement production of swine must minimize labor and provide an environment suited to the pig" (Jensen 1981, 7).

This is another example of the sow's agency as a temporally emergent phenomenon that arises in coordination with the physical environment and the human management system. While it is not a zero-sum game, the circumstances are such that as porcine choices are restricted, farmer obligations expand: if hogs are not allowed the option of separating their eating areas from their dunging areas then the hogs get dirtier and more prone to disease, which requires human labor to rectify in the form of manually cleaning out the pens and dealing with veterinary costs.

Even though the increased demand for human labor was enough to prevent many farmers from moving into confinement operations, one of the biggest problems that emerged with confinement involved nutrition. Detailed and accurate knowledge of the nutritional requirements of swine was not an issue when the swine had access to pasture, because the complex makeup of the pasture as a food source supplemented any inadequacies of an indoor diet (Mueller and Muehling 1964). However, as soon as swine were completely confined they were totally dependent upon the farmer to fulfill all their nutritional needs. Farrowing sows and their litters were the first group of swine to

experience confinement conditions, and their experience immediately highlighted a failure in farmer omniscience. Pigs are born with a seven-day supply of iron in their liver, but it cannot be supplemented from iron obtained through the sow's milk because iron cannot pass through the mammary gland. If pigs do not get additional iron they become anemic and susceptible to many secondary illnesses that may be lethal. This issue was unknown and unproblematic when sows farrowed outdoors because pigs would root in the ground and pick up enough iron from the soil.

In an attempt to alleviate the increases in health problems, farmers brought in an 8-inch square piece of sod for the pigs to nose in. For a while, farmers did not know why a small piece of soil in the farrowing pen prevented pigs from falling ill but they did recognize that the soil brought various diseases and parasites into the confined area that was otherwise clean. This in turn spurred the search for the factor in soil that was necessary for pig health and resulted in farmers collaborating with scientists in the land-grant universities. Although cordial relationships among farmers and scientists had been established earlier when finding out what swine do in confined buildings, comprehending nutritional requirements required a more systematic approach. This turn to a scientific form of knowledge also marked an entry point for the commodification of items that used to be produced onsite, in a move that David Goodman, Bernardo Sorj, and John Wilkinson (1987) call appropriation and substitution, as free soil is replaced by expensive synthesized iron supplements. Once iron was identified and synthesized, farmers no longer had to rely on possibly contaminated soil to get the pig to weaning, after which stage the pig obtained enough iron from his or her solid food. Tension remained between capital and health, and even though nutritional anemia in pigs was well established by the 1960s the suggestions that T. R. Greathouse and G. Richard Carlisle gave to overcome iron deficiency included placing "clean sod where the pigs can get to it. Or you can give each pig an iron pill according to the manufacturer's recommendations. Another effective but more expensive method is to use an injectable iron solution" (1963, 12).

We can see how more than just human agency was involved from the time of the first serious and widespread move to confine swine. This shift in hog-human intra-actions, with the swine's nutritional needs depending on the farmer, required a reconfiguration of relations among swine, vegetation, and minerals, which in turn was connected to the farmers' articulation with cir-

cuits of capital. Even confinement for such limited time as birth to weaning involved a new illness, new knowledge about nutrition and pig health, and new practices of cleaning and importing soil or injecting pigs.

The Farrowing Crate

By 1970, the five-by-seven-foot farrowing crate had become conventional equipment for farrowing houses (Muehling 1970a). The farrowing crate was another architectural accommodation that aimed to prevent the sow from crushing her pigs. The crate itself consisted of metal bars roughly six feet long, two feet wide, and four feet high. The sow was placed into the crate a few days before she was due to farrow, and there she would stay until the pigs were weaned. The crate enforced very close confinement to the extent that the sow could not turn around or even barely take one step forward or back (see figure 1). The crate was surrounded by a slightly larger pen, which brought the total dimensions up to five by seven feet, in which the pigs could roam while the sow remained contained (Baxter 1981, 291). When farrowing crates were first used in the late 1950s, farmers usually moved the sow into an outside area to eat, drink, and defecate for an hour every morning and afternoon. Many farmers did not like to provide this close attention, however, especially when they had a diversified farm that required their labor elsewhere (Muehling 1970b, 16). An accommodation to this dislike resulted in the development of slotted floors to cover the internal manure pits, and the farrowing crates were placed directly over the pits. This enabled the sow to be confined all the time and thus reduce human labor to a minimum. Or so the farmers thought.

Immediately there was an issue regarding the materials out of which the slats ought to be made, as well as their width and the size of the gap between them. Initially, the slats "were made of narrow wood (1 1/4 inches) and spaced 1 inch apart. Such wide spacings with narrow surfaces caused problems with the small pigs getting their legs caught, so recommendations [started to] call for narrower spacing" along with wider slats (Muehling and Carlisle 1967, 7). However, another problem emerged with the use of slotted floors with a narrow spacing of 3/8 inch. The farrowing crates were designed to prevent the sow from moving around and potentially squashing her young, and so when she was in such crates the sow could move barely at all. This meant that, for the most part, pigs were the ones who worked the manure through the slats

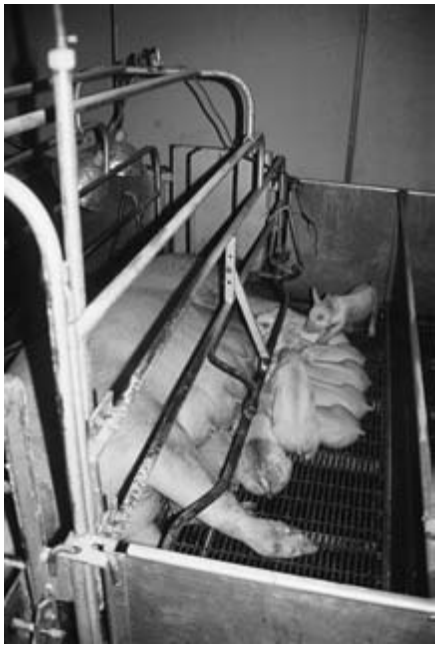

FIGURE 1 Sow with litter. (photo by the author)

because their movement was less restricted than that of the sow. Due to the reliance upon pigs to remove waste from the crates, the manure built up behind the sow before the pigs were born and until they were mobile (Muehling 1966, 2). Several adaptations in floor design were tried in an effort to overcome this problem. The first design had two holes (2 by 6 inches) in the floor at the back of the crate into which the farmer (or hired human labor) shoveled manure until the pigs were big enough to press the solids through themselves. These holes were covered with a metal mesh during farrowing so that the pigs did not fall into the manure pit. Another design retained the 3/8-inch spacing between slats except in the 2-foot section directly behind the sow where the spacing was widened to a 1-inch gap. This wider spacing allowed the manure to fall through with greater ease, although it too had to be covered during and shortly after farrowing to allow the pigs a chance to get to their feet (Muehling 1966, 2).

In addition to the unexpected importance of the width and spacing of slats, in small pens and crates there was the issue of whether the slats were parallel

or perpendicular to the direction of the sow. This is because "a sow pushes to the side with her feet when getting up and will get footing from the gaps between the parallel slats. Little pigs can also get better footing when they are nursing if the slats run parallel with the sow" (Muehling and Carlisle 1967, 7). Although this configuration seems common sense, it was not until both versions were built and a new form of porcine agency emerged with the intra-action of swine and flooring materials that farmers and the designers of swine confinement systems were able to see which version worked most effectively.

The materials from which the slats were made also offered resistance to the human goal of a swine confinement operation. Many different configurations and materials were tried: "At first, narrow oak slats 1 to 1 1/2 inches wide with 1-inch spacings were used in farrowing units. The slats had to be cut and placed when they were green because if they were seasoned first, they would be too hard to cut or fasten. But it proved difficult if not impossible to fasten unseasoned oak slats securely enough that they would not warp and leave uneven spacings after they dried. The problem of maintaining uniform spacing was compounded by the rapid wearing of the wooden slats" (Muehling 1979, 34–35). The hardwood characteristics of oak initially made it a good choice as flooring because it was more durable than the softer woods like pine.[3] Oak was also generally cheaper than other materials, it was available on many farms, and the farmers had experience with woodworking. Unfortunately, the very trait that made oak attractive for flooring—its hardness—meant that in practice it was an unsuitable material for slats because it warped as it became harder. In addition to wearing out more quickly than expected, wood slats were difficult to disinfect and keep clean. So farmers and designers turned their attention to other materials that could be used in slotted-floor buildings.

In searching for accommodations to the multiple resistances that producers faced as they tried to move swine into intensive confinement, the knowledge and involvement of a new social agent was brought into the assemblage. Animal scientists and agricultural engineers at land-grant universities and colleges, particularly those in Iowa and Illinois as the primary pork-producing states, engaged in a great deal of thought and experimentation in an effort to solve the problems that were emerging in the practice of confinement. In much the same way that Michel Foucault (1977) described psychology as a by-product of human incarceration and Pickering (2005c) demonstrated that organic chemistry emerged with the synthetic dye industry, so animal science

developed as an academic discipline along with the industrialization of chicken and swine farming (Coppin 2003). The knowledge of university scientists was tuned to physical materials, building design, and swine physiology and behavior. Indeed, a series of trials at the university experimental farms were required to see which of the various materials available at that time were best suited to be turned into slats for swine confinement facilities. Concrete and metal were the ideal candidates, and although both were eventually adopted, there was an extended period of resistance and accommodation until the correct constituency of each was achieved. At this stage concrete was perhaps the most popular choice because commercial forms were available for the farmer to mix and cast the slats in place. However, the interactions between slat and pigskin soon made it apparent that the correct balance of aggregate to cement was important, as was the technique of concrete finishing. The surface of the slats had to be smooth or the swine suffered terrible skin abrasions, which sometimes became infected and the consequent pain would prevent the animal from getting up to feed.[4] Concrete could be cleaned better than wood, but completely disinfecting the buildings continued to be difficult. Thus, some farmers turned to metal, which was both smooth and easy to clean. Different forms of metal were tried and many worked well, but metal was more expensive and had to be transported onto the farm rather than, as the case of wood and concrete, constructed in place. Metal also had the unfortunate tendency to corrode as it was exposed to manure, thus requiring more frequent replacement than originally estimated (Muehling 1966). Furthermore, metal slats were significantly colder than either concrete or wood.

Other problems came to light as farmers and swine worked through the earliest design versions of confinement. In many cases, the adjustments to one dilemma created difficulties in other areas. The needs of farrowing sows and pigs frequently offered scenarios such as the following: "Many of the early remodeled buildings were cold and drafty, with little or no supplemental heat or insulation. Experience has shown that a warm, draft-free building is necessary to raise small pigs successfully on slotted floors. With solid floors and bedding, the pigs can huddle together in the bedding next to the sow and keep warm. But with slotted floors and no bedding, air can circulate through the floor and the pigs cannot find a warm place in a cold room. Bedding cannot be used with slotted floors because it causes problems with handling the manure as a liquid" (Muehling 1979, 34). Once again, the necessity for pigs to have a

draft-free environment was something that farmers did not know about until farrowing was brought indoors into drafty buildings. On U.S. farms in the early 1950s, over one million pigs died annually from chill-related factors because they cannot regulate their own temperature until they are at least three weeks old (Newland, McMillen, and Reineke 1952). The architectural arrangement of space thus mandated the creation of new knowledge regarding the environmental requirements of pigs. The simple solution to chilling—provide bedding in the pens—did not match up with the manure-handling arrangements that were adopted to reduce human labor. Since farmers were unwilling to increase labor costs, another accommodation was sought to fulfill the needs of pigs that did not increase the amount of human labor. Eventually, electricity provided the solution in the form of heat lamps that were suspended over the pigs, which they could huddle under to keep warm. Of course, there was a period of adjustment whereby the correct height of the lamp and temperature had to be determined. If it were too cold, then the pigs would pile up and suffocate those on the bottom; if it were too hot, then the farmer wasted expensive electricity.[5]

The increased availability and use of electricity for supplemental heat, for pressure water systems, and for mechanical feed handling encouraged the interest of farmers in confinement facilities (Muehling 1979, 32), but by no means was their success assured. Indeed, a recurring theme throughout this chapter is that the responsibilities of farmers are directly proportional to the amount of control they try to assert over swine. The farmer, in conjunction with many technologies, must provide the items that swine need to live—at least until they can be profitably slaughtered—and as the ability of swine to provide those things for themselves is curtailed so then the farmer must find other ways, chiefly through human labor or capital-intensive technology, to fulfill the needs of the swine. That is, as farmers sought to minimize porcine agency they had to enroll other human and material agents to do the work previously done by swine for themselves.

Coincident with this transfer in power was an increase in specialization as farmers sought better ways to increase their income. By the mid-1960s the market price for hogs had dropped while the cost of living rose along with the price of land and hired labor. Many farmers sold their farms and moved into other jobs. Some farmers simply got rid of their hog operations and concentrated on crops, which required less daily maintenance for a better return

on investment.[6] However, a sizable number of people decided to specialize, which took the form of permanent buildings used exclusively for swine along with a concentration on specific stages of growth. The specialization in intensive confinement swine production was so pervasive and required so many new skills and abilities on the part of the farmer that a transformation ensued in the social organization of swine farming. One respected commentator in the mid-1960s described how he saw the emergence of "'a class of professional pork producers.' They're proud of their profession, interested in retailing and promoting pork as well as producing it, and willing to spend time and money on improving their industry" (Wolf n.d., A10). As swine farming became more capital intensive and specialized, the role of the farmer transformed into that of a pork producer with much greater emphasis on the production of a commodity than the raising of animals.

Complete Confinement

With a greater capitalist orientation in the swine industry came a search to increase revenue and reduce costs. However, although farrowing crates were designed in accordance with the producers' goal to decrease the incidence of pig death by maternal crushing, this specific assemblage of materials and swine did not always result in the successful achievement of that goal. The same degree of confinement that enabled easier management of the sow with regard to producer safety meant that "in certain crates the rotational movements of the front part of the body are reduced with the consequence that the hind quarters flop to the ground more violently than normal. . . . The rapidity and abruptness of these movements could and indeed have been seen to result in piglets being trapped against bars or rails or even crushed against the floor" (Baxter 1981, 288–89). Stan Curtis, an eminent animal behavioral scientist, also argued that farrowing crates created more problems than they solved and that they had never been systematically tested with regard to the claim that they saved more pigs than did pen farrowing (anonymous 1985a). It was widely acknowledged, however, that sows who farrowed in crates experienced a longer farrowing period with more complications and lactation problems than did sows who farrowed in pens (Curtis 1978; Vestergaard 1981). In addition, the limited amount of research that had compared pen to

crate farrowing concluded that there were more stillborn pigs—one-half pig per litter on average—when sows farrowed in crates (anonymous 1985b).

One of the reasons for reproductive problems in the use of farrowing crates is that "crate farrowing is also an 'unnatural' method of animal exploitation inasmuch as it attempts to suppress rather than exploit the animal's own biological adaptations. For example, . . . restraining the sow in a crate prevents her nest-building" (Baxter 1981, 305–6). Although swine of all ages who are kept in intensive confinement systems exhibit abnormal behavior, sows are the ones most affected by the confinement (Buchenauer 1981), perhaps because they are confined to the greatest degree for the longest period of time. It is well established that sows become very active twenty-four to thirty-six hours before giving birth as they try to build a nest. However, when sows are restrained and no bedding material is available to make into a nest, they become aggravated and display behavior such as bar-gnawing and pawing along with strenuous efforts to escape from the farrowing crate (Vestergaard 1981, 23). In one incredible case, a sow overcame the pain of a broken back to arrange straw into a nest (Coppin 2002, 140–41).

It is no wonder that there were problems with farrowing crates that constantly frustrated and thwarted the sows' agency, first by preventing their movement and then by disallowing the use of nesting materials. Even if sows could move in a farrowing pen, the use of totally slotted floors for manure management inhibited the use of any bedding material that would clog the liquid waste system. Accommodations to the sows' agency had to be sought elsewhere to ensure the welfare of sows in these situations, if none of the other material or management features were going to be modified. Purdue University opened a new laboratory on June 3, 2004, in order to systematically examine the welfare of swine in all aspects of commercial operations (Sheppard 2004).

Farrowing sows were the first group of swine to be moved into confinement, followed by growing-finishing hogs, gestating sows and gilts, and finally breeding sows.[7] Until the end of the 1970s, most producers kept gestating sows and gilts outside in the field with portable shelters for protection against the weather. Once the gestation phase was moved into confinement in order to enhance surveillance and record keeping as well as saving space, all sorts of problems emerged as architecture, management, and reproduction

FIGURE 2 Sows and gilts in gestation stalls. (photo by the author)

interacted in new ways. There were at least three main ways that sows and gilts could be confined indoors: group pens, individual stalls, or tied in place. The latter was popular for a while because tethering the females prevented their movement without the expense of constructing individual stalls or crates. A large number of swine could be housed in a building if they were confined to one place and were not given room to move around. This meant that each building had a greater return on investment as the amount of pork produced from within it rose. By 1980, gestation houses were in operation that confined pregnant sows and gilts from the time of breeding until a couple of days before farrowing when they were moved to specialized farrowing crates. The use of tethers either around the waist or neck was common practice at this time, but again it had been an empirical process to decide that metal collars were better because tethers made from soft materials, like leather, had to be very tightly tied in order to restrain the sows securely (U.S. Department of Agriculture 1981). Over time, producers shifted away from the use of tethers because of the problems they caused with sexual development (Hollis et al. 1977; Jensen 1981; Jensen and Carlisle 1975), and instead gestating swine were housed in individual crates like those shown in figure 2.

Breeding was the last phase of pork production to move indoors. In large part this was because it was considered to be the most important aspect of the operation owing to the essential role of breeding in production (Muehling 1979, 37). Even here, however, a tuning process was necessary despite all

of the knowledge gained from the previous experiences of moving swine into confinement at different stages of development. With confinement a series of reproductive problems emerged: it took longer for the swine to reach sexual maturity, gilts experienced lower conception rates, sows did not rebreed as quickly, and the entire breeding herd had a shorter span of reproduction because of problems with their feet and legs (Hollis et al. 1977; Jensen and Carlisle 1975, 67). A number of studies concluded that the greater the degree of confinement, the more extensive were the reproductive problems (Curtis 1978; Jensen and Carlisle 1975; Vestergaard 1981).

Politics and Agency

In addition to the resistance by the sows to constant intensive confinement, producers were also faced with an increasingly negative consumer response to the same conditions. Until the mid-1990s consumers had been primarily interested in the leanness, taste, and price of pork, bacon, ham, and other swine products. For the past ten years or so, many consumers—as individuals and organizations—have voiced their opposition to large-scale industrialized swine operations out of concern for swine welfare and for the impact on the community of the operations themselves (Coppin 2002). The emergent consequences of industrial pork production have included air pollution (Donham 1998), water pollution (Frey et al. 2000), economic decline (Horwitz 1998), and loss of a sense of community (DeLind 1998). Coalitions have been formed that include such diverse members as a neighbor to a pork production operation worried about odor, a suburban resident concerned about swine welfare, a small-scale pork producer troubled by the closed cash market due to vertical integration, and parents anxious about the increased incidence of antibiotic resistance due to subtherapeutic dosage in livestock feed. The response of sows and consumer activists has led to the banning of gestation crates in Florida,[8] legislation seeking a similar ban in other U.S. states, and various architectural rearrangements ranging from the micro level of an individual crate design to macro considerations of whether large-scale industrialized pork-producing facilities are ever appropriate and, if so, under what scenarios.

This kind of social resistance to large-scale intensive confinement pork production happens at both the level of collective action and of individual

private consumption. In particular, there are two forms of consumer politics that have materialized in response to industrialized livestock agriculture. One form includes those who identify themselves as vegetarians or vegans and refuse to eat animal flesh.[9] The other form includes consumers who specifically seek to purchase meat that is raised extensively, in small operations, and often without the use of antibiotics and other drugs. Although these forms of consumer politics do not share participants, they both strive to change the currently dominant mode of industrial agribusiness through their consumption patterns. In agro-food studies there is a lively ongoing debate regarding the effectiveness of consumer politics, as this academic field evolves from its Marxist production orientation (DuPuis 2002, 210–40; Goodman and DuPuis 2002; Guthman 2002; Hassanein 2003). However, with respect to the consumption of meat—when it is literally a question of (the quality of) life or death—the individual choices we make have immediate repercussions to many other animals, human and nonhuman. In this way, "personal choices have political ramifications, and decisions about food can give voice to political commitments . . . [as] food becomes a signifier for political, social, and ecological struggles" (Goodman 1999, 32). Of course, there is still a place for large-scale collective action, which, together with individual and organization action at all spatial scales, is described by Neva Hassanein as "food democracy." As she argues: "Active participation and political engagement—broadly defined—are prerequisites, if solutions to the ecological, economic, and social justice consequences of the dominant food system are to be achieved" (2003, 85). While there is no guarantee that active opposition to industrial agribusiness will succeed according to a predefined notion of success, it is certainly less likely to change if we are not engaged with its operations.

Early in this chapter I offered some thoughts about what agency might mean in different scenarios. Certainly what is understood to be agency is based on whether it is considered an inherent characteristic or a manifestation of a relation among two or more entities. As I have made the case here, it makes more sense (i.e., is more congruent with the empirical events) to comprehend agency as relational. We have seen some of the agential interactions at play in the transition from extensive to intensive swine facilities, and we have seen how the effort made by humans to seek greater control through limiting porcine agency places sows in a new relationship with their environment in which they express temporally emergent properties to which

humans must then respond. At the same time, farmers and swine are not static entities but rather adapt and change along with the situation, such that those farmers who choose to continue to work with swine evolve into pork producers with capital-intensive buildings and equipment, and sows develop the ability to conceive and give birth to larger litters under increasingly stressful conditions.

In addition, based on this study's attentiveness to the real-time dance of agency, it seems to me that there is a case to be made for recognizing the particularities of each agent. There are clearly ways in which the relations between farmer and sow differ from those between farmer and concrete or sow and concrete, even though the latter are lumped under the umbrella term of "nonhuman." The differences among these three agents matter, and they are irreducible to their ontological status. Our world is a lively place and we do ourselves a disservice by restricting our comprehension of agency—the ability to act and interact—to an inherent property only held by a few.

NOTES

1. This chapter is a distillation of one feature of the swine industry that I discussed in greater detail in my dissertation (Coppin 2002) along with its co-evolution with other social, physical, and natural features. The information is gleaned from face-to-face interviews with twenty-eight people involved with the swine industry and opposition groups, including pork producers ranging in ownership arrangements, specialties, and operation size, animal scientists, commodity group officers, and environmental organization officers. My information also comes from *The National Hog Farmer* trade magazine, the publications of the Illinois Pork Producers Association and the National Pork Producers Council, and all the related articles published in a random sample of twenty-two daily Illinois newspapers during the period of June 1995 to January 2000.
2. A sow is an adult female hog who has given birth to at least one litter of pigs.
3. Scientists at the University of Illinois at Urbana-Champaign conducted one experiment with pine slats that was quickly abandoned after the pigs ate through them in the first night and fell into the manure pit beneath.
4. One accommodation to the concrete slotted floors that was tried by researchers at the University of Nebraska at Lincoln was to crossbreed guinea hogs and

wild hogs to select for the mule foot mutation, which is a solid hoof rather than the usual split hoof. After a number of experiments the researchers decided that there was no difference between mule and cloven-hoof swine with respect to their success on slotted floors (anonymous 1967).

5. There was also a great deal of social accommodation and resistance to the extension of electricity into the rural United States that involved everything from new legislation, such as the 1936 Rural Electrification Act, to new appliances and reconfigurations of domestic labor (Coppin 2002).
6. Between 1950 and 1970 the number of people employed on farms dropped by 3.7 million to a total of less than 3.5 million (US Bureau of the Census 1975: 127).
7. A gilt is a female hog who has not given birth.
8. The use of farrowing crates is still legal.
9. All vegans and some vegetarians also refuse to use animal products; in the case of swine this would include items made from pigskin leather, hairbrushes made from bristles, certain glues and bone china.

Soul Collectors

A Meditation on Arresting Domestic Violence

KEITH GUZIK

A central element in the fight by feminists for gender equality has been the struggle against domestic violence. In challenging the prevailing understandings of domestic violence as both a "private" problem for couples to work out on their own and a psychological disorder affecting women who choose to stay with abusive partners (Roy 1977), feminists in the 1970s defined domestic violence as a "public" problem engendered by different social forces (Schneider 2000, 5–6). The gendered division of labor in society, for instance, rendered many women dependent on their partners for economic survival and thus prevented them from leaving abusive relationships (Martin 1976, 39–43). Cultural norms dictated that violence against women was permissible in certain contexts (Martin 1976, 61–66). The law, meanwhile, reinforced the definition of domestic violence as a private problem as police officers seldom arrested men who battered their wives and prosecutors rarely filed criminal charges in such cases (Binder and Meeker 1992).

In acting on the notion that "the personal is political," battered women's advocates challenged these socially constructed boundaries between "public" and "private." To counter the impact of the gendered division of labor that relegated many women to the "private" sphere of the home, feminists in Great Britain and the United States established shelters to provide victims a safe space away from their abusers (Schechter 1982). In place of the popular "public" images reinforcing detrimental cultural attitudes toward domestic violence—think of Rhett Butler slapping and then bedding a "hysterical"

Scarlett O'Hara in *Gone With the Wind*—feminists offered images and stories drawn from women's "private" lives. One such example was *The Burning Bed*, the network film based on a survivor of domestic violence, Francine Hughes, who resisted the physical and emotional abuse of her husband by burning him to death as he lay drunk and passed out in bed (Rapping 2000).

In the legal arena, feminists initiated a cluster of measures designed to extend the protections guaranteed citizens in "public" life to women enduring violence in the "privacy" of their homes. Orders of protection, or restraining orders, allow abused women to access courts and have judges issue orders directing their abusive partners to leave them alone. Presumptive or mandatory arrest policies encourage and/or mandate law enforcement officers to arrest abusive partners whenever "probable cause" exists that physical violence or threatening behavior has occurred. No-drop prosecution policies commit states' attorney's offices to pursue charges against domestic battery suspects even if victims do not support criminal proceedings (Schneider 2000, 92–95).

These legal measures represent a new regime of domestic violence "governmentality" that works upon violent men and victimized women in new ways (Merry 2002). Aggressive efforts in arrest and prosecution seek to punish the batterer and, as Elizabeth Schneider states, "send a clear social message that battering is impermissible" (2000, 94). Punishment is augmented by efforts to reform offenders in group therapy sessions designed to instill "new forms of masculinity" (Merry 2001, 16). Orders of protection, meanwhile, function as a spatial technology that controls domestic violence by mandating the physical separation of the abusive partner from his victim (Merry 2001).

The fact that this new regime of domestic violence governance has been established does not, of course, guarantee its success. As Schneider notes, "There is a fundamental contradiction . . . in the gap between the articulation of these approaches on the 'grand' level of theory and their implementation on the 'ground' level of practice" (2000, 94). While numerous studies have examined the operation and efficacy of these measures for victims of domestic violence (Ferraro 1989; Harrell and Smith 1996; Hoyle 1998; Ptacek 1999; Fleury 2002), my own research has sought to understand the operation on domestic batterers themselves of two pillars of this new regime: pro-arrest policing and no-drop prosecution. Out of intellectual curiosity, I have dabbled in science studies in order to understand more fully the operation of these two policies.

In the realm of policing I have found science studies, and particularly the work of Andrew Pickering, useful for understanding the obstacles facing domestic violence policing in the past as well as the accommodations that law enforcement has made to handle domestic violence differently today. In this chapter, I offer portions of this research hoping in the process to deepen the dialogue that science studies and the social sciences can have with one another. My conversation between these fields has three main points. First, the distinction between public and private, which feminists have recognized engenders domestic violence, is materialized in the space of the home in a *dispositif* of violence that heightens the agency of domestic batterers relative to that of the police. Second, law enforcement officers police domestic violence by employing tactics that capture the agency of batterers in different ways and disentangle them from their *dispositifs* and interpersonal relations of violence. Third, police officers in their capacity as capturers of domestic batterers represent a more general, though seldom considered, category of social actors—"collectors" I choose to call them—who reside in a time and space between the "ordered" and "un-ordered" worlds and continually cross this boundary to "collect" souls, lives, nature, information, and other materials to be used in different projects for ordering the world.

Regarding the Indolence of Police Officers

On June 10, 1983, Tracey Thurman called the Torrington, Connecticut, Police Department to report that her estranged husband, Buck, who had physically abused and threatened to kill her on numerous occasions, and against whom she had a restraining order, was standing outside her house. It was not the first time Tracey had contacted the Torrington police. In fact, she had notified them on at least ten previous occasions about Buck's physical abuse and threats. Some twenty-five minutes after Tracey's call, a single officer arrived on the scene. By that time, Buck Thurman had dragged Tracey by the hair to the backyard and stabbed her thirteen times. When the officer reached the backyard, Buck was still holding the bloody knife. In the officer's presence, Buck dropped the knife and stomped on Tracey's head until her neck broke. He then ran into the house, grabbed their son, returned to the scene, and dropped the child on the wounded woman, telling him that he had "killed your fucking mother." He then kicked Tracey in the head a second

time before three additional officers responded to the scene. After the arrival of the other officers, Buck continued to wander around the backyard, where a crowd had gathered, and continued to threaten his wife. When Buck attempted to attack Tracey, who was now lying on a stretcher, a last time, he was finally arrested and taken into custody.[1]

Tracey Thurman's story has come to represent domestic violence policing at its worst. The officers were slow to respond, giving Buck Thurman the time to nearly kill his wife. Once an officer was on the scene, he failed to detain Buck in any way, thereby allowing him to break her neck in his presence. Though additional officers finally did respond to the call, they too failed to detain Buck, letting him to continue menacing Tracey. That Tracey survived the attack is a miracle that owes nothing to the response of the police.

For battered women's advocates, Tracey Thurman's story provided further confirmation of what they had been claiming for years—that the police failed to take domestic violence seriously, and that this indifference contributed directly to men's violence against their partners. Feminists saw the inactivity of the police, like the agency of batterers, embedded in a larger network of social relations that turned domestic violence into a private matter undeserving of police attention. Legal statutes in most states, for instance, allowed the police to make arrests in misdemeanor cases only if the crime were committed in their presence or if a warrant had been issued (Martin 1976, 90). In ordering the world into a "public" space patrolled by officers and a "private" space that could only be pierced by an arrest warrant, this definition of police authority gave the police de facto legal backing to do nothing in domestic violence cases.

The view of domestic violence as a private problem was also perpetuated by police culture. On the one hand, the police officers—who were and still are predominantly male—believed, like the batterers, that domestic disputes were "a family matter" that should be worked out by the couple. Thus, rather than arresting a violent offender, the police would simply look to cool him down by "walking him around the block or joking with him about the violence" (Schechter 1982, 158). On the other hand, officers commonly engaged in "victim blaming" by believing that the woman provoked the abuse or that she was "unworthy" of assistance if she expressed ambivalence about taking legal action against her abuser (Hart 1996). "The thinking that prevailed at the time," as explained to me by the chief of the Plainsville[2] Police Depart-

ment where I conducted my research, "was that if the woman didn't do anything after she was hit, then why should we do anything?"[3] This standard for police action did not, of course, apply to victims of other types of violent crimes, thereby illustrating the boundaries by which officers distinguished domestic violence from other cases.

While feminists located the police's aversion to domestic violence cases in legal and cultural dynamics, the police themselves often noted the danger posed by these calls. Interpretations of FBI data found that 22 percent of officer deaths involved disturbance calls, thus giving credence to the view that domestic violence calls were particularly dangerous (Berk and Loseke 1980–81). Later research demonstrated, however, that these figures were inflated and based on misinterpretations of the FBI data (Garner and Clemmer 1986). Other studies likewise worked to dispel the "myth" of domestic violence calls as especially dangerous by showing previous estimates of officer deaths and injuries sustained in policing these calls to be exaggerated (Margarita 1980; Hirschel, Dean, and Lumb 1994).

The statistical assurance that domestic violence calls are not as dangerous as generally perceived did not eliminate police officers' belief that such calls are dangerous. For one, domestic violence calls do in fact result in an average of six to seven officer deaths each year. What's more, for the police, quality counts as much as quantity; that is, the deaths of officers responding to domestic violence calls tend to possess a distinct character that makes the police view them differently. The FBI reports used to cull statistics on officer deaths also provide qualitative summaries of the incidents. To demonstrate the quality of these deaths, I will cite three incidents that occurred in the mid-to-late 1970s, the time prior to the implementation of pro-arrest policing:

> A five-year veteran patrolman with the East St. Louis, Illinois, Department was slain after responding as a backup unit to a domestic disturbance call at an apartment building. The patrolman, a Negro male 30 years of age, arrived at the scene. While exiting his patrol vehicle, the patrolman was fatally wounded in the chest with a .22 caliber rifle. (Federal Bureau of Investigation 1975, 36)

> A 29-year veteran patrolman with the Indianapolis, Indiana, Police Department was slain after responding to a domestic disturbance call at a local residence. The

> patrolman, a Negro male 53 years of age, and a second officer were the first officers to arrive at the scene. The officers entered the residence and observed an individual suffering from a gunshot wound to the head lying on the floor. The second officer returned to the patrol vehicle to request an ambulance. While the patrolman was administering first aid to the individual, the subject entered the room and shot the patrolman in the chest with a .38 caliber handgun. (Federal Bureau of Investigation 1975, 62)

> When responding to a family disturbance call, a Milwaukee, Wisconsin, Police Department officer with over four years of service was killed. The 27-year-old officer and his partner were dispatched to the suspect's house, and as the victim officer was about to knock on the front door, a 38-year-old male reportedly appeared in the doorway and abruptly fired into the chest of the officer with a .30-caliber rifle. (Federal Bureau of Investigation 1977, 51)

In each of these examples, and most of those described in the FBI reports, the officer is killed with a firearm. Furthermore, the shootings tend to occur as officers arrive at the scene and are either exiting their vehicles or approaching the residence. This point was emphasized in a two-day seminar I attended on police training for domestic violence situations, in which the instructor repeatedly stated to the cadets that most officer deaths occur within the first minute of responding to the scene. As two of the three examples above demonstrate, officers are at a distinct disadvantage relative to their assailants at this time. The batterer is barricaded behind the walls of his home, while the officer is in the open. The batterer can use this position to establish sightlines with which to monitor the officer's movements and shoot him. In most homes the front door is the primary entryway into the residence. This gives the would-be assailant another clear line of fire for shooting a responding officer. While the door shields the officer's view to the situation inside, his knock on the door gives away his position to the assailant.

A smaller number of deaths occur once officers enter the residence. The interior of the home also provides advantages to the would-be assailant. The batterer is more familiar with the space than is the officer and knows where he can hide himself and weapons. In the second of the three examples, the batterer is able to hide in the house until the second officer leaves the scene, thereby allowing him to attack the remaining officer unobstructed.

In these scenarios batterers are able to use the material settings of their homes to resist the police's response to their violence. In this setting, the capacity of the batterer to resist the police and perpetrate violence against his victim is heightened. It is interesting to consider here as well the temporal dimension of the police officer killings. The fact that most occur within the first minute would seem to indicate that the heightened capacity of batterers diminishes as officers gain entry to the residence and are able to make contact with them.

Adherents of the traditional fields in the social sciences do not possess concepts that describe this phenomenon. They are, of course, skilled at describing the ways in which human agency is shaped by social categories and identities (race, class, gender), antagonisms toward and between such classifications (racism, class conflict, gender inequality), knowledge (education), and productive activity (economics). But, because the social sciences are founded upon the Cartesian separation between human intellect and the material world (Latour 1993), agency is only understood in them in terms of intentional actions taken by human beings, and thereby they miss how the world, as Pickering notes, "is continually *doing things*, things that bear upon us not as observation statements upon disembodied intellects but as forces upon material beings" (1995, 6). When material objects do enter the picture, they tend to stand as passive mediums for the expression and operation of human interests, goals, and desires. Thus, human actors can increase their agency by acquiring an education, a job, or a gun, to use Latour's (1999) example, but "the gun does nothing in itself or by virtue of its material components. The gun is a tool, a medium, a neutral carrier of human will" (177). Finally, such changes in power tend to be fixed in time, or at least until one drops out of school, loses a job, or drops a gun.

The temporally empowering nature of domestic space for batterers is clearly another matter. What this setting does resemble is the *dispositifs* described by thinkers riding the boundaries between poststructuralist and posthumanist thought (Deleuze 1992; Jullien 1995; Gomart and Hennion 1999). Deleuze roughly defines a *dispositif* as a "social apparatus" composed of "lines of visibility and enunciation," "lines of force," and "lines of subjectification," "all of which criss-cross and mingle together" (162). In discussing people's experiences with music and drugs, Gomart and Hennion explain that the enjoyment of them emerges through *dispositifs* of passion, or settings that

people actively construct so that they can become passive and allow the objects of their passion (music and drugs) to seize them. Jullien, meanwhile, uses *dispositif* to refer to those strategic arrangements of forces (weather, terrain, military strategy) that military commanders exploit to effect brave, moral, and loyal behavior on the part of soldiers under their command. Merging the elements of these descriptions, one might imagine a *dispositif* as a social apparatus or arrangement—possessing multiple lines of force accumulating over time and space—which operates beyond the immediate control and cognition of those exposed to it but is able to effect certain behaviors and experiences in them.

This definition of *dispositif* seems sufficiently broad to fit the domestic setting that empowers batterers in their interactions with the police. The home involves an arrangement of walls and openings created by humans within the larger natural environment that divides space into an inside and outside. The home offers the people inside cover from those outside, as well as sightlines with which to survey and attack those outside. The empowering aspects of the home are neither constant nor controlled by the people inside. Rather, the accumulation of force is contingent upon the outsider locating himself or herself in a sightline. Once the outsider is able to penetrate the walls and make contact with the individuals inside, the power of the arrangement diminishes significantly.

To describe the home as a *dispositif* is not to fetishize it. Rather it is an attempt to come to terms with a dimension of the police's experiences with domestic violence policing that has historically contributed to their differential treatment of these calls. Regardless of the actual number of officers killed while responding to domestic violence situations, officers simply do not like entering settings where they cannot observe potential criminals. With its array of blind spots, dark corners, and hiding places, the home is a feared space that officers are unenthusiastic to approach.

To the extent that the materiality of the home has historically functioned to inhibit police action against domestic violence, it has also functioned as a physical barrier that creates "private" and "public" spaces that reinforce men's violence against women. This idea extends the significance of feminist understandings of "private" and "public." If the law has historically supported domestic violence by limiting the authority of "public" actors to intervene in "private" violence, and if culture has enabled domestic violence by shap-

ing "public" attitudes that violence is permissible in "private" contexts, the materiality of the home has reinforced violence against women by creating a "private" space that empowers batterers vis-à-vis their partners and "public" interventions from the police.

Policing Domestic Violence

Feminists have employed a pair of strategies to neutralize the obstacles inhibiting the response by police officers to domestic violence calls. First, they launched legislative efforts and lawsuits designed to force the police into action (Buzawa and Buzawa 1992). Legislative changes in various states have allowed officers to make warrantless arrests in misdemeanor domestic violence cases if "probable cause" exists that abuse had occurred. Lawsuits, meanwhile, have led municipalities and insurance companies to pressure police departments to take domestic violence cases more seriously. It is primarily in response to liability concerns that departments around the country now have pro-arrest domestic violence policies.

Second, feminists have kept pressure on law enforcement to implement the legislative and administrative changes. This has led to joint efforts between feminist groups and police administrators to develop training programs and accounting procedures to monitor officers' performance on domestic violence calls. The procedures seek to mitigate the effects of traditional policing culture on officers' job performance by challenging police stereotypes about domestic violence and making their handling of these calls more transparent (Guzik 2005).

While these efforts to reorder the boundaries between "public" and "private" and thus push police departments to change their response to domestic violence calls are interesting in their own right, what I want to focus on in this section are the efforts to overcome the more practical challenges associated with handling domestic violence calls. Pressed into action by vigorous feminist activism, the police have had to develop new tactics and procedures to respond to these calls that are directed at the specific attributes of batterer agency, including the material settings in which domestic violence occurs as well as batterers' influence over their partners. These tactics facilitate officers' crossing from the "public" into the "private." To help wrap our minds around this performance, I want to begin with a somewhat lengthy case study

of a police response to domestic violence that I observed while conducting my research. While the level of abuse present in this example lies at the opposite end of the spectrum from the three summaries provided before, the description will nevertheless provide a grounding with which to better understand the tactics used by law enforcement officers to police domestic violence.

> On the night of November 8th, I [the author] accompanied Officer Debnitz, an officer with the Plainsville Police Department, as he responded to a domestic disturbance involving a verbal argument between a woman and a man. Parking his cruiser down the street from the house, Officer Debnitz and I soon caught up with two officers already at the scene as they were approaching the residence, a medium-sized house in the poorer section of town. Making our way onto the porch, we could hear yelling from inside the home. One of the officers walked down the porch to a nearby window and peered inside. Another officer knocked on the door, using the butt of his flashlight to intensify the sound. The door opened soon afterward.
>
> Inside, in a small living room, a middle-aged man stood facing a middle-aged female, with some distance between them. Both were visibly agitated. One of the officers asked, "What's the yelling about?" With that, the man burst out, "She's a stupid ho,' that's the problem." The woman quickly responded with an insult of her own, "Ho'? You must be talkin' about your mama then!"
>
> With the argument beginning again, the officers quickly moved themselves deeper into the small room, getting between the two parties. Separating the couple, two of the officers led the man out of the house. The third officer stayed inside to interview the woman.
>
> Outside the house on the front sidewalk, the two officers stood facing the man. The officer asked him for identification. Still visibly agitated, the man reached to pull out his wallet and presented his driver's license. The officer again asked what had happened. The man responded loudly with fragments of a story intermixed with insults towards the woman.
>
> "That woman's crazy. She's the type of woman who doesn't know when to stop. I was just sitting there in my chair in the other room, relaxing and having a couple beers, and then she's gotta come up and get on my case. She just wouldn't leave me alone."

While the man was talking, the officer took down his information into a notepad while the sergeant stood watching him. When the man paused with his story, the officer asked whether he had hit her.

"No, man, I didn't hit her. We was just arguing, you know . . ."

"Yeah, but when things get heated like this, people sometimes hit one another. You didn't touch her at all, even brush up against her?"

"No, no, serious. We were just yelling at each other." Giving his answer, the man started on another line, expressing his regret for the incident, "Man, I'm sorry we're arguing and got you out here."

The officer recording his information answered coolly, "Don't worry about it. We all get like that sometimes."

The man started back upon his previous line of argumentation. "She's just such a bitch sometimes. She just won't leave me alone."

"Yeah, I hear you," responded the officer.

The officer, having completed taking down his information, then asked whether the man was employed. He answered yes, explaining that he worked at the local university as a custodian. The officer made note of this. Slowly, the man was gathering his composure. Eventually, the officer talking with him made his way back to the house. There, he spoke with the officer inside the house to compare the stories each party had given. The woman also had reported that no physical contact had occurred during the dispute.

The officer returned to where the man was standing. Addressing him by his name, the officer asked, "Now, Donald, do you have anywhere else you can stay tonight? Given that you guys have been arguing, it would be best if you could go somewhere else for the night."

"Yeah, I'll just go to a hotel and stay there."

The officer continued the conversation. "Good, good. Also, if you need to get some things out of the house, we can go back in now and get them out."

"No, I got everything I need with me," he answered. The man continued to gain his calm as his conversation with the officer continued.

> "Alright, but if you want to come back tomorrow to pick some things up, you should call the police department first, OK? We'll send over an officer to help you pick up your things, OK? We don't want you coming over here tomorrow and having another incident like today."
>
> "Yeah, I got it. So, I'll call you guys then tomorrow to come get my things."
>
> "That's right." The officer handed the man a card with his name on it and the number for the department. The scene was coming to an end. The man began making his way up the sidewalk in the direction of the hotel where he was heading. As he went, the officer inside the house exited, and the woman in the house came out to the porch. The two parties saw each other and immediately began exchanging insults again.
>
> "You fucking asshole" came from the porch.
>
> "You fucking bitch" came from the sidewalk.
>
> The officers spoke up to the man to keep on his way to the hotel.
>
> The man responded, "I'm going to a hotel tonight. And tomorrow, I'm coming here with the cops and I'm going to get my shit out of here. You hear me?"
>
> One of the officers broke in to reinforce the point to the man, "That's right. Good. You call us tomorrow when you come back. Now let's get going."
>
> With that, the man crossed the street and made his way through a deserted lot across from the house.

This scene captures well the fundamental change in the nature of domestic violence policing since the feminist campaign to transform the legal response to intimate partner abuse. The officers note that a verbal argument has taken place, that the parties are still very upset with one another, and that the potential for renewed conflict exists. In response, the officers, despite lacking the legal basis for making the man leave his residence for the night (there is no probable cause that a crime has taken place), convince him to leave for the night and come back with them the next day.

What is also noteworthy in this scene is how seamlessly the police move from the "public" to the "private." While this certainly is in part a result of the

level of conflict present when the officers arrived, it owes as well to the tactics the officers use to intervene in the dispute. Using this case as a backdrop, I will review here some tactics that officers employ to navigate through three stages of police work: responding to the scene, establishing control, and conducting investigations. In borrowing from the vocabulary and imagery of the mangle, this review will describe how the police, in moving through these stages, use different tactics that "capture" the agency of batterers and engage them in different performances, each of which serves to further disentangle them from their material and interpersonal relations of violence.[4] In doing so, officers not only cross from the public to the private to provide victims respite from domestic abuse, but they also locate domestic violence in batterers themselves.

Responding to the Scene

As noted above, the first minute of the response by officers to a domestic violence call places them at greatest risk. To manage the potential dangers associated with domestic violence *dispositifs*, officers first rely on dispatchers to provide a detailed description of the scene, including the type of dwelling (apartment or home), the level of conflict, the presence of weapons, and the location of the assailant. Once approaching the residence, officers are instructed to "avoid the use of sirens and emergency lights," which would signal to the batterer the arrival of police as well as "increase the tension of persons emotionally out of control." Officers are also taught not to "park the police unit directly in front of the residence," which would again signal the police's arrival as well as offer the batterer a clear line of fire. In advancing to the dwelling itself, officers are trained to minimize their exposure to sightlines from the home by using trees and other elements of the material setting to cloak their presence.[5]

Once at the entrance, officers are instructed to wait outside long enough to make an assessment of the situation in the residence. Using a window to peek inside or simply by listening carefully, the officers seek to gauge the number of people in the dwelling as well as the severity of the conflict and the presence of weapons, all of which dictate whether they will gain entry by knocking on the door or by knocking it down. If the officers knock, they are taught "to stand on the side of the door" in order to deny the would-be assailant another clear line of fire.

In the example above, Officer Debnitz is careful to park his car away from the front of the house. Nevertheless, the officers approach the residence rather casually, having been told that the dispute was verbal. On the porch, the officers are able to make a quick assessment of the situation inside. Yelling can clearly be heard. And one of the officers is able to peer into the window and observe that no weapons are involved. In this case, a simple knock on the door is enough to secure entry into the residence.

Responding to domestic violence calls is not always so smooth, of course. On one occasion I accompanied an officer responding to a domestic dispute involving a physical altercation at a second-story apartment. Apartment houses are especially problematic for officers, who have to turn a blind corner and walk a staircase in order to reach the residence. In this case, the lead officer approached the front door and heard "people bouncing off the walls." This not only signified that the physical exchange was in progress, but also that the assailant(s) were not sitting on the other side of the door waiting for him to knock or enter. As such, the officer took the initiative and broke down the door in order to make contact with a man on top of his wife.

In other instances assailants may try to flee the scene, as occurred on another occasion I was with the police. On the one hand, this act serves to lessen the potential threat of approaching a residence; on the other hand, however, it demonstrates that the offender is unlikely to comply with police requests. In this call, the dispatcher also had noted that the dispute involved a knife. In facing a situation of an armed suspect fleeing the scene, the officer directed me to stay in the car and then had the other responding officers, including a canine unit, form a perimeter around the house in order to prevent the suspect from escaping. As it turned out, the suspect had run out of the house simply to throw away a collection of stolen credit cards, his possession of which had initiated an argument between him and his girlfriend.

As these tactics demonstrate, officers rely on information, space, patience, and powers of perception to respond to domestic violence calls. By relying on the information obtained by dispatchers, by parking away from dwellings, and by pausing outside entryways to assess the situation, officers balance the force relations involved in this initial, most hazardous phase of domestic violence policing and thus reduce the potential danger of the domestic setting. In doing so, the officers bring the "public" sphere of the law through the front door of the "private" sphere of abuse.

Establishing Control

Once inside the home, officers work to "establish control" of the scene. Establishing control is in one sense a matter of manpower. At least two officers are dispatched to each domestic violence call in order to be able to handle each of the parties. In another sense, establishing control is a matter of skillful practice. While the term "establishing control" evokes images of authoritative, strong-armed tactics, officers are taught to shy away from such confrontational "control actions" in policing domestic violence in favor of more courteous and caring "supportive actions,"[6] or what I call "persuasive tactics." The reason for this approach, beyond the fact that officers are now trained to use nonconfrontational techniques more generally, is that the offender or both parties are likely to be "heated" and engaged in verbal or physical disputes when the police arrive, thereby presenting the risk that aggressions will either escalate or turn against those intervening against it. This is especially undesirable given that the batterer is more familiar with the material setting of his home than are the police officers.

Practically speaking, in order to establish control when parties are physically or verbally engaged in a dispute, officers are taught to separate the couple as quickly as possible. While this may require confrontational tactics such as pulling one party away from another—actions that run the risk of escalating the violence—the officers in the example above were able to separate the couple with the persuasive spatial technique of simply getting "in between" the parties. To further achieve separation, the officers need to "break the eye contact of the disputants" as quickly as possible (Hendricks and McKean 1995, 152). This is accomplished by employing persuasive communicative techniques, such as asking questions of the person, which aim to divert his or her immediate attention from the dispute, and by using persuasive physical techniques such as mildly "herding" one person away from the other (153).

After separating the parties, officers work on "cooling off" heated persons. Persuasive techniques are again thought to be more effective than force to achieve this end, and one such tactic is to keep the people separated from each other. Officers are taught to position the parties with their backs to one another, with enough distance between them that they cannot easily hear each other speak. Such a positioning prevents a resumption of conflict that visual or verbal contact could provoke. The perimeter that is formed by this

spacing also allows each officer to maintain sight of the separate parties and of the other officers handling the case.

In place of this spacing, the officers I observed often simply removed the male party from the residence. This sometimes proves necessary given the limited amount of space inside the dwelling with which to achieve an effective positioning. However, the tactic also increases officer safety by removing the stronger, and often more volatile, person from the domestic setting with its various weapons and hiding places. With this tactic, officers literally move the domestic battery suspect from the "private" out into the "public."

"Cooling off" a person also involves discursive techniques, which can be seen in the above example. Learning and then addressing people by their names works to grab their attention and cool them down. Increasingly in vogue among departments over the last few years is verbal judo. Based on "the principle of judo itself, using the energy of others to master situations," verbal judo is "a set of communication principles and tactics that enable the user to generate cooperation and gain voluntary compliance in others under stressful conditions." As George Thompson, the creator of verbal judo, explains it, "you are not counteracting their approach and hammering back at them. Rather, you are moving with them, using their momentum to pull them off-balance . . . it should be redirective rather than confrontational" (Thompson and Jenkins 1993, 89). By offering "heated" suspects mild, affirmative statements, officers are able to keep them engaged and expending energy, while denying them the stern response that would feed their aggression. The officers "project empathy," thereby serving to calm the person and make him easier to talk to (30).

In the example above the officers employ verbal judo to cool down the suspect, Donald, from his irate state. Rather than responding to his aggressive statement, "She's such a bitch sometimes," with a similarly aggressive statement ("Well, you're acting like an asshole"), which then could aggravate him, the officers offer a mild, affirmative statement to deflect the abuse of the abuser, "Yeah, I hear you." He cools down considerably once the police direct him to the topic of his employment.

Verbal judo can be employed at different times during the police-suspect encounter. For instance, Frederick Wiseman in his documentary *Domestic Violence* (2001) shows Tampa police officers placing a batterer under arrest. The man verbally resists the detention, asking, "Why do you always take the wom-

an's word?" The question implies that he sees himself as the victim of an injustice. Rather than responding, "Because guys hit women more often" or "Because you hit her," comments that risk provoking the person, the officers reply, "When it comes to domestic violence, if someone says violence happened, that's what happens." Here, the officers refuse the batterer's game of placing guilt on one of the involved parties and instead deflect it to the law.

As this description shows, officers establish order in domestic violence calls by matching the performance of the disputants with their own performances that redirect the action in various ways. By placing themselves in between the parties, the officers stop the dispute; by herding the man, the officers bring him out of his home; by accepting his verbal abuse, the officers cool him down and tire him out; and by keeping him talking, the officers pull his mind away from the dispute. Through their ability to "capture" the various performances of the disputing parties, police officers come to bring the order and control of "public" life to bear upon the disorder and conflict they find in the "private" sphere.

The efficacy of these performances and the potency of these tactics is evidenced by the point in the scene when the officers end their engagement with Donald and he is making his way to the hotel. Seeing his wife, who has come out to the porch, he immediately becomes heated again, and the two throw another round of abusive comments at one another. The presence of three officers nearby does nothing to prevent the abuse. Rather, the fact that the officers are no longer engaging them with policing techniques allows the abuse to resume.

Conducting Investigations

In the first two stages of domestic violence policing, officers enter the "private" sphere to gain control over it and ensure the safety of the people therein, all of which corresponds to their "order maintenance" function (Wilson 1968). To "enforce the law," officers conduct investigations in order to determine whether a breach of the law has occurred.

Conducting investigations in domestic violence cases can sometimes be simple—if, for instance, only one party has physical injuries. But in most cases domestic violence investigations are more complicated than this. That is, because two (or more) parties are often actively involved in disputes, determining the primary aggressor proves complicated. In addition, because the

disputes involve family members and intimate partners, the disputants and/or witnesses are often unwilling to provide statements about the incident for fear of incriminating a loved one. This is often the case for women who call the officers for protection from their abusive partners, but are unaware of the pro-arrest policy and are opposed to criminal proceedings against them (Hoyle and Sanders 2000). Women's willingness to defend their abusers functions as another element of abusive relationships that, like the law, culture, and the materiality of domestic space, sustains men's violence against women.

The first step in overcoming these obstacles is provided by the separation of the parties. By splitting up the couple, the officers are able to provide an abused woman with the security and privacy she may require to tell her story without fear of retribution from her partner. Separating the partners also ensures that the couple will not be able to collaborate on their stories should the victim want to protect her abuser. In this way, isolation serves as a tactic that deprives the batterer of his ability to influence and manipulate his partner in their "private" relationship to resist the application of "public" law.

To talk with people, officers again rely on persuasive communication tactics. Officers engage reluctant and difficult suspects, victims, and witnesses through different interview techniques, many of which are described in various studies and training materials (e.g., Berg 1999, 159–65). For example, officers I have spoken to use "persuasion" with a suspect by telling him that "there are two sides to every story" and that they will only have the victim's side of the story unless he cooperates (Leo 1996, 664). As with the amicable traffic stop, where the officer will light-heartedly ask the driver, "Do you know why I stopped you?" the persuasion tactic invites the suspect to incriminate himself by talking about his behavior.

In the training seminar I attended, the instructor emphasized using "theme-building" with uncooperative suspects. Taught as part of the Reid technique for conducting interviews, the officer here, as with verbal judo, looks to use the person's aggression productively. As the instructor described it, the officer drops a subtle comment to the suspect ("Boy, a person in your situation would probably want to hit someone"; "It must be hard dealing with this") in order to "hook" him into discussing the event. If the "hook" takes the officer then "reels him in."

In the scenario described above, the officers employ a technique akin to "theme-building" when they say to Donald, "Yeah, but when things get

heated like this, people sometimes hit one another. You didn't touch her at all, even brush up against her?" The hook to the suspect is that violence is to be expected in such circumstances, especially light violence. Such comments can be effective in eliciting a response from a person, and even an admission of guilt.

This "hook" clearly possesses gender dimensions. The hooks are cast by men, who are the majority of police officers, to men, who are the majority of batterers. What the officers hope to catch with these hooks is the trust of the suspect, who may see in the male officer a person who can understand his feelings of aggression and frustration toward his partner. In this sense, "theme-building" looks to catch the inner abusive attitudes of the batterer and turn them against him. The tactic is, of course, somewhat unseemly, as it gives the appearance of a male police officer approving of or minimizing the man's use of violence against his partner. Not only is such minimization an abusive tactic used by batterers themselves (Ptacek 1988), but the complicity of officers with domestic violence has long been a concern for those fighting this social problem. In the course I attended, the instructor teaching this tactic to the cadets cautioned them about its effects for victims: "If the victim hears, talk about it with her, that it's just a tactic. Tell her, 'he hit you and now he's off to jail.' "

The officers I spoke with emphasized that no single interview technique is followed more than any other. To the contrary, the selection of interview technique is a matter of personal preference, circumstances, and instinct. In one case described to me by an officer, for instance, a woman had called the police to report that her ex-boyfriend, Jesus, against whom she had an order of protection, had shown up at her apartment to harass her and a male friend. When the officer arrived at the apartment, he encountered the woman and a man. Asking the pair whether he was Jesus, the officer received no response. He sensed that the woman was afraid to answer. This placed the officer in a predicament. Protocol called for separating the pair, which would allow the victim to answer freely. However, no other officer had yet responded to the call and, as the officer explained, "I don't like turning around on a potential suspect." To overcome this obstacle, the officer changed tactics by asking the woman, "Is Jesus in the apartment? Nod 'yes' or 'no.' " That the woman felt free to nod yes indicated to the officer that the man he was facing was not Jesus, but that Jesus was still somewhere in the apartment. Following this, the officer searched the apartment and arrested her ex-boyfriend.

On another occasion, a dispatcher working the 911 line had a caller hang up on her. Units are sent to investigate 911 hang-ups to determine whether the call was a mistake or an unsuccessful attempt by a victim to call for help. When the officers arrived at the scene, a Mexican man answered the door and explained that he had accidentally dialed 911 while trying to phone his mother in Mexico. He apologized for the mistake. The lead officer replied calmly that he understood, and then he politely asked the man if he would mind if they took a look around the apartment. Although the man had the legal right to refuse the request, he agreed. As the officers made their way through the apartment, they found a woman crying. The woman later told them that she had been hit and thrown over a chair. The police then arrested the man.

In investigating domestic violence cases, officers penetrate further the "privacy" of domestic violence. Once again, officers use policing tactics to capture the agency of the parties involved and redirect their performances. By separating a couple, officers diminish the influence that the batterer exercises over the victim and places her in a situation in which she feels freer to exercise her agency and explain what happened. Having isolated the suspected batterer from his violence *dispositif* and abused partner, the police look to socialize him into a new relationship with them. Using gender and politeness against him, officers attempt to capture the batterer's propensity for abuse in a conversation that can expose his "private" behavior and thus incriminate him.

Soul Collectors: The Police as Capturers of Agency

In the previous section I described the tactics that officers use to police domestic violence. To respond to the scene and mitigate the potential threats of the domestic setting, officers park their cruisers away from the residence, use the material setting outside the home to shield their approach, pause outside entryways and listen or peer inside the home to assess the situation, and stand to the side of entryways when knocking on doors. Once on the scene, officers establish control over domestic disputes by separating the parties, breaking their visual and audio contact, and accepting the verbal abuse of "heated" suspects in order to cool them off. Once in control of the scene, officers dig into the past to investigate the occurrence of domestic violence by providing victims the safety needed to tell their stories and by engaging suspects in "friendly" masculine talk that can draw confessions from them.

Through these tactics, the police progressively dislodge the batterer from his relations of violence and tip the balance of power in their favor.

This description of tactics bears some resemblance to the microphysics of power described by Foucault (1965, 1973, 1977, 1979a) in his genealogies of the prison, asylum, and clinic and by English-speaking Foucauldians in their studies of governmentality (Rose 1999; Dean 1999; Valverde 1998). In the manner that Tuke's Retreat engaged the madman with such techniques as observation to help him construct a "consciousness of himself," and to detach him "from a liberty of mind that would be fatal and engage him in a system of responsibility," so the police engage batterers in various techniques to affect their behavior (Foucault 1965, 247).

However, rather than simply replicating the classic Foucauldian story of shaping individuals into new subjectivities, the performance of domestic violence policing evidences a mode of power distinct from that of discipline. Foucault's genealogies and the subsequent studies of governmentality by Foucault scholars transpire in specific sites of authority, such as the prison, hospital, insane asylum, church, schoolyard, group therapy setting, and so forth. In these sites, authorities cast subordinated persons into a plethora of power relations (usually involving surveillance and routinized practice) that cast them as new subjects: the sane person, the healthy patient, the forgiven sinner, the controlled alcoholic, the free citizen. These practices and sites of subjectification, though possessing their own distinct histories, appear to operate in a timeless fashion. Indeed, this body of work is so penetrating precisely because it has us recognize our contemporary "compassionate," "progressive" treatments of the weak as pieces of an ongoing historical project to dominate and govern the souls of people.

Domestic violence policing contains few of these elements. Rather than being situated in a privileged site of power, the police operate at the border between "public" and "private" spheres. It is significant that the dominant material setting in the story of domestic violence is the home, which is the space of the batterer rather than that of the police. Importantly, power in police-batterer encounters is much more diffuse than it is in Foucault's stories. The batterer possesses considerable agency in his ability to strike down officers responding to the scene as well as his own domestic partner. Foucault's prisoners eventually do riot against the prison, but this expression of agency is a deviation from the normal story of discipline and governmentality. The

temporality of these stories is different as well. Whereas the operation of discipline is ongoing in Foucault's genealogies, the police only look to affect the agency of the batterer long enough to stop his violence, assess whether he has to be arrested, and then detain him if necessary.

What these differences underscore is that the practice of domestic violence policing is set to an objective distinct from that found in the work of Foucault and of governmentality scholars. The objective of the police is not to reform the batterer—to work his soul and have him see the wrongness of his ways. Rather, it is to simply capture his soul and pass it along to the jail and to the courts.

This does not mean that the two systems of power discussed here are at odds with one another. Instead, the police are simply one part of a larger regime of governmentality (Merry 2001) that seeks to protect victims and reform offenders. In this regime, disciplinary power is concentrated in batterer intervention groups—the group therapy programs for domestic batterers. Within this system, the police operate to funnel batterers to those sites where their souls will be worked on. In this sense, the police can be seen to represent *soul collectors*, or agents crossing the boundaries between a nonviolent, "public" world and a violent, "private" world to collect subjects who can be integrated into disciplinary programs of reform.

To the extent that poststructuralist and posthumanist scholars have established that projects of discipline (Foucault), governance (Rose, Dean, Burchell), ordering (actor-network theory), and enframing (Pickering, this volume) are constitutive of society, it would seem that *collectors* represent a more general category of social actor whose performance is also central to society. Like the police officer responding to domestic violence, collectors lie at the boundaries between worlds—be they ordered and disordered, governed and ungoverned, or civil and savage—which they continually cross in order to collect souls, subjects, agents, materials, and so forth to deposit back into programs of socialization.

Collectors abound in our society. Emergency medical technicians, for instance, work the boundaries between life and death by collecting survivors of accidents and other calamities to place in the rejuvenating care of doctors in hospitals. Workers for the Department of Children and Family Services, like the police, operate at the boundaries of "public" order and "private" disorder and look to collect children from high-risk environments and place

them with "normal" families and psychologists in order to "heal." Firefighters work at the boundaries of life and destruction in order to capture forests and homes from the advances of flames, which environmental scientists and architects can later rehabilitate. Astronauts and space probes cross into space to collect specimens and data that are relayed back to Earth and ordered by scientists into networks of action.

Unlike the authorities who manage the projects of ordering society, collectors do not possess a privilege of power relative to their objects. Whereas Tuke and Pinel could rely on "keepers" to subdue the outbursts of madmen (Foucault 1965, 251) and use dungeons to confine "those who cannot be subjected to the general law of work" (268), collectors, in crossing the boundaries between order and disorder, come into contact with spaces and actors whose agencies always hold the potential to overwhelm their own: emergency medical technicians can easily be infected from liquid-borne and airborne pathogens such as hepatitis C, HIV, and tuberculosis (LaTourrette et al. 2003); firefighters can be consumed by the flames they battle; astronauts can be overwhelmed by the physical forces they seek to traverse.

The temporal dimension of collecting is distinct as well. Whereas authorities have a privilege of time in ordering their objects (instructors can fail students and have them take the course again next semester), collectors often need to accomplish their work swiftly: aggressive batterers can kill their partners if the police are unable to respond promptly; accident victims will perish if not attended to quickly; energy supplies on space vessels become exhausted.

Under these conditions, collecting demands a more agile performance than does discipline. The administrators of disciplinary projects rely on routinized practices and forms of knowledge that are recorded, disseminated, and learned in textbooks to perform their ordering work. Collectors, conversely, often need to deviate from the script of their training and "tune" (Pickering 1995, 20–22) their performances to those of the agents they interact with in order to tip the balance of power in their favor.

Thus, whereas a facilitator in a batterer intervention program has learned that she can always encourage the participation of a reluctant newcomer by having other group members share their experiences with violence, the police officer needs to be able to sense fear in a frightened victim and quickly establish a new form of communication with her in order to capture her assailant.

Whereas the environmental scientist can collect and study samples in the lab and pore over scholarly texts to decide the best course of action, firefighters engaged in the "choreography of fire" (see Franklin, this volume) speak of "outguessing the fire" and the need to "make flexible decisions because the fire is always changing."[7] Even in space exploration, the ability to collect data and information is contingent on the adaptability of probes to the settings in which they find themselves. In 2004, during the early stages of the Mars Rover mission, NASA scientists were surprised to find one morning that Opportunity, one of the two Rovers, had managed to increase its energy level by 2–5 percent, thus contributing to its continued defiance of the ninety-day lifespan that engineers had originally ascribed to it.[8]

Rather than a disciplining of the subject, then, the performance of collecting might best be described as a "dance of agency" in which collectors, like Pickering's scientists, continually "tune" and adjust their performances to "capture" the agency of outsiders. Without aspiring to overstate the case, I believe that the fates of society lie in these dances of agency. The survival and extension of different ordering projects hang together with the ability of collectors to successfully capture the agency of the outside agents with which they come into contact. In turn, the failure of collectors to tune their performances to and capture the agency of outsiders comes to define the boundaries of society itself.

The recognition of "collectors" points to a broader application of the mangle framework offered by Pickering. By being sensitive to the distribution of agency in the social world as well as the varied performances of actors, we are able to understand the operation of our social world in novel ways. In this sense, the mangle invites social scientists to tune themselves more fully to the performance of the world in time.

NOTES

1. Thurman vs. City of Torrington, et al. Civil No. H-84–120, United States District Court for the District of Connecticut, 595 F. Supp. 1521; 1984 U.S. Dist., October 23, 1984, available at LexisNexis Academic. See also Brennan 1989.
2. This name is fictitious. The names of places and persons in this research have been changed to protect participants' anonymity.

3. Plainsville Police Chief, interview with the author, March 18, 2003, Plainsville.
4. I borrow the term "agency" from Pickering (1995), who describes science as a practical engagement between human and material agents in which scientists look to "variously capture, seduce, download, recruit, enroll, or materialize" material agency (7).
5. The quotations and general information here and below are taken from International Association of Chiefs of Police 1989.
6. The distinction between "control" and "supportive" actions is from Sun 2003, 27–28. The identification of the application of these terms in domestic violence policing is mine.
7. Forces of Nature, "Interview with Kenneth Rice," 2001. Available at the Web site of Oracle, ThinkQuest Library.
8. "Rover Gets Mystery Power Boost," November 5, 2004, available at the Web site of BBC News.

Resisting and Accommodating Thomas Sargent

Putting Rational Expectations Economics through the Mangle of Practice

ESTHER-MIRJAM SENT

During the 1960s the field of economics experienced the so-called rational expectations revolution. The central tenet of rational expectations is that individuals should not make systematic mistakes: that is, that economic agents are not stupid; they learn from their mistakes and they draw intelligent inferences about the future from what is happening around them. While the adaptive expectations hypothesis had the disturbing implication that it allowed individuals to make systematic forecasting errors period after period, the rational expectations hypothesis asserted that people learn from their mistakes: people with rational expectations did still commit errors, but not the same ones each time. Individuals could differ from one another in their expectations and still be rational if they were using different information. But when all of these individual expectations were added together, errors tended to cancel out, thereby producing an aggregate view of the future that reflected all of the available information.

Many stories can be identified in the work of historians and philosophers of economics who have endeavored to explain the rise of rational expectations economics (Sent 1998b, 2–12). These stories are neither mutually exclusive nor mutually exhaustive. An additional complication involves the fact that there are multiple definitions of rational expectations. However, historians and philosophers of economics have each tended to focus only on one story about the rise of rational expectations economics and on one interpretation of the rational expectations hypothesis. In this chapter I show, instead,

that it is possible for many interpretations to be held comfortably by one and the same person. It does so by picturing economics as a field of emergent human and disciplinary agency engaged by means of a dialectic of resistance and accommodation. The novel point that the analysis makes consists of showing that facts and knowledge in rational expectations economics represent assemblages of human and disciplinary performances that emerge in time, and also pass in time. Specifically, I consider Thomas Sargent, who has been instrumental in the development of the field largely due to his efforts to connect economic theories and the econometric tests of those theories. Instead of relying on how others perceive Sargent's achievements, I start from his own conceptualization of his contributions.

Drawing on Andrew Pickering's dialectic of resistance and accommodation (Pickering 1992, 1995; Pickering and Stephanides 1992), in this chapter I narrate multiple stories about the rise of rational expectations economics in following the course of Sargent's career. In the process, a variety of interpretations held by one person can be observed. The dialectic of resistance and accommodation allows me to describe a process in the making from the perspective of Sargent. That is, facts and knowledge in rational expectations economics are temporally emergent—they come to light in time through practice. As my analysis will show, facts and knowledge in rational expectations economics do not represent truth as such, but rather are tenuous assemblages of human and disciplinary agency that can fall apart as disciplinary winds change and new currents of thought come into fashion.

The starting point of my analysis is Sargent's definition of good economics. In the fashion of Pickering's mangle, we witness how as a result of disciplinary agency Sargent's different free moves kept getting obstructed by his encounters with resistances, which resulted in forced moves of evolving interpretations of rational expectations and kept getting obstructed by his encounters with resistances due to disciplinary agency. The free moves reflected the tentative choices Sargent made, carrying with them no guarantee of success.[1] The forced moves served to elaborate the choices through disciplinary agency.[2] Resistances that emerged when the extension of culture was not successful were accommodated by Sargent through changing his interests, changing his free moves, or ignoring the forced moves.[3] Following the emerging dance of agency through time, we observe Sargent exerting

his human agency by tinkering with different sets of free moves rather than adjusting his definition of good economics.

In this chapter I show that Sargent witnessed the emergence of a variety of interpretations of rational expectations during the dance of agency, in which the partners are alternately the human agent and the disciplinary agent. I further illustrate that these phases are connected through Sargent's continuous efforts to establish symmetry among agents, economists, and econometricians by means of a variety of free moves. According to Sargent, "The idea of rational expectations is . . . said to embody the idea that economists and the agents they are modeling should be placed on an equal footing: the agents in the model should be able to forecast and profit-maximize and utility-maximize as well as the economist—or should we say econometrician—who constructed the model" (1993, 21). In other words, Sargent saw no reason for the superiority of one category of individuals over another group of people.[4]

As I show in the following sections, Sargent gave the rough notion of symmetry a more precise formulation by embedding it in different sets of free moves. Each of the sections contains a brief case study of how Sargent's search for symmetry evoked different forced moves in the form of distinct interpretations of rational expectations, and how he was repeatedly obstructed by his encounters with resistances (see also Sent 1998b). These resistances that emerged due to disciplinary agency then evoked accommodations. In the next section I discuss how Sargent came to the idea of rational expectations as an econometric concept. In the second section I analyze Sargent's attempts to interpret rational expectations as both an econometric and a theoretic construct. In the third section I evaluate his efforts to incorporate general equilibrium theory into the symmetry structure. In the fourth section I discuss Sargent's eventual interpretation of rational expectations as the final outcome in a learning process.

Phase One: Accommodating Randomness

In what follows I use Pickering's insights to address Sargent's interpretation of rational expectations economics in the late 1960s and early 1970s. During this period, the concept of adaptive expectations was under severe attack in economics for fitting econometric models that forecast better than economic agents. Moreover, theories developed by neoclassical economists were de-

terministic while models employed by econometricians were random.[5] This conflict was an obstacle in Sargent's efforts to exert his human agency by searching for symmetry. Some economists sought to meet these objections by using the rational expectations hypothesis (Begg 1982).

Inspired by these changes in his environment, Sargent attempted to reestablish symmetry by making free moves toward the perspective of time-series econometrics, in particular distributed lags and the term structure of interest rates (Sargent 1968, 1969).[6] Through his analysis of distributed lags for interest rates Sargent became aware of the role of expectations, because orthodox neoclassical theory stated that they influence the relationship between spot and forward rates, nominal and real rates, and short-term and long-term rates. Furthermore, the free move to expectations, or more specifically rational expectations, provided Sargent with an answer to how symmetry might be achieved, as they allowed him to introduce probabilistic ideas into economic theory as well. He considered rational expectations a more elegant way to resolve the separation between the randomness of distributed lags in econometrics and the determinism of neoclassical models. Since Sargent initially started from the viewpoint of econometrics, an econometrically motivated interpretation of the concept of rational expectations emerged as a forced move, which involved treating the econometrician and the agents in the model in a symmetric fashion. His scientific culture, in turn, further directed his plans and intentions toward serious resistances, which are obstacles in his attempt to satisfy his interests.

Since he focused on interest rates, Sargent also encountered the importance of Lévy stable distributions with infinite variance and the associated problem of constructing statistical estimators as a forced move.[7] With his student Robert Blattberg at Carnegie Mellon University, Sargent established that with Lévy stable distributions almost every technique of modern econometrics is useless and would have to be discarded (Blattberg and Sargent 1971). As a result, almost all references to stable Lévy distributions in economic variates disappeared by the mid-1970s, and many of the earlier enthusiasts recanted with regard to Lévy stable distributions (Mirowski 1989b, 1990). The threat of Lévy stable distributions was averted by ignoring them, without a direct critique of the earlier findings of infinite variance. Randomness, therefore, was tamed by assuming that variances are finite.

Sargent was especially troubled by these resistances thrown up by disciplinary agency, for he sought to exert his human agency by establishing symmetry between techniques used by economic agents and the models developed by econometricians. In particular, the emergence of an econometrically motivated interpretation of rational expectations as a forced move required the availability of statistical estimators. Whereas Lèvy stable distributions previously only threatened neoclassical econometrics, they could now also compromise economic theory based on rational expectations. When stable laws enter the stage, econometricians and agents would run into resistances with the construction of statistical estimators. Rather than relinquishing the econometrically motivated interpretation of rational expectations through distributed lags, Sargent's dance of resistance and accommodation led him to somewhat silently give up Lèvy stable distributions with infinite variance.

In this first phase of his quest for symmetry among agents, economists, and econometricians, therefore, Sargent encountered the resistance that Lévy stable distributions lack an algorithm for estimating the parameters. This obstructed his human agency in its attempts to connect the randomness in the models used by econometricians and agents with the determinism in the models developed by economists. Therefore, relinquishing Lévy stable distributions and their forced moves served Sargent well in his attempts to establish symmetry among agents, economists, and econometricians. Yet this act led him to tame disciplinary agency by adopting the "unrealistic" assumption that data previously shown to have exhibited infinite variance now followed a distribution with finite variance. Hence, this phase illustrates the first instance of the mangle of practice at work.

Phase Two: Accommodating Prediction

While econometricians were the first promoters of rational expectations, their initial focus on lag distributions changed to vector autoregressions during the late 1970s and early 1980s.[8] While the desire to establish symmetry among agents, economists, and econometricians continued to guide Sargent's human agency, the change in his disciplinary surroundings led him to advocate a different connection. That is, while he continued to start from the perspective of econometrics during this phase of his work, he now tried to establish symmetry by making a free move toward vector autoregressions.

The vector autoregressive model was designed especially to forecast. Indeed, the model was not based on economic theories at all;[9] instead, its main applications were in engineering. Christopher Sims, one of the pioneers of vector autoregressions in economics, believed that theoretical restrictions in statistical inference should be kept to a minimum (Sims 1980). Whereas large national econometric models were successful in the 1950s and 1960s, their performance hit rock bottom in the 1970s. The models did not successfully predict and could not explain the simultaneous high inflation and unemployment rates. Vector autoregressions, on the other hand, seemed capable of producing forecasts that were, compared to the standard variety, more accurate, more frequent, and cheaper. It was a straightforward, powerful, statistical forecasting technique that could be applied to any set of historical data.

Inspired by these developments, Sargent exerted his human agency by concentrating on restricting vector autoregressions as a free move on the econometric side of symmetry. As before, Sargent ended up with an econometrically motivated interpretation of rational expectations as a forced move. Rather than handling distributed lags, symmetry between agents and econometricians now required that agents with rational expectations fit vector autoregressions. The inclusion of economists in Sargent's symmetry pictures further mandated using the acquired econometric information to construct a theoretical model. However, a major disciplinary resistance in the form of observational equivalence (Sargent 1976) emerged and hindered Sargent in fully exerting his human agency. That is, contradictory theoretical models both could generate the very same vector autoregressive relations. To incorporate economic theory in his symmetry structure, Sargent felt he needed to overcome this resistance of observational equivalence by an accommodation that established a stronger connection between vector autoregressions and economic theory.[10]

With the aid of his colleague Lars Hansen, Sargent responded to the problem of observational equivalence by showing that vector autoregressive models were not necessarily atheoretical (Hansen and Sargent 1981a, 1981b, 1990, 1991b). In particular, Hansen and Sargent argued that their goal "has been to create a class of models that makes contact with good dynamic economic theory and with good dynamic econometric theory" (1991b, 1). In response, they made a different set of free moves. Having grounded "good dynamic econometric theory" in the engineering tools of vector autoregressions, Hansen and Sargent searched for "good dynamic economic theory" in the engineering

theory of recursive dynamics and linear optimal control.[11] The combination of vector autoregressions—recursive dynamics or linear optimal control—and rational expectations helped Sargent to establish symmetry in this phase. Yet, disciplinary agency called forth new resistances because this combination was technically not very successful, difficult to implement, and based on controversial assumptions. As in the previous phase, the consequences of Sargent's free moves led him to adopt "unrealistic" representations.[12]

In addition, Sargent became aware of the fact that his analysis relied on outdated engineering techniques that required much stability.[13] He had largely avoided questions about the way in which economic agents make choices when confronted by a perpetually novel and evolving world. This was the case despite the importance of the questions, because disciplinary agency showed that his tools and formal models were ill tuned for answering such questions. Changes in his environment and the appearance of a few extra resistances were necessary for Sargent to move in this direction. Before I discuss this final phase, I will outline the additional resistances that Sargent encountered.

Phase Three: Accommodating Sameness

This phase is centered on Sargent's eventual forced move to the interpretation of rational expectations as individual rationality and mutual consistency of perceptions. From the early-to-mid 1980s, Sargent focused on the free move of incorporating general equilibrium theory in his framework of rational expectations and vector autoregressions.[14] The general equilibrium framework imposed full theoretical restrictions on the coefficients in the vector autoregression and therefore avoided the problem of observational equivalence encountered earlier. Whereas the previous two phases in Sargent's work started with the conception of agents as little econometricians while economists were added as somewhat of an afterthought, the phase discussed in this section started with the free move of conceiving of agents as little economists while econometricians were added as somewhat of an afterthought.

Though the pioneer of rational expectations, Robert Lucas, had used general equilibrium theory from the start, it was not until the late 1970s that Sargent moved in this direction. During that time, he spent a year as a visiting professor at the University of Chicago and took two courses from Lucas. Sargent sought to establish symmetry by linking the free moves to vector au-

toregressions employed by econometricians and the general equilibrium theory developed by economists through the concept of rational expectations. Hence, in the interpretation of the concept that emerged as a forced move, agents have expectations that are rational when these depend, in the proper way, on the same things that, according to economic theory, actually determine that variable. A collection of agents works to solve the same optimum problems by using the relevant economic theory, and the solution of each agent is consistent with the solution of other agents. Econometric methods can then be used to estimate the vector autoregressions that result from this economic model. For Sargent, establishing symmetry among agents, economists, and econometricians with this setup was facilitated by the fact that general equilibrium theory involved an a priori bias toward symmetry among agents. As a result, the forced moves that emerged in association with disciplinary agency led Sargent toward symmetry not only among categories of people but also within groups of individuals.

Though Sargent had finally achieved symmetry, my narrative does not have a happy ending here. Instead, Sargent encountered new resistances that emerged from disciplinary agency due to the combination of rational expectations, general equilibrium theory, and vector autoregressions. First, if there is symmetry among the agents, then there is no reason for them to trade with each other, even if they possess different information. Instead of a hive of activity and exchange, Jean Tirole (1982) proved that a sharp no-trade theorem characterizes rational expectations equilibria (Sargent 1993, 113). Second, agents and econometricians have to be different in order to justify the error term. When implemented numerically or econometrically, rational expectations models need to impute more knowledge to the agents within the model who use the equilibrium probability distributions than is possessed by an econometrician who faces estimation and inference problems that the agents in the model have somehow solved (Sargent 1987c, 79). Third, there is a need for asymmetric actors in rational expectations economics for the concept of policy recommendations to make sense. In particular, making recommendations for improving policy implies the assumption that in the historical period the system was not really in a rational expectations equilibrium, having attributed to agents expectations about government policy that did not properly take into account the policy advice (Sargent 1984, 413). A fourth resistance deals with the issue of conceptualizing learning if agents are

thought to be little econometricians. In particular, econometric metaphors of reasoning possess a blind spot for the process of information search and errors made in information collecting, because econometric theories of inference and hypothesis testing are applied after the data has been collected; they do not start until the variables and numbers needed for the formulas are available (Sargent 1993, 23). These resistances, combined with those outlined in the previous section, eventually jointly transformed Sargent's entire program. As I will describe in the following section, Sargent tried to reimpose symmetry among agents, economists, and econometricians by making them all boundedly rational.

In this phase, therefore, forced moves associated with general equilibrium theory led Sargent to embrace symmetry not only among but also within categories of individuals. However, due to resistances that subsequently emerged as a result of disciplinary agency in Sargent's attempt to connect the techniques used by agents, the theories constructed by economists, and the models developed by econometricians, Sargent was unable to maintain symmetry within the setup he had developed. A "realistic" account required heterogeneous agents, an asymmetric government, and difference between agents and econometricians.[15] In an effort to accommodate the emerging characteristics of the dance of human and disciplinary agency, Sargent sought to reestablish symmetry through the use of bounded rationality. This is the final phase in his work to which I now turn.

Phase Four: Accommodating Learning

In what follows I discuss how Sargent eventually changed his attitude toward rational expectations in response to developments in the late 1980s. During this period, Sargent became involved with the Santa Fe Institute, where researchers were exploring themes such as complexity, intractable unpredictability, spontaneous self-organization, adaptation, nonlinear dynamics, computational theory, upheavals at the edge of chaos, inductive strategies, and new developments in computer and cognitive science. The Santa Fe Institute, which was founded by a number of distinguished physicists at the Los Alamos National Laboratories, originally had nothing to do with economics. This changed after the workshop, "Evolutionary Paths of the Global Economy," was held September 8–18, 1987, at the institute campus in Santa Fe

(Anderson, Arrow, and Pines 1988). This successful gathering served as the inspiration for the economics program at the institute, which focuses on the economy as a complex, constantly evolving system in which learning and adaptation play a major role.

One area that received a great deal of attention during the workshop was the specific question of how economic agents take the future into account when making decisions. The axiom of rational expectations seemed patently untrue to the physical scientists, who were acutely aware of the difficulties inherent in predicting the future.[16] The problem in developing a more "realistic" model was that if economic agents were assumed to be able to anticipate the future, but not perfectly, then it is hard to know just how imperfect rationality should be. One suggestion was to develop theoretical economic agents that learned in the way that actual economic agents did, which was in line with Sargent's desire to restore symmetry. Before analyzing Sargent's embracement of the approach based on the Santa Fe program, however, we need to consider prior accommodation efforts by Sargent to deal with the problems outlined in the previous sections.

Sargent was bothered by the asymmetry among agents, economists, and econometricians that emerged from disciplinary agency within the setting of rational expectations, general equilibrium theory, and vector autoregressions. In response to this resistance, he was led in the mid-1980s to revise part of his framework. Instead of starting from rational expectations, Sargent made a free move to agents with adaptive expectations in work mostly coauthored with Albert Marcet, who was a graduate student at the University of Minnesota during Sargent's tenure there and who subsequently followed in Sargent's footsteps by accepting an assistant professor position at Carnegie Mellon University (Marcet and Sargent 1986, 1988, 1989a, 1989b, 1989c, 1992). The models they developed were adaptive in the sense in which that term is used in the control literature (but not in the macroeconomics literature).[17] In particular, the agents were assumed to behave as if they know with certainty that the true law of motion is time invariant. Because the agents operate under the continually falsified assumption that the law of motion is time invariant and known for sure, the models do not incorporate fully optimal behavior or rational expectations.

Because Sargent was unwilling to relinquish rational expectations entirely, he did not see learning as new to economics. Instead, he saw it as a way of

strengthening the standard ideas and dealing with their problems—as a way of understanding how economic agents will grope their way toward neoclassical behavior even when they are not perfectly rational (Sargent 1993, 23). In particular, he tried to reinforce rational expectations by focusing on convergence to this equilibrium (Marcet and Sargent 1992, 140). He also tried to use learning with adaptive expectations to deal with some of the problems associated with rational expectations (Sargent 1993, 25). Finally, incorporating learning could assist in the computation of equilibria (Marcet and Sargent 1992, 161).

This new framework, however, did not fully allow Sargent to satisfy his interests due to the emergence of new resistances in disciplinary agency. That is, the representation resulting from the forced moves was "unrealistic" in the sense that agents were assumed to have already formed a more-or-less correct model of their existing situation, and learning was just a matter of sharpening up the model a bit by adjusting a few knobs. Since Sargent had moved toward picturing economists and econometricians as being far from rational and knowledgeable about the system they analyze, this "unrealistic" picture still left him with a rather weak attempt at exerting his human agency.

Sargent was unhappy with the "unrealistic" interpretation of learning under adaptive expectations that had emerged due to disciplinary agency, and he wanted to find something closer to the way economists and econometricians learn. How could he circumvent the forced moves that resulted in the "unrealistic" representation? In attempting to answer this question, the Santa Fe meeting inspired Sargent to appeal to artificial intelligence. Instead of assuming that agents were perfectly rational, they could be modeled as being artificially intelligent and learning from experience like real economic agents. Rather than modeling the economy as a general equilibrium, societies of interacting artificially intelligent agents could be organized into an economy. Reluctant to abandon his earlier contributions completely, Sargent did not fully embrace the Santa Fe approach. Instead of relinquishing the neoclassical notion of an equilibrium, he focused on convergence to equilibrium (Marimon, McGrattan, and Sargent 1990).

Sargent saw what he called his bounded rationality program as an effort to restore symmetry among agents, economists, and econometricians. Whereas resistances had earlier frustrated his attempts to establish symmetry through the use of rational expectations, he now moved to picturing agents, economists, and econometricians alike as being boundedly rational but converg-

ing to rational expectations. Ironically, however, the move to artificial intelligence came along with forced moves that left Sargent with a new asymmetry that emerged between him and the agents in his models. Specifically, Sargent had to be smarter when he made the agents more bounded in their rationality, because disciplinary agency illustrated that his models became larger and more demanding econometrically. Furthermore, artificial intelligence did not allow Sargent to fully establish symmetry, because the proliferation of free parameters in the bounded rationality program left him with an asymmetry between economists and econometricians: "Bounded rationality is a movement to make model agents behave more like econometricians. Despite the compliment thereby made to their kind, macroeconometricians have shown very little interest in applying models of bounded rationality to data. Within the economics profession, the impulse to build models populated by econometricians has come primarily from theorists with different things on their minds than most econometricians" (1993, 167–68).

This final phase illustrates how Sargent's attempts at exerting his human agency by establishing symmetry continued to be frustrated as a result of the emergence of resistances due to disciplinary agency. Sargent himself acknowledged that neither learning through adaptive expectations nor learning through artificial intelligence established the symmetry he sought. Whereas the disciplinary agency associated with adaptive expectations excluded agents from the symmetry structure, the forced moves associated with artificial intelligence continued to exclude agents from the symmetry structure and further left Sargent with an asymmetry between economists and econometricians. Will Sargent ever be able to establish symmetry among economists, econometricians, and agents? Will he continue to encounter forced moves and resistances that keep him from establishing symmetry? What will emerge from the interaction of human and disciplinary agency? We will have to wait and see.

Conclusion

In this chapter I have shown how Thomas Sargent was faced with the emergence of different interpretations of rational expectations in different periods as a result of the dance of human and disciplinary agency. I have outlined four case studies of Sargent trying to establish symmetry among agents, economists, and econometricians. The first case study was staged in the late 1960s

through early 1970s. The events explored in the second study took place in the late 1970s through early 1980s. The third study was set in the early-to-mid-1980s. The events discussed in the final case study took place in the late 1980s through early 1990s.

Sargent's community in the late 1960s through early 1970s consisted of his student Robert Blattberg, among others. In this setting, Sargent made the free moves to focus on the randomness of lag distributions, the determinism of neoclassical economic theory, connecting economic theory and econometric method through rational expectations, and the term structure of interest rates. As a result of those decisions, Sargent was led to adopt an econometrically motivated interpretation of rational expectations and to acknowledge the importance of Lévy stable distributions following the forced moves. The resistances he ran into were that for Lévy stable distributions there was no general estimation method and the properties of estimators could only be investigated in an indirect way. He accommodated these by giving up Lévy stable distributions despite the evidence in favor of their "realism." Christopher Sims and Lars Hansen were Sargent's collaborators in the late 1970s through early 1980s. Influenced by a change in his economic environment and by Sims, Sargent tried to combine rational expectations with vector autoregressions and to use the acquired statistical information to construct a theoretical model. This proved to be problematic because the resistance of observational equivalence implied that contradictory theoretical models could generate the very same vector autoregressive relations. When Sargent tried to accommodate this resistance by collaborating with Hansen on recursive dynamics and linear optimal control models, new resistances emerged because Sargent's models were technically not very successful and were difficult to implement. Furthermore, disciplinary agency led Sargent to develop models based on "unrealistic" assumptions. In the early-to-mid-1980s, Sargent worked with Robert Lucas, among others. In this environment, he initially adopted free moves toward general equilibrium theory, vector autoregressions, and rational expectations. This move promised to allow him to establish symmetry not only among but also within categories of individuals. However, he found that asymmetry appeared as a consequence of the no-trade theorems, incorporating information gathering, error term justification, and policymaking recommendations. Sargent tried to accommodate these resistances and restore symmetry by adopting adaptive expectations and artificial intelligence.

Albert Marcet and the Santa Fe Institute were part of Sargent's environment in the late 1980s through early 1990s. In these surroundings, Sargent first focused on adaptive rather than rational expectations. This reduced the asymmetry among agents, economists, and econometricians, but disciplinary agency prohibited him from fully establishing symmetry. Sargent tried to incorporate a more "realistic" interpretation of learning by finally adopting a version of artificial intelligence that was limited to convergence. Yet, resistances continued to frustrate Sargent's search for symmetry since he was left with asymmetry between himself and agents and between economists and econometricians.

Sargent entertained different interpretations of rational expectations in different periods. In the late 1960s through early 1970s he used an econometrically motivated interpretation of rational expectations with a focus on distributed lags. In the late 1970s through early 1980s this emphasis changed to vector autoregressions. During both of these phases, Sargent started with the conception of agents as little econometricians while economists were added to the symmetry picture as somewhat of an afterthought. In the early-to-mid-1980s, Sargent focused on how rational expectations in a general equilibrium framework could lead to vector autoregressions. During this phase, he started with the conception of agents as little economists while econometricians were added as somewhat of an afterthought. In the late 1980s through early 1990s, Sargent tried to show convergence to rational expectations through learning by agents, economists, and econometricians alike through the use of adaptive expectations or artificial intelligence. Furthermore, Sargent's choices were partly inspired by his social environment; Blattberg in the late 1960s through early 1970s, Sims and Hansen in the late 1970s through early 1980s, Lucas in the early-to-mid-1980s, and Santa Fe and Marcet in the late 1980s through early 1990s. It was further shown that as a result of each interpretation of rational expectations, Sargent had to deal with different resistances due to disciplinary agency.

Rather than analyzing rational expectations economics in general, I have focused on the account of one of the central players in the rational expectations movement, Thomas Sargent. What were the alternatives available to him? What choices did he make? What were the emerging consequences of those decisions due to disciplinary agency? How did he accommodate undesirable consequences? The framework I used to answer these questions was

inspired by insights from Andrew Pickering. I started out with Sargent's interests, which were situated in and subject to change through scientific practice. I showed how Sargent tried to extend culture to serve his interests and how he used his motivations as a standard for judging whether the extension of culture was successful or not. The free moves reflected the tentative choices that Sargent made, carrying with them no guarantee of success. The forced moves served to elaborate the choices through disciplinary agency. Sargent could accommodate resistances that emerged when the extension of culture was not successful by changing his interests, changing his free moves, or ignoring the forced moves.

In this chapter I have pictured economics as a field of emergent human and disciplinary agency engaged by means of a dialectic of resistance and accommodation. I have used the framework of interests, moves, resistances, and accommodation to illustrate the emergence of continually changing interpretations of rational expectations in Sargent's work and to provide an internal criticism. The insight that Sargent ran into resistances in his attempts to satisfy his interests can be used to resist his analysis. Rather than imposing outside standards, I have shown that Sargent was unable to meet his own standards. This kind of analysis provides an interesting alternative to the many different, simple, and equally (un)compelling stories about the rational expectations revolution that have been circulating among members of the history of economics community up until now. It differs by showing that facts and knowledge in rational expectations economics represent assemblages of human and disciplinary performances that emerge in time and also pass in time. The novel point that the analysis makes concerns the temporal aspects of facts and knowledge in rational expectations economics and how they are highly delicate and subject to change.

An additional attraction of the approach I used in analyzing Sargent's work is that there is a symmetry in the treatment of the "interests" of Sargent and the "interests" of the agents in his model. As Wade Hands notes: "While economists do not normally use the term 'interests,' they do in fact explain economic behavior on the basis of the 'interests' of the agents involved" (1994, 81). In fact, Pickering "has been criticized precisely because [his work] characterizes the behavior of scientists in the way that a neoclassical economist would characterize individual behavior" (84).[18] While Sargent has endowed his agents with neoclassical behavior, here I characterized his

behavior in a neoclassical economic way. The fact that this is precisely the symmetry that Sargent eventually sought to achieve serves to strengthen the arguments for using Pickering's framework.

NOTES

I am grateful to Keith Guzik, André van Hoorn, and Andrew Pickering for their helpful suggestions.

1. Following Pickering (1992, 1995; Pickering and Stephanides 1992), Sargent's initial steps consisted of free moves made in an effort to serve his interests. However, these were tentative and revisable trials that carried no guarantee of success.
2. The consequences of the initial steps are labeled Sargent's forced moves. These revealed how his scientific culture further directed his plans and intentions.
3. Resistances are the obstacles Sargent encountered in his attempt to satisfy his interests. Faced with a failure to satisfy his interests as a result of resistances, Sargent was led to accommodate them by tinkering with the elements of the structure he had built up as a result of his free and forced moves.
4. Since Sargent never explained the justification of symmetry among agents, economists, and econometricians, I can only speculate on this issue: first, Sargent might have defended symmetry as a quality inherent in things; second, he might have argued that symmetry follows from a power of recognition inherent in the mind; third, he might have claimed that symmetry is a matter of metaphor.
5. In economics, the dominant or mainstream approach is known as neoclassical economics. Econometrics is the branch of economics that applies statistical methods to the empirical study of economic theories and relationships.
6. A time series is a sequence of data points, measured typically at successive times, that are spaced apart at uniform time intervals. Time series analysis comprises methods that attempt to understand such time series, often either to understand the underlying theory of the data points (Where did they come from? What generated them?) or to make forecasts (predictions). Time series prediction is the use of a model to predict future events based on known past events: to predict future data points before they are measured.

   For models with one dependent and one explanatory variable, the distributed lag will look like this: $y_t = \alpha + \beta_0 x_t + \beta_1 x_{t-1} + \ldots + e_t$.

The term "structure of interest rates" refers to the phenomenon that interest rates vary with time—where interest rates for longer time periods often are higher than those for shorter time periods.

7. A probability distribution assigns to every interval of the real numbers a probability, so that the probability axioms are satisfied. A Lévy stable distribution is a special type of probability distribution whose characteristics are explained in the text. Variance is the expected value of the square of the deviation of a random variable from its own mean.
8. A process y_t is called a vector ARMA(p,q) process if
$y_t = \Theta_1 y_{t-1} + \ldots + \Theta_p y_{t-p} + \nu_t + A_1 \nu_{t-1} + \ldots + A_q \nu_{t-q}$

where

$$\Theta_n = \begin{bmatrix} \theta_{11,n} & . & . & . & \theta_{1k,n} \\ . & . & & & . \\ . & & . & & . \\ . & & & . & . \\ \theta_{k1,n} & . & . & . & \theta_{kk,n} \end{bmatrix}, n = 1, \ldots, p$$

$$A_n = \begin{bmatrix} \alpha_{11,n} & . & . & . & \alpha_{1k,n} \\ . & . & & & . \\ . & & . & & . \\ . & & & . & . \\ \alpha_{k1,n} & . & . & . & \alpha_{kk,n} \end{bmatrix}, n = 1, \ldots, q$$

and ν_t is k-dimensional vector (or multivariate) white noise defined by $E[\nu_t] = 0$, $E[\nu_t \nu_t'] = \Sigma_\nu$ (positive definite) and ν_t and ν_s are independent for $s \neq t$. The process y_t is called a vector AR(p) process if $q = 0$; that is,
$y_t = \Theta_1 y_{t-1} + \ldots + \Theta_p y_{t-p} + \nu_t$
and y_t is called a vector MA(q) process if $p = 0$; that is,
$y_t = \nu_t + A_1 \nu_{t-1} + \ldots + A_q \nu_{t-q}$.
9. Whereas time-series analysis examines variables over time, structural analysis studies the relationship between different variables at a point in time.
10. I should note that while these problems led Sargent to change his approach, they never bothered Sims because he was indifferent to symmetry.

11. Recursive dynamics computation has been shown to allow the efficient simulation of systems with large degrees of freedom. Optimal control is a mathematical tool that allows users to find optimal paths over time for different variables that describe a dynamic economic system.
12. It is important to stress that Sargent himself acknowledged that it is difficult to take seriously the predictions of his models in this phase.
13. Specifically, they presumed a stationary process, which is a stochastic process in which the probability density function of some random variable X does not change over time or position. As a result, parameters such as the mean and variance also do not change over time or position.
14. General equilibrium theory is a branch of theoretical economics that seeks to explain production, consumption, and prices in a whole economy. It does so by using a bottom-up approach that starts with individual markets and agents. Note also that Sargent did not make use of Walrasian general equilibrium analysis but rather employed representative agent analysis instead.
15. Again it needs to be emphasized that Sargent himself recognized these emerging characteristics of the dance of human and disciplinary agency due to the free moves, forced moves, and resistances.
16. Note that the earlier defense of rational expectations by Sargent and the current criticism of rational expectations by physicists relied on different notions of "realism." Spelling these out, however, is beyond the scope of this chapter.
17. In engineering and mathematics, control theory deals with the behavior of dynamical systems over time. Macroeconomics is the study of the entire economy in terms of the total amount of goods and services produced, total income earned, the level of employment of productive resources, and the general behavior of prices.
18. While Pickering (1995, 7) freely admits intentionality as a central feature of human action and would not disagree that humans make intentional choices on the basis of their beliefs and desires, the weight of his research and argument lies in demonstrating how human behavior is not a derivative of such interests. Instead, his stories of human action (scientific practice) highlight how such action is bound together with material, nonhuman performances. In fact, once we look at the case studies themselves, we find that human intentions, goals, and desires get mangled and emerge in time as a result of these human and nonhuman performances.

The Mangle of Practice and the Practice of Chinese Medicine

A Case Study from Nineteenth-Century China

VOLKER SCHEID

At the dawn of the twenty-first century, Chinese medicine has become a global medical system employed worldwide by physicians in more than 120 countries. Cybernetics, systems theory, black and white boxes, inferential statistics, dialectical materialism, and the Enlightenment teleology of scientific progress have become integral to how physicians using Chinese medicine define what they do (Meng Qingyun 2000, 539–88; Zhu Shina and Sun Guilian 1990). The use of PET and CT scanners, blood pressure readings, and notions of the mind borrowed from Western psychology constitute routine practices in hospitals of Chinese medicine where they are used side by side with older tools and technologies such as pulse diagnosis and strategies of formula composition (Ots 1990; Scheid 2002). In the West, meanwhile, Chinese medicine has been indigenized within a process of synthesis that reconfigures it as simultaneously fulfilling medical, psychological, and religious functions (Barnes 1998).

While such rearticulations are there for all to see, the definition of Chinese medicine in the West remains stubbornly tied to an oppositional rhetoric that configures medical practices as discrete systems offering competing frameworks for relating to health and disease. Usually the goals of this rhetoric are polemical: when the dynamic nature of biomedical science is contrasted with "a static historical tradition" underpinning "complementary medical techniques" (Vickers 2000); when two thousand years of Chinese medical history

are condensed into a single "essential underpinning paradigm" (Heptonstall 2000) that can more easily be defended against criticism on the grounds of cultural incommensurability; or when Chinese medicine is promoted as a synthetic science irreconcilably different from the analytic orientation of biomedicine (Porkert 1978). In other contexts the creation of essential difference proceeds by subtler routes. Anthropologists and historians, for instance, readily acknowledge the historical plurality of Chinese medicine and the openness of medical systems. But heterogeneity on the level of description is all too often homogenized once more on the level of explanation by evoking distinctive cultures, practices, aesthetics, or styles of reasoning (Scheid 2002).

Andrew Pickering's "mangle of practice" offers a useful tool for avoiding this search for essences because of the universalism at its heart. Self-consciously conceived of as a theory of everything, the mangle undercuts claims of uniqueness, superiority, and exceptionalism and reduces all traditions of medicine and inquiry to the same processes of practice. At the same time, its focus on the shifting articulations between humans and nonhumans within an unceasing "dance of agency"—processes of articulation that need to be described and analyzed in detail in order to be understood—guards against slipping back toward the essentialism that usually informs theories striving for universal applicability. In drawing on Pickering's mangle I have been able to delineate contemporary Chinese medicine as a field of practice populated by diverse human and nonhuman agents (physicians, patients and their families, the state, technologies or curing, herbs, agents and vectors of disease, etc.) that come together within constantly evolving syntheses (Scheid 2002).

In spite of the success of my project in describing Chinese medicine as a field of ongoing transformation and emergence, in my focus on plurality and difference I failed to pay equal attention to the indubitable stabilities that mark out Chinese medicine as a living tradition. I also missed the opportunity of using Chinese medicine as a practice from which to reflect back onto the mangle itself. Pickering's claims that the mangle functions as a theory of everything, furthermore, are not yet supported by many empirical studies that focus on non-Western and nonscientific practices. In this chapter I seek to address all of these issues. To this end I examine the emergence of a distinctive style of medical practice in nineteenth-century China. Known as the

"current of Menghe learning" (*Menghe xuepai* 孟河學派), it was one of the last styles of practice within the Chinese medical tradition that developed completely independent of Western influences.[1] In what follows I show first that the emergence of this style of medicine is, indeed, a product of mangling, and thereby I extend the scope of my previous work backward in time. Unlike many moderns who, as Pickering suggests in his own contribution to this book, hide their participation in the dance of agency behind a veil of being, physicians in late imperial China perceived the world as being in a constant state of flux. They therefore developed strategies of agency that fixed on this very dynamic and sought to exploit it for their own advantage. In the concluding section I contrast this stance with that taken up by Pickering himself.

Society and Medicine in Late Imperial China

Menghe is a small town in rural Jiangsu Province, located about halfway between Shanghai and Nanjing. During the second half of the nineteenth century, this provincial backwater produced a current of medical learning whose influence was still felt one hundred years later in Maoist China. Its members were related to each other by kinship, apprenticeship, and ties based on native place centered on a network of four medical families. During the nineteenth century the most powerful of these groups was the Fei family 費, and its most famous member was Fei Boxiong 費伯雄 (1800–1871). As the semi-official *Draft of Qing History* (*Qingshi gao* 《清史稿》) claimed: "Of all Jiangnan physicians at the end of the Qing, [Fei] Boxiong was the most outstanding" (Zhao Erxun 趙爾巽 1976: 13883). In his writings Fei Boxiong defined the basic parameters of the Menghe medical style, and my account situates its emergence within the wider context of his life.[2]

Menghe belongs to an area known as Jiangnan (literally, "south of the Jiangzi"), which consists of southern Jiangsu, northern Zhejiang, and eastern Anhui provinces. In late imperial China, just as today, this was China's most prosperous and influential macro-region whose scholars, artists, and merchants dominated culture, society, and economy throughout the empire. The Fei family members had long been part of the Jiangnan elite, and they judiciously exploited their social connections to establish themselves as a well-known lineage of master physicians. Fei Boxiong himself was on friendly terms with some of the most powerful Chinese government officials at the time. They

came to him as patients and invited him to their homes for social visits. He may even have treated the emperor and the empress dowager; his student and son-in-law Ma Peizhi 馬培植 (1820–1907) certainly did. Fei Boxiong's skill as a physician made his acquaintance desirable to his elite clients. Even more important was the fact that they shared the habitus of the gentleman (*shi* 士). A gentleman in late imperial China was a widely educated man of letters, for whom medicine was but one means of seeking to understand the world. Other means included the study of philosophy and literature, meditation, self-reflection, and the pursuit of painting, poetry, and other arts. These activities might be pursued alone, but just as often they were done together with a network of friends. The goal of this process of self-cultivation was to become a sincere (*cheng* 誠) person: one who grasped the Way (*dao* 道) and the patterns (*li* 理) according to which the world operated, and one who therefore could intervene in it for the benefit of himself and others. Knowing the world and acting in it thus naturally fused with each other, while knowledge of the Way was, by definition, not possible by cognition alone (Lloyd and Sivin 2002, 16–18, 190–91).

The most significant event in Fei Boxiong's life was the Taiping rebellion of 1851–1864, an uprising by a religious sect that almost brought the Qing state to its knees. The rebellion caused tremendous devastation throughout Jiangnan, much of it due to the scorched-earth tactics used by the government to suppress it. To the Fei family members and their circle, the rebellion brought into renewed focus anxieties regarding the decline of their culture that had festered since the Manchu conquest of China in the seventeenth century. Intellectually, this unease expressed itself in concerns regarding the loss of unity within the Confucian tradition, which since the Song dynasty had fractured into several competing currents of learning. During the Qing era, this led to the emergence of an intellectual movement known as Han learning (*Hanxue* 漢學), which aimed to restore a secure foundation to scholarship—and thereby society—by basing it on a more authentic reading of classical texts (Elman 1984).

Scholarly medicine during the Qing experienced a similar crisis. Even though physicians agreed on shared principles embedded in the canons of antiquity, they were divided into competing currents that had developed these principles into different directions. Two broad strategies aimed at resolving the ensuing tension between tradition and innovation gradually emerged.

The first attempted to limit the scope for interpretation by using strategies of exclusion. The preferred tool for this strategy was the anthology (*zongji* 總集), a genre of writing that ordered selected doctrinal texts and commentaries into a single tradition by connecting them to each other through kinship terms. Teachings or voices that did not fit were labeled heterodox (*yiduan* 異端; literally, "of another beginning") and excluded from the genuine lineage (*dipai* 嫡派) of transmission. The Manchu court quickly adopted this strategy in its attempts to control all intellectual activity from above (Wilson 1995).

The second strategy focused on the personal development of medical skills. Physicians connected to this movement sought to avoid the biases associated with any one particular medical doctrine by studying widely and by creating unique syntheses. Such practitioners often portrayed their craft as a reflection of individual genius unconstrained by orthodoxy. The Suzhou physician Xue Xue 薛雪 (1681–1770), for instance, compared his style of medicine to the artistic genius of the poet Yuan Mei 袁枚: "My medicine is the same as your poetry. It is simply an expression of the spirit. As the saying goes, [other] men's [spirits] are confined to their home. Mine comes from beyond the heavens" (Waley 1970, 51–52). This style of medicine was particularly influential in Jiangnan.[3]

Socially, too, the status of physicians in late imperial China was extremely insecure. Successful physicians could acquire great fame and wealth but their position in the eyes of the elite was forever tainted by perceptions of medical practice as an art or craft dependent on techniques (*shu* 術). Physicians, furthermore, had to attract patients in a fiercely competitive medical market utterly devoid of government control or regulation. Thus social connections, recommendations from elite clients, and various forms of self-promotion were as essential to career development as were clinical skills and authentic knowledge. Menghe physicians were able to draw on all of these resources even as they themselves were shaped by them. Their medical style thus emerged in a process of mangling that created a temporarily stable articulation of all the various agents with a stake in its construction.

The Roots of the Menghe Medical Style

One of the distinguishing features of Menghe medicine in the early and mid-nineteenth century was a close-knit network of well-established medical fam-

ilies (not all of them belonging to the elite) related to each other by ties of kinship and marriage as well as master-student ties. Physicians from these families competed with each other for patients and status but also were mutually supportive by sharing opportunities for learning and the exchange of information through a variety of formal and informal channels. As a classically trained scholar Fei Boxiong could draw on all of the resources of that mode of learning and pass himself off as a "famous gentleman who had become a famous physician" (Fei Boxiong 費伯雄 1863, 3). Yet in order to become a successful clinician he also utilized specialized medical techniques that had been passed down within his own family and in other Menghe lineages, and also within local folk medical traditions. To legitimize this mode of learning Fei Boxiong openly criticized the scholasticism of his literati peers and advocated the pragmatic use of the widest range of available resources in the development of tradition. He also avoided getting drawn into arguments between competing factions in the field of medicine and instead emphasized syncretism and innovation. Chao Zude 巢祖德, a Menghe physician who practiced in Shanghai during the 1940s, provides evidence for the enduring legacy of this attitude: "Given the flourishing of science throughout these last twenty years, why should those studying [medicine as a] profession base themselves [merely] on the ancient methods? I personally study them together with Western learning. [Regarding this attitude] we can take into consideration how the Menghe physicians enriched their [own] knowledge through studying and grasping [the ideas of others] in the Qing dynasty. In researching and collecting the theories of [their] contemporaries, they were not limited by sticking to the ancients" (Chao Zude 巢祖德 1945, 1:6a-b).

Although this attitude was widely shared among physicians in Menghe and beyond, Fei Boxiong's achievement was to give voice to it and thereby turn it into an ideology. His two most important medical works—*The Refined in Medicine Remembered* (*Yichun shengyi* 《醫醇賸義》) and *Discussion of Medical Formulas* (*Yifang lun* 《醫方論》)—were published during the Taiping rebellion, which Fei Boxiong experienced as a time of great social and personal tragedy. When the Taiping rebels occupied Menghe in 1860 they destroyed the printing blocks of a ten-volume work on medicine in which Fei Boxiong had collected his life experiences. He spent the next four years in exile in northern Jiangsu, a period during which he lost both his wife and his daughter. Yet the general breakdown in social order also presented him with the opportunity to

turn his style of medical practice into a program of medical reform. Written with the professed purpose of guiding students of medicine back toward the correct path of orthodoxy, *The Refined in Medicine Remembered* and *Discussion of Medical Formulas* proposed a unique solution to the problems of post-Song medicine that synthesized its two dominant currents. These volumes were inspired by a search for authenticity and excellence that aimed to realize in the present the most exalted models of the past and thereby lead students of medicine toward the most refined style of medical practice.

The Medicine of the Refined

What I term "refined" Fei Boxiong himself defined by means of the term *chun* 醇. Chun denotes something unadulterated and therefore pure and simple, as well as the actual process of purification.[4] In late imperial China, the term "chun" was also used to designate authentic Confucian orthodoxy (*chun ru* 醇儒 or 純儒). According to Fei Boxiong, chun "refers to the appropriate [application] of the fundamental patterns (*li* 理) of medical [knowledge]" (Fei Boxiong 費伯雄 1865, 92).[5] It is the activity of "striving for merit without excess," an ability that in his eyes had almost been lost. In order to become an effective clinician a physician must sort through the many different doctrines and practices of the tradition and distill from them those that are most refined. Hence, Fei Boxiong noted, "the only method of helping students [to obtain the] correct [principles of medical practice] is to be selective in order to control excessive flourishing, to give clear instructions that guide them back to the pure and proper and not towards the desire of wanting to be different" (1863, 6). Medical education, in this view, conjoined moral and practical considerations into an ongoing process of self-cultivation. This implied that knowledge could not be offered to students in the form of simple propositions. Rather, it had to be distilled slowly and meticulously by reading the classics and comparing them first with each other and then with the clinical experience of one's teachers and of oneself.

This was "knowledge painfully acquired" (*kun zhi* 困知), a standard concept in Ming and Qing Confucianism (Luo Qinshun 羅欽順, 1986). Fei Boxiong saw himself as a paragon of what such effort could achieve. He claimed to have studied every important medical book written, retaining their essence

while discarding the chaff, and thereby to have gained a penetrating understanding of the dynamics of health and disease. In his own clinical practice, Fei Boxiong channeled this understanding into a style that he referred to as the medicine of "harmonization and gentleness" (*he huan* 和緩). These were carefully chosen terms, which marked off his own preferences from those of his competitors through a dazzling display of scholarly references. On one level, the terms "harmonization" and "gentleness" refer to the most fundamental principles of medical practice. Understanding the essence of a clinical problem reduces even complex issues to simple patterns. These can then be responded to by equally simple and "gentle" (*huan* 緩) treatment strategies that are efficacious because they return the body to a normal state of "harmony" and "balance" (*he* 和). In Fei Boxiong's own words:

> Irrespective of whether one takes common illnesses or rarely encountered disorders, only if one knows their regular [dynamics] does one have a method through which to understand their transformations. Therefore, with regard to providing a name for [such practice] in its daily [occurrence], from early on one has used harmonization and gentleness as its natural designation. Although there exist many kinds of disorders, they do not go beyond internal damage and external contraction. Supplement that which is insufficient in order to return the correct. Drain what is in excess to restore balance. This is all there is to the harmonizing method and to moderate treatment. Poisonous drugs cure five out of ten illnesses, fine drugs cure seven out of ten and this, too, refers to the harmonizing method and to moderate treatment. There exist no miraculous methods in the world, only plain ones and the perfection of the plain is miraculous. If on the contrary one is dazzled by the different manifestations [of disorders] taking them for new ones, hence uses [treatments] that disregard the [orthodox] norms in the desire for immediate effects, one will on the contrary speed up disaster. This is because of not [adhering to] harmonization and gentleness. (1863, 6)

Readers familiar with Chinese thought and its logic of efficacy will find myriad references in Fei Boxiong's discourse on harmonization and gentleness, including allusions to Laozi's notion of noninterference (*wu wei* 無爲); to Sunzi's strategies of warfare that seek to achieve effects by exploiting the disposition of a situation and by valuing the application of minimal force; to Buddhist notions of mindfulness that are realized through "effortless

effort"; and to concerns for harmony, balance, and orthodox norms that are expressed in the Confucian classics. Indeed, as we shall see below, Fei Boxiong was open to and influenced by all of these various currents of learning.

More literally, his terms referred to the doctors He and Huan who lived in the state of Qin in the sixth century BC and are the first Chinese physicians known by their actual names. In a culture dominated by a pervasive attitude of historicism, where authority was derived from adherence to past models rather than the promise of future achievements, bolstering one's own ideas in this manner was a well-established strategy. Yet there are other, more historically specific, insinuations at play in Fei Boxiong's rhetoric through which he positioned himself in relation to the key debates that defined medicine and society at the time. The authors of the *Draft of Qing History* were quite aware, for instance, that Fei Boxiong's notion of harmonization and gentleness constituted more than a mere clinical strategy. It was an attempt to return Chinese medicine to a state of unity believed to have been lost with the emergence of distinctive medical currents during the Jin-Yuan period. Hence they concluded that "in discussing medicine, he admonished against one-sidedness yet also against mixing [things] up. By defining the [essence of the] ancient medicine through the terms 'harmonization and gentleness' he demonstrated that he understood [its original] intention" (Zhao Erxun 趙爾巽 1976, 13883).

I showed above that during the Qing era traditional admonitions against one-sidedness had become linked to a more comprehensive critique of post-Song neo-Confucianism. Many modern scholars consider Fei Boxiong to have been aligned to this current of conservatism. Indeed, his return to the medicine of He and Huan bears a strong resemblance to the ideology of Han learning and its attempts to ground practice in the oldest and most authentic sources of tradition. On closer inspection, however, it becomes clear that Fei Boxiong took a more balanced view. Although he warned against the potential bias of Jin-Yuan doctrines, he also emphasized their usefulness. If the ancient classics themselves did not offer up their wisdom to the reader without the effort of interpretation, then later works, too, needed to be carefully analyzed for their potential contribution to a shared tradition. In commenting on the doctrines of Li Dongyuan 李東垣 (1180–1251) and Zhu Danxi 朱丹溪 (1281–1358), the two most emblematic Jin-Yuan physicians, Fei Boxiong explained: "It is not that [Li] Dongyuan and [Zhu] Danxi have led people astray.

People have been led astray by the mistake of not studying Dongyuan and Danxi well. I [personally] hope that the scholars of the world will employ the differences between the various physicians in order to further the commonalities [between them]. In this way, through the application of all their energies [our] discussions of patterns and application of treatment will be transformed and must [of necessity] return to become one" (1863, 14). Viewed from this perspective, Fei Boxiong's notion of authenticity or the refined in medicine emphasized singularity and subjectivity at the same time as it sought to ground medicine in the most ancient past. In that sense, the medicine of the refined therefore also attached itself to the poetic vision of medicine advocated by Xue Shengbai more than a century earlier.

Authenticity in Practice

Already during his lifetime Fei Boxiong was renowned for his gentle approach to treatment. As noted in 1888 in the *Supplement to the Wujin and Yanghu Gazetteer* (*Wu-Yang zhiyu* 《武陽誌餘》): "In treating [medical] disorders [Fei Boxiong] disliked the use of fierce and harsh prescriptions. He [held instead that] the right [way was for treatment] to be governed [by the principles of] harmonization and gentleness" (Jiang Yuxian 蔣毓銑 1888, 72:9b-10a). Another gazetteer observed that "his prescriptions and [choice of] drugs focused on nourishing the most subtle *qi* (*lingqi* 靈氣). He avoided the use of harsh formulas. [In so doing] he established the method of using light drugs for a heavy hit (*qingyao zhongtou* 輕藥重投)" (Zhang Yuzhi 張愚直, n.d.).

As with all gazetteer accounts, elements of truth, fiction, and exaggeration go hand in hand. In his prescriptions, Fei Boxiong certainly did prefer to use drugs that were light (*qing* 輕), balanced, and commonplace (*pingdan* 平淡). Such drugs were cheap, mild in their actions and effects on the body, and used to regulate the body's physiological balance rather than to attack manifest symptoms. He did not invent this method, however, but merely followed a style of prescribing that had become popular throughout the Jiangnan area in the Qing. Its mode of drug usage responded to—and in turn amplified—long-established local beliefs that attributed to Jiangnan southerners a more delicate constitution than to the robust northern Chinese. The increasing importance that southerners attached to these beliefs during the Qing was tied to the emergence of a distinctive Jiangnan identity that defined itself in

opposition to the Manchu north. Jiangnan people thus became increasingly suspicious of taking drugs associated with potent effects. They considered these drugs to be more appropriate for treating northern constitutions and feared that they might kill rather than cure (Hanson 1997).

This attitude put physicians in a difficult position, especially those who valued classical formulas composed of these drugs. Unless they abandoned their usage they risked losing patients. Yet, by abandoning them they surrendered some of their most valuable clinical tools. To escape this double bind physicians resorted to strategies that included psychological methods of persuasion and even outright deception. Fei Boxiong's medicine of harmonization and gentleness, too, had its roots in such considerations, as a later student of the family explains: "There were [two] famous physicians in antiquity. One was called He and the other Huan. Harmonization (*he* 和) means to avoid the use of harsh and violent drugs. Gentleness (*huan* 緩) means not eagerly rushing after immediate effects. Harmonization and gentleness are known as that [technique], whereby one can avoid patients becoming suspicious and fearful [of one's prescriptions) and instead affirm their trust in what one does" (Ding Zezhou 丁澤周 1960 [1927]).

Fei Boxiong's upper-class patients, who perceived themselves as being the most delicate of southerners, were in particular need of such strategies. Fei Boxiong described these patients as suffering from complaints that were frequently psycho-emotional in nature. Concerned about their fragile constitutions, not used to exercise, stressed by too much work and too much thinking, and unable to express their personal worries due to concerns about face and issues of propriety, many of these patients came to him for the treatment of "exhaustion and fatigue" (*xulao* 虛癆) due to "damage by the seven [emotions] (*qi shang* 七傷)." They often lived far away, staying in Menghe for a few days only, or they invited Fei Boxiong to travel to their homes in nearby cities. In spite of the chronic nature of their complaints, they were only rarely able to return for frequent follow-up consultations. Local peasants, on the other hand, had an interest in limiting the number of consultations to reduce costs.

According to a later member of the family, when Fei Boxiong treated his patients he did not merely "gauge the [condition of] their lives" by means of pulse diagnosis. He also "gauged their economic [situation]" and prescribed accordingly. Here, resorting to harmonization and gentleness proved practi-

cally useful for other reasons. The use of relatively inexpensive and mild-acting prescriptions formulated to be taken over long periods did away with the need for continual adjustments—as was the norm and necessary with harsh formulas—and thus with further consultations or expense. "His medical fees thus were charged only once and therefore could not have been any cheaper." Yet, this was only possible because harmonization and gentleness also had other connotations. Hence the family member asks: "How could the enduring power of this consistent style [of prescribing] have been achieved without [grasping] the essence of the refined?" (Xu Xiangren 徐相任 1933).

Fei Boxiong did not shy away, however, from using powerful drugs and quick-acting prescriptions when the situation demanded it. He argued that his ability of penetrating to the essence of phenomena—be they a pattern of symptoms, the function of a formula, or the action of a drug—allowed him to prescribe in a manner that was appropriate to any given situation without the risk of producing negative effects.[6] "The art of composing formulas," according to the family member quoted above, "lies in harnessing and guiding the powerful and outstanding nature of drugs in order to let them achieve effects that are beyond the ordinary. In this manner that which is not good is guided to become good and that which is not pure is guided to become pure" (Xu Xiangren 徐相任 1933).

It would be a mistake, therefore, to understand Fei Boxiong's clinical style as a simple response to local contexts of practice or as a technique employed to increase patient compliance. It was both of these but also more. As Fei Boxiong's friend, the retired scholar Zhu Yubin 祝譽彬, notes: "[Even if] poetry and medicine are not the same, their refined nature (*chun* 醇) is nevertheless the same" (Zhu quoted in Fei Boxiong 費伯雄 1863b, 1b). Zhu Yubin goes on to argue that although a good poet, like a good physician, must base himself on past models, he will never achieve excellence if he remains tied to the past. For that would be repetition and not authenticity. Instead, he must use the past to construct an accurate understanding of what the present demands and respond to this in an appropriate manner.

The efficacy of medicine and poetry alike is viewed here as being rooted in the subtleties of personal understanding rather than in the fixed nature of a disease or the rules of composition, and in a physician's ability to sense the needs of his clients or audience. The reading and memorization of classical texts and their interpretation under the guidance of an experienced teacher

provide the foundation of such efficacy. Its final realization, however, expresses an understanding achieved only by the individual mind. In fact, a medical primer from the early Qing that Fei Boxiong had annotated was titled *Awakening of the Mind in Medical Studies* (*Yixue xinwu* 《醫學心悟》), and he used this work as a study guide in the education of his own disciples. The author of the work, Cheng Guopeng 程國彭 (1662–1735), reveals yet another layer of influence on Fei Boxiong's medicine, when he clearly defines in the foreword what he meant by the term "awakening of the mind" (*xinwu* 心悟): "I admonished [my students in the following manner]. Awakening of the mind [refers] to the mechanism of reaching higher levels. Explaining through words is important for those studying at lower levels. While my students read the book, I added [verbal] commentaries drawn from my wide reading. They pondered forcefully in order to push their intellectual attainments to the most subtle realms. Then, when the mind becomes like a clear mirror, the brush can draw spring flowers [i.e., healing formulas] that rescue the people, because where no drug is prescribed falsely, [each] prescription must be effective" (1998, 5).

The awakening of the mind refers to a moment of insight when, after much study and application, even the most difficult problem becomes simple and clear. Many other physicians had advocated the necessity of such insight for the practice of medicine. One of these was Yu Chang 喻昌 (1585–1664), one of the first scholars to transfer the methods of evidential scholarship into the medical domain, and for whom Fei Boxiong held high regard. Yu Chang's medicine was equally influenced by Buddhism, however. This influence was so strong, in fact, that the editors of *Draft for a Qing History* noted, "[Yu] Chang had mastered the principles of Chan [Buddhism]. His [understanding and practice of] medicine frequently issued from profound awakening (*miao wu* 妙悟)." Yu Chang himself emphasized the importance of a divine awakening (*shen wu* 神悟) and "of a culture that does not come from writing" (*wu wen zhi wen* 無文之文) in the development of the medical tradition (Zhao Erxun 趙爾巽 1976).

The tension between self-conscious verbal knowledge and the nonverbal knowledge of spontaneous insight explicated by Yu Chang and Cheng Guopeng is a recurrent theme in Chinese intellectual history. It not only defined Chan Buddhist concerns with enlightenment but also underpinned distinctive Confucian visions of learning. Confucians understood spontaneous

judgments—like that of Confucius who at the age of seventy "followed his desires and still did not transgress"—to be the result of long years of study and self-cultivation. Fei Boxiong, too, accorded fundamental importance to knowledge "that can be apprehended but is difficult to communicate in words" (*keyi yihui, nan yu yanchuan* 可以意會, 難于言傳). He considered such understanding essential in order to penetrate beyond the descriptions of disease in the literature to their myriad manifestations in actual clinical practice. In this manner, he opened up a way for innovation that did not challenge ancient precedent yet was not bounded by it either. He explains this in the following discourse on treatment:

> While craftsmanship does not detach itself from established practice, reality never entirely conforms to such established practice. Yue Zhongwu deeply researched into battle formations. In arranging formations prior to giving battle, he would base himself on ordinary strategies. The marvelous use [of these formations], however, rested entirely on his outstanding [capacity] to adapt them according to the opportunities that presented themselves [on the day of battle]. Was that not definitely so! In using ancient formulas I, too, favor this [strategy]. In formulating individualized treatment for identical disorders [one must be aware that although] the observed symptoms and signs may differ, the ensuing disorder is nevertheless the same. Being responsive to changes in a disorder [means] that without adopting a prejudicial manner one still has a definitive view that is systematic and orderly. It is not therefore my intention to teach people to be dismissive of the old and neglect the classics. Rather, I would like people to model themselves on the intention of the ancients without being stuck in their strategies. As for using ancient formulas to treat contemporary disorders, there often are occasions in which the two are as incompatible as ice and coal. One must be especially meticulous in examining this [issue]. (1863, 15)

The Menghe Style of Medicine and the Mangle

Fei Boxiong's vision of medical practice was widely shared among Menghe physicians. It was embraced by his students and by many others throughout the Jiangnan region who felt an affinity to his style or reasoned that they could benefit from being associated with his fame. In adopting the general ideology and rules of practice of the medicine of the refined, these physicians once

again adjusted it to their own specific needs. Disseminated through essays, books, and now the Internet, Fei's ideas remain influential today. In 1985, Zou Yunxiang 鄒云翔 (1897–1988), vice president of the Nanjing College of Chinese Medicine, went so far as to define Fei's emphasis on harmonization and gentleness as embodying Chinese medicine's most fundamental characteristics: "Regulating disease depends most of all on the capacity of a patient's system for maintaining the yin/yang balance of the body. Using drugs in this way is what is referred to as a few ounces being able to shift a thousand pounds" (1997, 298).

I have described the extent of Fei Boxiong's legacy elsewhere and shown how it shaped a distinctive Menghe medical style (Scheid, 2007). Here, I want to draw attention to how this style emerged not as the product of some creative genius—though Fei Boxiong was, by all accounts, an exceptionally gifted physician—but within a process of mangling to which this genius constituted just one input. Fei Boxiong's trademark style of using mild and inexpensive drugs within complex formulas intended for long-time consumption is an obvious example of this process. Earlier I noted that this was shaped by his clients' financial constraints and their cultural anxieties and concerns about morbidity. His style was, furthermore, informed by culturally specific aesthetics of practice and a desire to ground medicine in ancient precedent. Ability to pay, embodiment of disease, perceptions of self, and medical aesthetics, in turn, were the products of wider economic, political, and cultural agencies that shaped desires, caused illness, and guided choice. The preference of Jiangnan patients for light drugs thus cannot be explained without reference to the politics of identity in late imperial China and the tensions between Han southerners and Manchu northerners. The use of light drugs also is tied to the vision of medicine as art propagated by some physicians in eighteenth-century Jiangnan. By using common drugs to achieve miraculous results these physicians created effects as awe-inspiring to their audience as the expression of complex feelings in poems composed of everyday words.

There is thus no single cause or agency that determined Fei Boxiong's style of medical practice. Each cause (or agency), furthermore, is itself revealed as the product of multiple prior causes (or agencies) that elude fixation, and each is itself reconfigured as it fixes on others. Fei Boxiong, for instance, manipulated the many associations of harmonization and moderation to create an effective medical style that also fulfilled ideological functions. However,

once he had become known as an expert in the use of this style, his own efficacy was, paradoxically, reduced. Although he treated acute illness and employed potent drugs, he became famous for treating chronic complaints. As a result he is remembered today as a physician from whom one can learn to treat complex conditions with mild prescriptions but who has little to say about acute disorders.

Fei Boxiong's definition of medicine and therapeutic principles emerged through a similar interplay of agencies. In his own writings, Fei Boxiong expresses how strongly the destruction of the Taiping rebellion affected his life. These experiences reinforced an already existing intellectual orientation inherited via Han learning that hoped to return a fractured tradition to a state of unity anchored in the past. In the competitive environment of Menghe, however, Fei Boxiong would have been foolish to ignore the numerous other medical resources available to him. Hence, he emphasized a medical style rooted in the classics but expressed in the present through its subjective interpretation and adjustment to circumstance.

Fei Boxiong's medicine of the refined thus demonstrates the workings of the mangle in practice. It is a synthesis that succeeded in momentarily stabilizing the diverse agencies at play in his life and in the medical tradition of which he was part. Most obvious, from the perspective of the mangle, is the fact that the medical tradition is experienced not as a toolbox of knowledge and techniques to be employed at will but as something difficult and resisting. Becoming a good physician is the arduous struggle of penetrating to the pure and refined, a process of learning that takes place within a more comprehensive project of self-cultivation. Its goal is to become a sincere person—one who has insight and knows the Way. Such individuals, by definition, have been transformed by their encounters with the world, and as they grasp this world they also change it. It is for this reason that physicians of the refined have the license to change tradition even as they are the perfect embodiment of its permanent power.

Chinese Medicine and the Mangle

Fei Boxiong's vision of medical practice embraces an ontology of process not dissimilar from that which informs Pickering's mangle. Like other scholar physicians in late imperial China, Fei Boxiong defined the tension between

the regular manifestations of illness described in textbooks and their constantly changing manifestations at the bedside to be the core problem of effective practice. Like them he proposed to resolve this tension by "subtle insight responsive to change" (*lingwu biantong* 靈活變通). This agency is explicitly modeled on that of the successful general who flexibly adopts the military tactics he has learned according to the circumstances he encounters on the battlefield. The French philosopher Francois Jullien (1997, 1999) has analyzed in detail the logic of efficacy that underpins this practice in Chinese culture at large, a logic that underpins human agency not only in medicine and warfare but also in poetry, painting, and statecraft. Contrary to the situation in the West, where human agency is closely tied to the function of the will that seeks to impose itself upon the world, efficacy in Chinese culture reflects a desire to grasp and exploit the natural disposition (*shi* 勢) that resides in any constellation of agencies. Reading such dispositions enables the successful general or physician to turn the dance of agency to their own advantage. A famous Chinese myth, which I relate below, demonstrates how such agency operates. This myth tells how the Great Yu tamed the floods of the Yellow River, and as such it complements Pickering's story in this volume of the human will in action in the Mississippi Delta.

The Great Yu, one of China's ancient culture heroes, is said to have lived approximately 2000 BC. At the time, the regular flooding of the Yellow River presented his people with a major threat to survival. Yu's father, Gun, had been charged with controlling these floods, but he had miserably failed in this task. Like the Army Corps of Engineers in the Mississippi Delta, Gun had constructed huge dikes and embankments. Without the technological means of his modern peers at his disposal, however, the Yellow River proved stronger than Gun. No matter how high Gun constructed his dykes, the river would eventually rise above them. His son, concerned with saving family honor as much as with conquering the floods, changed tactics. Deciding to go with the water's intrinsic disposition—which is to flow downward—he aimed at facilitating its journey from the mountains to the ocean. He dredged the river and dug canals that would divert floodwaters into the sea. Legend has it that these works took thirteen years to complete and involved the superhuman effort of cutting a pathway through Mount Longmen, which was then in the path of the Yellow River.

The myth of the Great Yu, read together with my account of Fei Boxiong's medicine and Jullien's wider exploration of Chinese notions of efficacy, allows me to tease out some of the agencies that tie the mangle to its own specific contexts of emergence even as it seeks to function as a theory of everything. I will identify two such attachments. The first is Pickering's inspiration by 1960s experimentalism and the counterculture in which this was embedded. His preference for an engagement with nature that accepts humans as participants in an open-ended dance of agency with the nonhuman world resonates with the ecological movements that grew out of the same culture. The Chinese view is altogether different. The Great Yu, just like the engineers fighting the Mississippi, perceives of nature as a danger, and the Chinese physicians, just like their biomedical counterparts, perceive of disease as an enemy and the fight against it as a battle. However, where the engineers and biomedical physicians seek to impose their will onto other agents, the Great Yu and the Chinese doctors seek to manipulate those other agencies to their own advantage. Hence, physicians in late imperial China were not at all averse to duping their patients provided it helped them in achieving their goal. Lu Yitian 陸以恬 (1993), for instance, recounts how the Jiangnan physician Ma Yuanyi 馬元億 circumvented his patients' aversion to the harsh-acting herb ephedra by soaking soybeans in an ephedra decoction and then including these soybeans (rather than the ephedra) in his prescriptions without telling them he had done so. Jullien argues that the more effective the manipulation of other agencies proceeds, the less visible it becomes. From that perspective, Ma Yuanyi's agency was highly efficient. Fei Boxiong's style of seeking to achieve maximum effects with cheap and ordinary drugs expresses the same desire. These examples show that in seeking to understand the process of practice that construct worlds the mangle has an orienting rather than an explanatory function. It directs our understanding toward the processes of emergence that Pickering calls practices, but each of these processes acquires meaning only if it is placed into the context of a wider field practice.

The second difference between the mangle and Chinese understandings of process is their focus. Whereas the former is concerned with ontology and understanding, the latter seeks to enable action. Following Jullien, this difference of focus marks the essential difference between China and the West. In the traditional Chinese view of the world there is only process. Once this is

accepted to be the case, effective action no longer depends on knowing how things are but rather on knowing in which direction they are moving. It drives a search not for essences but for relationships, dynamics, and subtle influences. In its emphasis on ontology and explanation the mangle of practice thus remains tied to a distinctive Western tradition of thought and practice. Its concern with understanding becoming would have be alien to the Great Yu or Fei Boxiong, even if they would immediately have grasped its focus on emergence. Exploring these differences and their implications opens up a vast new field of investigations for further studies of the mangle in practice.

NOTES

1. For a more detailed discussion of this current of learning, see Scheid (2004 and 2007). See also Chen Daojin 陳道瑾 1981; Fu Fang 傅芳 1985; Huang Huang 黃煌 1983, 1984; and Yang Yanjun 楊研君 1984.
2. The development of medicine from the Jin and Yuan through to the Ming and Qing is discussed in more detail in Chao 1995; Furth 1999; Hanson 1997; Leung 1987; and Wu 1998.
3. For a discussion of the development of Chinese medicine in the Suzhou region, see Chen Daojin 陳道瑾 2000; Chao 1995; and Hanson 1997.
4. The original meaning of *chun* is that of a thick or rich wine (*hou jiu* 厚酒), which is produced through maceration. From that was derived its extended sense of something pure, simple, and unadulterated (*jingchun bu za* 精純不雜).
5. The original text reads: "*zai yili zhi de dang, er bu zai yaowei zhi de xin qi* 在醫里之的當, 而不在藥味之的新奇." I follow Zhang Xinghua 張腥華 (2000, 500) and read 醫 instead of 億.
6. This can be deduced from a survey of his case records (Fei Boxiong 費伯雄 1984).

Nature comes from fw *nature*, of and *natura*, L, from a root in the past participle of *nasci*, L—to be born (from which also derive *nation*, *native*, *innate*, etc.). Its earliest sense, as in oF and L, was (i), the essential character and quality of something. Nature is thus one of several important words, including *culture*, which began as descriptions of a quality or process, immediately defined by a specific reference, but later became independent nouns.—RAYMOND WILLIAMS, *Keywords: A Vocabulary of Culture and Society*

Mårup Church and the Politics of Hybridization

On Choice and Becoming

CASPER BRUUN JENSEN and RANDI MARKUSSEN

Mårup Church in Lønstrup, on the windswept northwest coast of Jutland in Denmark, is facing a predicament. Every year the sea eats farther into the dune on top of which the church is situated. A century ago the pace of this movement was two meters per year at most, but since the 1980s it accelerated to around four meters per year. By the late 1990s it seemed that it would be only a few years before Mårup Church would no longer exist and that the dead buried in its graveyard would tumble into the sea. At the end of the millennium, however, the situation took a surprising turn when an innovative system for coastal protection was implemented at the beach in front of the church.

The predicament of Mårup Church generated a heated debate. Should the coastal area around the church be protected or not? Should the church be saved or not? In this chapter we address the ways and means of disagreeing

on this issue through an analysis of the debates and the types of images that are exercised as people discuss the topic. We argue that different positions on the controversy are part of incompatible ontological constellations, which they also help to transform.

Here are some sample comments taken from the Danish press:

> Coast protection completely destroys the cliffs. Take a look at what is happening around Lønstrup, where the clay cliffs are grown over and have become green. The drama disappears, says Birthe Kristensen, who grew up in the area.
>
> Kirsten Segelcke Hesselgren, . . . [whose] great-great-grandfather traded by ship out of Lønstrup and owned most of the town, finds the argument for Nature's free play peculiar: We regulate Nature in all other areas. Why are we not allowed to keep a unique cultural landscape such as the one we are discussing? No tourist will want to visit an empty cliff after the church has fallen into the sea.
>
> It seems incomprehensible that we take it so lightly that the church . . . is disappearing. Might we have developed an inclination to just let things vanish? Have we been influenced by the world of finance, where billion-sized losses disappear into thin air these years, "evaporate," as it is called in good "banking-Danish."[1]

Several entities are invoked and evaluated in these short excerpts: the coast (protected or not), the cliffs (dramatic or not), nature (free or controlled), culture (threatened or protected), and even modern Danish society as such (determined economically, and indifferent to places that should be valued). Exploring the debate a bit further, we will also encounter entities as diverse as tourism and religion. Common to them all, however, is their seeming ability to be, in Bruno Latour's term, Janus-faced—that is, to take on opposing appearances, depending on who is invoking them.[2]

As indicated by the quotes above the debate is *markedly hybrid*. We find it illuminating that arguments, whatever their starting premises, consistently span modern categories such as nature, culture, politics, economics, history, geography, and geology, and that they are transformed in the process.[3] In thinking of Latour, we expect that this proliferation of categories from which argumentative resources are brought forth and mixed testifies to the high level of controversy of the case.

In this chapter we explore how the involved actors deal with these controversies. How do they articulate the complexity of the processes of change in nature and culture in the context of Mårup Church? We do not understand articulation as relating solely to discourse, or see it as the prerogative of human actors. Rather than viewing these arguments as *representations* of, say, differing political ideologies, we view them as part of ontological *performances* played out in an environment quite different from that of a purely human stage, and likewise generating a different order of transformational effects (see, e.g., Cussins 1996).

We want to observe how particular agents lean on and use specific versions of reality and thereby participate in *ontological dramas*, which would allow the church to stand or fall. To illustrate this situation we first point to how stories of origin act in different constructions. Following Geoffrey Bowker, we refer to these as configurations of time and space: "Emerging here is [the] insight that—since we live in a world where the human/nonhuman (nature/society) boundary is increasingly less well-defined, then we need analytical categories that allow us to account for the unified representational time and space applied to both bureaucratic and scientific work" (1994, 15–16). In a state of hybridity, concepts and practices of a scientific, bureaucratic, and popular nature spill over into each other, mix, and then transform. For this reason, we see the debates on the possible futures of Mårup Church as a site especially well suited for exploring ontological politics, or the politics of hybridization.

It is noteworthy that a discourse of nature management has gained momentum within administrative agencies in Denmark and in many other countries as well.[4] This discourse defines change in relationships between nature and culture as one of choice, which thereby becomes an important resource in allowing people to politicize questions pertaining to such relationships. In our case, this is exemplified by a group of people called the Friends of Mårup Church, who stirred up a controversy over the future of the church in the 1990s. But while the idiom of choice is prevalent, it turns out to be of limited help in coming to terms with the political controversies engendered by ontological transformation, as displayed in the case. Within a horizon of "choices" every possibility comes to seem "on a par," thus removing all prioritized resources, natural or cultural, that might traditionally have been engaged in order to find a solution to the controversy.

Our analysis points to the diverse ontological configurations on top of which choices are constructed and through which they come to seem obvious as freely made decisions. Viewing the case as an ontological drama thus highlights choice as a particularly *decontextualized* political frame of understanding, notably one relying exclusively on human capacities, as separated from environmental and other material powers.

In the following pages we describe the ontological configuring of Mårup Church and the controversies surrounding it. First, we explore the organization of the Friends of Mårup Church and their arguments with Danish government agencies, after which we look at media coverage and the popular constructions of the stakes of the debate. Next, we look at the information politics of the Danish Forest and Nature Agency as it redefines the stakes by imposing a specific configuration of time, space, nature, and culture in Mårup. Finally, we focus on the surprises of material agency in the form of pressure-equalizing pipes.

The manifest hybridity of available choices as formulated by the actors in the Mårup Church case, along with the transformational possibilities implicit or explicit in their suggestions, undermines the ability of independent choices to do their work effectively. For this reason, we see the Mårup case as a good experimental site for considering which meaning might be given to the suggestion, developed elsewhere in this book (see Pickering and also Asplen), that as posthumanists we ought to learn how to embrace becoming.

Political Controversies

On July 14, 1993, the Friends of Mårup Church was formed with the following goals: "To support the work of securing Mårup Church for posterity at the place in which the church was built in the thirteenth century; to support the endeavor to keep the environment intact; and to spread the knowledge of the cultural and historical values attached to the place."[5] Should the group disband, its accumulated means would go to "the care of nature and culture in Lønstrup." Only a few years ago, the demise of Mårup Church seemed a real possibility in light of the speed with which the sea was approaching the church and of the political willingness to let "nature take her course." The Web site of the Friends of Mårup Church documents the importance of its tasks, with special focus on the church as an entity that encompasses nature,

culture, and history. It notes that no secular buildings are as old as the Roman churches, which, furthermore, reflect the Danish transition from Catholicism to Protestantism. The interior of the church is decorated with art dating back to the twelfth century. The church itself is part of the Danish architectural heritage and is considered to be "a natural and inalienable element in the Danish cultural landscape." Along with this material emphasis is a spiritual dimension, notably expressed by a visit to the graveyard: "We all know the peculiar sensation of being immersed in the past while going for a walk in a graveyard. Here one meets one's own kin, the more or less conspicuous persons of the parish, people one has heard about, and the engravings of the gravestones often inspire to reflection."

The Friends of Mårup Church met with remarkable success on the level of public support. Since 1995, forty thousand signatures supporting the preservation of the church have been collected, and in 1998 the group had approximately six hundred dues-paying members. One common sentiment is that it would be "indecent" to let the church fall. As Tove Marquardsen, chairman of the group, stated: "In ten years we cannot with decency stand here on a flat field with an ice cream shop and a sign saying that once there was a church, a graveyard and a wonderful landscape."[6]

The group's appeal to moral responsibility and its reverent attitude toward the church emphasizes, as does its very name, that it represents a human-centered position. As the Friends of Mårup Church perceive it, the effort to protect the coast embraces both the conservation of the church and the preservation of the natural landscape above the cliff. As noted at the Web site of the group: "Few people experience nature's decomposition of the cliff from the beach, which the Forest and Nature Agency finds so important. Why not take into consideration the two to three million people who enjoy the scenery from the land side?" In this discourse the church and the graveyard can be seen to embody original culture, authenticity, and conservation of nature. Here the idea of letting nature take its course is not regarded as an inevitable condition, a fact of life or fate, but rather as a human choice. The policy of nature played out in the controversy not only involves the idea of the protection of nature but also engages in an increasingly multilayered language of nature development and management (Hajer 1999). The idea of choice is in alignment with the systematic effort in nature supervision that started in 1989 in Denmark, when the Law on Nature Management was passed. The report

"Ten Years of Nature Management, 1989–98" states that choice is the main objective in the approach:

> In nature management, society makes choices about the nature we want, and we arrange nature according to our wishes. When various wishes exist, they often reflect different primary interests, which nature management must try to reconcile. . . . The Danish landscape is culturally formed, and nature's own processes shape only few landscapes, such as Råbjerg Mile. Within the mosaic of Danish landscape, the Nature Management Division [of the Ministry of Environment and Energy] works toward a diversified use of the area, allowing for more space for nature and its processes, because it can deliver "free services" in demand in modern society. Also, culturally created types of nature need care and cultivation. . . . It is primarily man's interests in nature that counts, but no objective standard of evaluation exists to form the basis for choice among various qualities (Brix 1999, 11).[7]

The discourse suggests that nature is no longer to be viewed as the basis for the meaning of cultural practices but rather itself needs protection and development. Man is in a position to control nature and has long made his mark on landscapes. Danish nature is described as almost entirely "second nature," to use the phrase with which William Cronon (1991) designated the cultural impact on the shaping of landscapes and the naturalization of such "artificial" developments. In some places, however, such as Lønstrup, although the coast still counts as first nature it is only to be reinscribed as a component in line with the culturally shaped natures within this economic and utilitarian discourse. Choice presupposes the human subject at the center of a world in which both nature and culture are increasingly reconfigured as environment. A few years ago, legislation was extended to cover both the natural environment and a so-called cultural environment: "The cultural environment includes all fixed elements and unified wholes that people create and the traces they leave. The connection between culturally shaped elements in the landscape and the local natural conditions is of utmost importance. Both the elements of the cultural landscape, such as in field structures, relics of the past, and moors, as well as elements of nature such as soil and subsoil water conditions are important in order to understand the cultural environment" (Brix 1999, 113).

The managerial discourse finds no hierarchical relationship between natural or cultural assets but instead sees choice, in a phrase suggested by Strathern

(1992), as a matter of style and consumption of both. This discourse indicates that a politically managed natural and cultural environment implies conflicts of interests, and plural perspectives on both nature and culture, and choice is highlighted as a central value. This makes the question put by the friends of Mårup Church a pertinent one: Why not choose to secure the church?

The discourse is not only a Danish phenomenon. It bears witness to international efforts to put environmental matters on the political agenda. The Rio declaration, which was adopted at the United Nations Conference on Environment and Development in Brazil in 1992, even links the idea of sustainable development with democratic processes and public participation. The conference passed an action program for the twenty-first century, named Agenda 21. The idea of Agenda 21 encourages people to take responsibility for global problems by getting involved in their local affairs. The declaration promotes principles such as transparency, dialogue, and co-operation across traditional disciplines and sectors in order to invent new approaches and to integrate local environmental initiatives into public planning and management. [8]

Thus the Friends of Mårup Church figure as a local Agenda 21 initiative in the attempts by its members to make the public aware of the controversies surrounding the church. Appeals have been made to both local and national authorities through a flurry of letters sent to representatives of the municipal council, parliament, and the Danish Forest and Nature Agency. In addition, group members have distributed numerous press releases and made other publicity efforts. In what follows we look at how the official authorities responded to their strategy.

In 1997, the Friends of Mårup Church met with their local members of parliament, who agreed to raise their issue by asking the minister to consider alternative models of coast protection and to reconsider whether a specific preservation plan for Rubjerg Knude and Lønstrup cliff existed that would make it impossible to keep Mårup Church at its present position. In his response, the minister referred to the arguments put forward in the Preservation Act of 1948:

> Because of the beauty of the landscape and its magnificent and characteristic nature, it should be preserved for posterity in its present state. The area, which for the most part is found in a natural state without disfiguring buildings, is in the opinion of the agency the most magnificent on the West Coast. Its singularity is

> enhanced by the fact that the white sand of the dune, which cannot be tamed because of frequent landslides, can be seen to shine in characteristic formations far into the countryside. Since it would be of extraordinary value to secure this area in its present state, the agency holds the opinion that there should be quite broad considerations as to the extent of the preservation. Here, Nature is so great that nothing positive can be gained by piecemeal preservation.[9]

The Preservation Act of 1948, and later supplements from 1965, speak only of preserving the landscape and the coast in its existing state without considering how to deal with the dynamic aspects of the site. The minister went to great lengths to argue that the original aim should be understood as preserving primeval natural surroundings and processes and a configuration of time and space that accepts the decomposition of the cliff and the disappearance of part of the landscape. Thus, coast protection goes against the spirit of the law and, in consequence, the church will also disappear. The Friends of Mårup Church argued, however, that the original aim of the preservation must have been to *keep* the countryside and make it available for the public. Consequently, the idea must be to protect the church and its surroundings.

According to the minister and the Forest and Nature Agency, this choice was an impossible one because it displayed a configuration of time and space that did not reflect the transformative effects of coast protection: "The dynamic character of the cliff will be changed into a static grass-grown slope, leaving Mårup Church with its surroundings as an advanced point and an unnatural element in the landscape, which the preservation intends to be kept without interference. Furthermore, the coast inspectorate estimates that such coast protection will probably only last for seven to fifteen years before it needs further steps, and we must also stress that there may be unintended side effects on neighboring coasts."[10] Even though the discourse of nature management and natural and cultural environments stressed human choice and the control of nature, a closer look at a specific case such as this shows that it is seldom without cost.

According to Andrew Pickering (1995), one can argue that material agency participates in transforming not only the natural and cultural environment but also human agency and choice. However, the minister and the Forest and Nature Agency did not draw this conclusion. They suggested that the idea of a "first" or "natural" nature should be an objective value in this case, thus

making the decision not to intervene a legitimate political choice. The ministry concluded by translating "natural nature" into geological values: "A continued natural decomposition of the cliff is the development that should be given national priority, based on an overall weighing of cultural, historical, landscape and geological values."[11]

The controversy demonstrates how the discourse on nature management and natural and cultural environment makes room for discussions on what counts as nature and culture. It invites co-operation across traditional disciplines and sectors and encourages the development of multiple perspectives to be taken into account in a democratic political process. Even though the minister's answer might be said to (re)invent a first nature as a basis for the meaning of cultural practices, we can see that within this discourse the Friends of Mårup Church became capable of insisting not only that their choice was just as natural given that coast protection was a possibility but also even something to experiment with in order to invent futures other than the one the minister anticipated. Thus, the controversy aptly demonstrates what Marilyn Strathern (1992, 176) has called a flattening between the terms culture and nature. Nature increasingly becomes a question of cultural style at the same time that culture becomes a question of the exercise of natural choice. It is not only at this political level that the controversies over Mårup Church take place, however. We now turn to how the press and public saw the case in the 1990s.

The Shipwreck of the *Crescent*

Our first example of Mårup Church in the press is from *Jyllands Posten*, the largest daily paper in Denmark. We follow the narrative threads as they unwind in the feature article published on October 4, 1997, "Why Mårup Church Is Unique."[12] The article is split into four main parts that are spread over six columns. The first section presents the visual qualities of the church and asks whether it should be allowed to tumble into the sea. Poul Henrik Harritz, president of the Danish Society for the Conservation of Nature, is cited as suggesting that the church should indeed be allowed to fall. His main reason for this stance is that the expenses of protecting the coastal area around the church would be unwarranted, since "it has not yet been argued why Mårup Church is unique in a national context." The rest of the article aims at providing this argument.

The second section of the article presents the historical aspects of the issue. During the Napoleonic wars, England destroyed the Danish fleet and attempted to cut in half the "twin kingdom" (Denmark and Norway). It was as part of this mission that the English vessel the *Crescent* was caught in a violent storm off the coast of Lønstrup on the morning of December 5, 1808. As the ship sank 238 English sailors died and only about 60 survived in part because there were too few lifeboats. The deceased were buried in the graveyard of Mårup Church. The tragedy of the shipwreck is narrated in gruesome detail: "This was the most terrible: People in the boats had to cut off the fingers and hands of their wretched shipmates, to prevent the boat from being dragged down." The only redeeming feature of the story was the hospitality of the local population; the few survivors were brought to nearby farms and houses, and "peasants and their wives came driving from inland farms with warm clothes and food."

In the third part of the article the aftermath of the tragedy is summed up, with special focus on the behavior of the local populace. The Scottish priest James McDonald is cited as stating that "it is to the credit of the population that not a single hateful utterance was heard, even though people are very incensed toward us after the bombardment of Copenhagen and the loss of the fleet." In yet another example, "a man who stole the gold watch of the captain, as it washed ashore, was exiled from the area."

The concluding section of the article returns to the present. At the time of writing there were but twenty meters of land between the church and the coast: after a few more autumn storms the church would be gone and the dead from the *Crescent* would once again be swallowed up by the sea. In arguing against allowing this to happen specific elements belonging to various categories are woven together. It is here especially notable that history is used as a prioritized resource for explaining the uniqueness of the church. Going back in history, we find poor peasants at war—not only with Englishmen but also with a raging, uncontrollable nature. In this war humans must stand together. In a sense, by helping the surviving sailors, the peasants manifest their own humanity *against* nature. This is also recognized by the statement made in the article that there are many Englishmen among the two hundred thousand tourists visiting Mårup every year—many of whom express their gratitude in guestbooks.

Gratitude seems to be temporally and historically transferable through the local culture. The honor of the populace of almost two hundred years ago is

still inscribed on the present inhabitants of Lønstrup. The narrative logic of the article posits the sinking of the *Crescent* as an origin and proposes that a shared humanity links the past to the present. A particularly large symbolic investment is placed on the centrality of the church as a sort of obligatory passage point (Latour 1987, 150), through which history and historical values are able to persist in time. Letting the church disappear is thus analogized to forgetting humanness.

Our purpose is not to dismantle this narrative but rather to add more material to it. While this gives us no purchase on the actual decisionmaking concerning the future of the church, it helps to make explicit the lack of "natural" grounds for presenting such an argument. Since no argument seems authoritative, there is a continued need for discussants to introduce increasingly diverse argumentative resources, and our contextualization aims at displaying this effort. In order to do so, we turn now to a number of other ways of framing the key issues of the article related above.

Bravery or Misery?

In "Why Mårup Church Is Unique" the local inhabitants participated in a dangerous drama with nature in order to save the lives of the English seafarers. Although the country was at war with the English, common humanity brought the two peoples together against this stronger and more uncontrollable foe. In the lengthy middle section of the article, this notion is posited as the "fourth dimension" constructing Mårup Church as a unique site worth preserving.

In another article, "The Glorious Victory of 'The Crescent' Stored in a Museum Basement," published by the Danish Fishermen's Association, the story of the events at Lønstrup is very different.[13] Although the account of the shipwreck is similar to that given in "Why Mårup Church Is Unique," the activities of the inhabitants of Lønstrup are shown in another light: "Naturally, in the days after the shipwreck, the poor coast-dwellers were most interested in the riches this ship, and the misfortune of these people, had brought." In this story not a word is uttered about the bravery of the people of Lønstrup, but quite a lot is stated about looting and pillaging: "After need had forced the people of the coast to seize what drifted ashore from the shipwreck, during the first years of the nineteenth century others followed, attempting to secure

gain by turning over the wreckage, and today not much is left of 'The Crescent.' " Here the inhabitants are not characterized as brave and self-sacrificing but rather miserable and needy. This is not a story that could be easily used to make a strong case for the necessity of protecting the church.

The Anchor and the Bones

We do not know whether the actions of Lønstrup's inhabitants correspond more closely to the first story or the second one. In any case, even without local tales of heroicism the stories working to protect the church can succeed because they can turn to narratives about the dead. It is commonly and legally accepted that graveyards should be protected out of respect for the dead. Although "The Glorious Victory of 'the Crescent' Stored in a Museum Basement" was not an article devoted to coast protection, the dead were capable of exercising the imagination of its author, who thereby might be said to implicitly have supported this cause. The article writes, for example, of a "Tim Thornborough who, incidentally, was rather appalled by the thought of what is happening to the grave of his compatriots in Mårup, where the sea is approaching."

Thornborough is far from being the only person appalled by this scenario. In fact, stories were often vividly told of what might happen when the sea reaches the graveyards. For example, two teenagers from Halvorsminde Youth School asked the following question as part of their project on Mårup Church: "Not only the church, but also the graveyard will tumble down, and can you really ask the inhabitants of Lønstrup to walk on a beach and find the remains of their ancestors?" [14] The national press offered similar comments: "Soon, the drama will heighten considerably, when the sea and the erosion reach the graveyard, and remains of coffins and bones start to appear and fall down, ending up spread about on the beach."[15] The Friends of Mårup Church have also been explicit about this problem; their comments mix the legal issues of desecration with more emotionally charged expressions: "Desecration of graves will take place, because with the church goes the churchyard. Relatives will have to go down to the beach to pick up [the remains of] their parents, grandparents and great-grandparents."

The situation is further complicated by the circumstances of the *Crescent*. It is clear that the church is in an especially central position because so many sail-

ors are buried there. This is noted in common lore, but it is also officially acknowledged through the anchor of the *Crescent*, which is placed by the church, and by a plaque, erected in 1895 by the British Admiralty, which serves as a memorial for the sunken ships the *Crescent*, the *St. George*, and the *Defence*. The possibility that the church will be swallowed by the sea offers a vivid reminder of human vulnerability in relation to nature, and it articulates these memorial objects as *memento mori*, or reminders of (our) deaths. Thus, the church figures as a return of the insight that humanity is perishable, which has otherwise been increasingly repressed by the modern technological capacity for concealing processes of deterioration.[16] Through these various effects, the church and the anchor are reinforced as obligatory passage points for considerations of natural and cultural relationships in the Lønstrup area. They also make visible a remarkably limited imagination, which figures human-nature relationships only in terms of control versus submission.

Tourism

Earlier we looked at some of the ways in which decisions are made regarding what is deemed important in the nature and culture of Lønstrup. We encountered narratives supported by entities as diverse as history, law, religion, nature, and culture (with each taking specific forms as they were presented). Here we will add tourism to the picture. Like the other entities, it does not come alone but in a complex package. Tourism can be used to support the cause of coast protection only if it is configured in certain ways—for instance, by linking it with narratives of historical authenticity and heroics, as we described above.

In one of the quotes given at the opening of this chapter, Hugo Gården suggests that modern Danes may have developed a tendency to let things "evaporate"; including Mårup Church. Later in his article he argues that local inhabitants are trying to develop Lønstrup as a "cultural place" with selective, quiet tourism. He notes, critically, that administrative politics is centred in Copenhagen, where there is little concern about western Jutland. Nevertheless, he is interested in reaching these administrators and in arguing the point with them. To do so, it is not enough to invoke Mårup Church or the anchor of the *Crescent*, although these are important elements supporting the "cultural-place' argument. In his view what is needed should be seen in

terms of economics: "In a larger context it (protection of the church) is even economically feasible, if one considers coast-protection as a commercial investment. Tourist turnover in Hjørring municipality is roughly half a billion [Danish] crowns, making a net profit of a respectable number of millions."

The economics argument is used as a last resource to draw attention to Lønstrup, and it is quickly abandoned after its presentation. It stands in an odd textual tension with the priority given to Lønstrup as a locality with only selective tourism. Nevertheless it is recognized as a possible key element in reaching the Copenhagen administrators. But if cultural history is central in this narrative, and not merely derivative of economical interest, tourism should be carefully circumscribed. Not all tourism meshes well with the argument for church protection. As Gården notes: "This is why there are no discos or noisy motorbikes as in Løkken and Blokhus. There are no concrete-block hotels with three hundred or four hundred rooms. There are no water parks. On the other hand, there are several artisans with their shops and cultural activities."

Yet, some kinds of tourism fit perfectly with the agenda of protecting the church: "Until now the Friends of the Church ensure that it is open every weekend in the winter months, and every day during summer, when tourists flock to the place. Midnight concerts, services, and other cultural arrangements are held during the season."[17] It would seem that the narrative of Lønstrup as dwelling place for the local population is, indeed, more or less uncontested. Tourists will be able to visit in order to experience authentic local culture, primarily mediated by the church. It is possible, however, to recontextualize and complicate the narrative. The author of an article published in 1990, "The Grill-Towns: Scattered Notes from a Journey along the West Coast," has little to say about Mårup. What he does say is this: "The anchor of the English frigate the *Crescent* is rusting. . . . Dead flies from last year lie on the benches of the church. The frames of the altarpiece stand empty against the wall of the Roman choir. The pulpit is rotting. The rest is emptiness."[18] From at least one outsider's point of view, then, Mårup Church was not very impressive in 1990. It did not seem as if many people cared for Lønstrup as a cultural place, with the church as centerpiece. But if this description fitted Mårup church prior to the formation in 1993 of the Friends of Mårup Church, it certainly no longer does. Although our point is not to dismantle any particular construction of priorities, the "The Grill-Towns" functions as a contextualizing device. In particular, it helps us suggest that authenticity is

not simply found in cultural history but is actively invoked and constructed. We argue that this construction takes the shape of an attempt at *configuring time and space* and of stabilizing these as part of specific ontological constellations, which include or exclude the church. The authenticity of the church and the issues regarding the *Crescent*—and, through temporal transferral, the struggle of the local inhabitants of Mårup—are animated through the engagement of organizations such as the Friends of Mårup Church. The group's successful configuration of natural and cultural times and spaces has had an impact on which stories it is ontologically and morally feasible to tell about Mårup today. This aligns our argument with Sharon Traweek's suggestion that "ideas about time and space structure social relations, and the spatial and temporal patterns of human activity correspond to people's concept of time and space" (1998, 157).

The Information Politics of the Danish Forest and Nature Agency

Debates in parliament and articles in the media are not the only source of information about what counts as important in nature and culture at Lønstrup. People who visit Mårup Church are likely to find, in a box close to the entrance to the church, a brochure about the place published by the local branch of the Danish Forest and Nature Agency in 1998.

The agency administers the Protection of Nature Act, the aim of which is to "safeguard and restore nature, landscape, and environment in Denmark in respect of human conditions of life and the protection of flora and fauna."[19] The agency also administers the Preservation of Buildings Act, which is intended to protect buildings of architectural and historical value. Since 1988 the agency has been in charge of keeping up Mårup Church and its graveyard, a responsibility formerly that of the Danish National Museum.[20]

The front of the Forest and Nature Agency's 1998 brochure depicts the church's lovely wooden altarpiece with two women, one with a boy child on her lap, the other with a book, sitting on a row of seats. Inside the folder, one learns that this altar, a piece that belongs to Mårup Church, is a late gothic woodcarving representing the Virgin Mary with Jesus as a child and with her mother Anna. One also learns, however, that the piece cannot be found in the church because it was moved to Lønstrup Church "a long time ago" together

with the rest of "the most precious parts of the furnishings." This message stresses that what counts as Mårup Church has long been distributed, not only in time but also in space. There is no simple way of encountering Mårup Church, even when one is standing right in front of the building. This is what the Forest and Nature Agency testifies with its signature at the bottom of the page. The object it has chosen to illustrate the identity of the church is no longer at the location identified as Mårup Church.

If we are to understand this message in the light of the controversy about the church, we can suggest that the brochure expresses a strategy that naturalizes the situation in a paradoxical sense. On the one hand, it proposes that there is nothing new in confronting a situation of even radical change. What is extracted from the history of the church is precisely that change is what its history is about. On the other hand, change is not so much seen as opposed to "how things used to be"—that is, tradition—as tradition is seen as made up of changes. But if change is an integral part of tradition, then it can easily be understood as something that happens within a natural order of things, in culture as well as in nature.

The forces of nature are precisely the topic of the main part of the brochure. The right column shows a fascinating map of the space around Mårup Church. The upper part depicts a bird's-eye view of the landscape, with the church and the churchyard. The statement "You are here" is marked just inside the entrance to the churchyard, thus situating the reader in time and space. The church is shown as casting a shadow on the northern side, as if the sun were (eternally) shining from the south. The lower part of the map depicts in a more abstract manner how the coastline has gradually moved between 1970 to 1997, the year in which it is shown touching the northwestern part of the graveyard. This adds a historical dimension to the picture and dramatically but obscurely demonstrates what the subtext makes explicit: the erosion is accelerating.

At the top of the left column the Forest and Nature Agency further explains how natural forces are threatening the place: "Since the church cannot be preserved physically, we must preserve its memory by securing as much information as possible about its history. The agency has therefore worked out a plan for a safe, controlled demolition of Mårup Church." The brochure itself works as part of this plan by announcing that in 1998 several events will take place, including the removal of the remaining furniture from the church

and the initiation of several archaeological investigations, both of which are described in detail on the next page of the brochure.

This narrative proposes that it is not possible to describe the church within a framework presupposing a unity of time, place, and action, nor has it been for a long time. Thus we learn that the history of the church goes back to the twelfth century, and we are told about its style and the radical changes of the buildings that have taken place over the years. We also learn that local people as early as the 1920s prepared to take down the church because they were building a new one. The agency quotes a document laid with the cornerstone of the new church in the year 1926: "Through the ages the sea has taken the part of Mårup parish outside the church, and in addition made the nearest area about it barren. It is by now solitary and remote in relation to the present houses. And as the church is also small and dilapidated, the idea of building a church in Lønstrup has naturally grown in the community."

We learn that originally the National Museum wanted to preserve the church, against the wishes of local inhabitants. The narrative argues that not only has the church not been in regular use for a long time, but also that it was a state agency and not the local community that took an interest in its preservation. Consequently, it is due to the National Museum that Mårup Church and the graveyard still exists. In this story it is hardly the church seen as a "natural" and "inevitable" entity that acts as an obligatory passage point. Obligatory, rather, are the scientific, bureaucratic, and national agencies that have demonstrated the wisdom of keeping the church until now. The irony is that without this effort, the proponents of further coast protection to preserve the church today would not even have a church to argue about.

The headline "Nature" is placed right in the middle of the brochure, and in this section the Forest and Nature Agency explains the geology of the place and argues why it is the coast that needs to be preserved: "The stretch of coast in question represents the best illustration of what geologists call 'glacial tectonically displaced parts of the underground' in Europe, and probably in the whole world. The whole stretch of coast was therefore preserved in 1946, with the purpose of conserving this unique landscape. One of the expressed purposes of the preservation is to ensure that the natural processes in connection with coast decomposition and sand dune formation can continue unhindered. This implies that coast protection affecting the preserved stretch of coast would be in conflict with the preservation order." Just as in the case

of the history of the church, we are confronted with an origin story where present decisions are legitimized by stressing that the position is in agreement with the earlier generations' views on the matter.

Finally, at the back of the brochure, the agency states its plans regarding the graveyard and the monuments. They argue that they consider it unethical to carry out archaeological investigations in the graveyard, a statement that adds an ethical dimension to the other arguments: "Nature will take its course, so that over the years the graveyard will disappear because of the natural decomposition of the coast." Here the reader is offered a practical solution to the situation that others have considered scandalous: the bones from the graves, soon to be found on the beach. The reader is assured, however, that the agency plans to rebury the bones in a special grave in the Lønstrup graveyard. The text even makes explicit, in the only italic type used in the brochure, that the "*unlawful gathering of bones is a desecration of a grave and is a criminal offence.*" As for the monuments from the *Crescent*, they will be kept in place but gradually moved as the coast disappears.

Soon after the brochure was published the Friends of Mårup Church responded to these aggressive moves, as they perceived them: "Why empty the church years before it is threatened by the sea? Why close the church in the tourist season, if only for a short period of time?" Members of the group protested in a press release and, once again, contacted their local members of parliament. In November 1999, the friends delivered forty thousand signatures of protest to the local Division of Nature Management, at the same time that a local firm, Skagen Innovation Center, delivered a request to the authorities for a permit allowing them to experiment with alternative methods of coast protection in the area. In response the division granted an exemption for a period up to April 1, 2000.[21]

The Surprise of Material Agency: The Politics of Drainage Pipes

Skagen Innovation Center added another ingredient to the Mårup controversy —one that would determine the future of the church at least temporarily. The intervention by this company took the form of drainage pipes. These pipes, made of plastic or metal, measure a few meters in length and have a diameter of roughly three inches. They are open at the top, with the purpose of creat-

ing a pressure-equalizing effect by connecting air with the beach water. According to the innovators the effects of this are beneficial: "The concept consists in specially developed drainage pipes, established vertically in the beach profile, often in combination with so-called fascines, consisting of pine trees and branches, which . . . hold the sand. A development of the beach profile is achieved hereby, based on pressure equalizing. . . . Sand is deposited on the beach, instead of the waves eroding the profile. Within a short time-span a balanced profile is built up, which reduces the risk of deteriorating the cliffs and the land behind."[22]

Although members of the Forest and Nature Agency and a number of outside scientists have been skeptical about the efficacy of this solution, because of political pressure, and the feeling that "it couldn't hurt to try," the experiment commenced. The initial results of the effort appeared to be successful and deterioration was halted in 2000. In January 2001 another three-year permit for testing the method was granted. In July 2003 the minister of the environment from the new Danish government visited the area on the invitation of the Friends of Mårup Church. Impressed by the results of the project, he promised that the church would regain a number of its deported items.[23] In spring 2004 yet another temporary extension of the test phase for the pipes was granted. As of the writing of this chapter the church still stands.

It might be tempting at this point to reach the reassuring conclusion that science, as usual, trumps politics and human affairs. But the activities of the drainage pipes, in spite of their seemingly simple operational principle, confound scientific expectations because their effect seems to have no physical basis. Under the headline "Trouble with Magical Pipes," one concerned scientist writes to warn coastal authorities everywhere: "Jakobsen's idea is that the pipes will make the water table drop and therefore enhance infiltration and sediment deposition. The problem with this is that there is no reason these pipes should make the water table drop. Jakobsen seems to think that the beach groundwater hangs on a vacuum like the water in [an] inverted bowl . . . If that were the case, his pipes would have the same effect as opening the valve. The beach water table is, however, not under a vacuum and there is no reason that the pipes should affect the water table. Certainly not on the scale of tens of meters, which is the usual recommended distance of installation."[24]

Among Danish experts, the response has been pragmatic. Professor Hans Burchardt from the University of Aalborg carried out a controlled test with

similar pipes in northern Jutland and concluded that the beach "grew" on the stretches where pipes were used. While Burchardt has no physical explanation for the success of the pipes, he does not think that this is problematic since the pipes are "very cheap and do no harm."[25] Although this argument is a recurring one, it is also in notable tension with the earlier statement made by the Forest and Nature Agency that argues against coastal protection because "the dynamic character of the cliff will be changed into a static grass-grown slope, leaving Mårup Church with its surroundings as an advanced point and an unnatural element in the landscape, which the preservation intends to be kept without interference."

In the hands of later users, however, the focus on emergent consequences for the dynamics and aesthetics of the landscape has been replaced with an economic argument exclusively emphasizing cost efficiency. This forgetfulness with regard to the original argument in terms of environmental transformation is the more surprising because the Forest and Nature Agency, while not denying that cliff deterioration has (temporarily) stopped, is still arguing against the use of the pipes: "The situation has changed drastically since the late 1990s, where four meters of cliff disappeared each year. With that speed it was estimated that the church would fall down quickly, but since then not much has happened. There are some who believe that coastal protection by means of pressure-equalizing pipes in the water in front of the church has curbed the deterioration of the cliff, but no one knows for sure. On the other hand it is a fact that the winters of recent years have been mild to the landscape of the west coast."[26]

While the church thus remains, this situation can be ascribed not to experimental pipes but instead to natural events (or lack of them) such as few severe storms and little rain over recent seasons. According to this logic, the Forest and Nature Agency can safely prolong the testing period, since they are convinced that normal weather conditions will inevitably return sooner or later, at which point both pipes and church will be defeated and their point of view rectified.

Merography in Mårup

In our exploration of the ontological drama playing out around Mårup Church we have seen how the organization supporting the church has articulated a

strong public argument within a cultural idiom. The church should be preserved in an authentic state because it is the primary historical site of the area and works as a mediator between past and present. In this construction, culture *should* remain stable and vigorous, but it is only able to do so through the materiality of the protected church, supported by drainage pipes. The authenticity of Mårup as a cultural environment of the present is imagined as conditioned on the existence of the church and the preserved landscape. Becoming, in the shape of uncontrolled nature, should be tamed.

In the construction proposed by the Danish Forest and Nature Agency, priorities are reversed. Nature is the point of departure, and as a "regulative ideal" it should take its course. This course, however, is characterized by constant change. This notion is brought to bear on the culture of Mårup, where tradition, too, is conceptualized as made up of changes. Cultural authenticity seems an implausible resource with which to build a defensive argument from a point of view that imagines nature and culture as transformational. Thus the church is far from being seen as a natural, static object, but rather is viewed as a transferable, distributed entity. Implicit in this construction is the idea that if nature or culture does *not* take its proper course, then government agencies will step in and make it do so. From the point of view of the Friends of Mårup Church, this suggests that nature is *not* taking her proper course but rather is fully regulated. These ontological constellations, as we have seen, are resolutely incompatible. This incompatibility is obviously not going to prevent an outcome, but it nonetheless intensifies our awareness of the virtual and creative potential that this specific event and the current processes display. For better or worse the event captures our imagination because of its dramatic qualities and the possible disappearance of the church. What difference, though, does it make to this case to speak of ontological constellations rather than human representations? To address this question, we turn to two theorists of complexity and heterogeneity, Marilyn Strathern and Andrew Pickering, and use them as guides into a consideration of hybridization and becoming, humanism and posthumanism, and their politics.

Strathern has proposed that cultural reconfiguration works by fitting natural and social elements together in imaginative ways. The particular "merographic" quality of modernity is that no combination seems impossible, because in each case "what looks as though it is connected to one fact can also be connected to another. Culture and nature may be connected together as

domains that run in analogous fashion, insofar as each operates in a similar way according to laws of its own; at the same time, each is also connected to a whole other range of phenomena which differentiate them—the activities of human beings, for instance, by contrast with the physical properties of the universe. This second connection makes the partial nature of the analogy obvious. It presupposes that one thing differs from another insofar as it belongs to or is part of something else. I call this kind of connection, link or relationship *merographic*" (1992, 73).

According to Strathern, modern knowledge production and decisionmaking is characterized by constantly investigating the context of something and the assumptions on which it is grounded, and making them explicit. As in Strathern's remarkable analysis of modern kinship, it is difficult in Mårup not to recognize the flattening of the modern distinction between nature and culture. What is at stake in the controversy is not only the possible loss of Mårup Church but also of innocent ideas about authenticity, nature, and culture. Strathern terms this situation "post-plural" (3–4). This paradoxical expression covers the notion that in contemporary merographic culture everything seems up for grabs, except choice. By explication one can always pluralize options, since the effort of making explicit offers new possibilities for reconnecting an entity or idea to another. As Stathern states, the notion of "Making things explicit" refers to "a practise of literalisation, that is, a mode of laying out the coordinates or conventional points of reference of what is otherwise taken for granted. One effect of literalisation is to realise that describing a process of construction is itself a construction of sorts. This is the autoproof of social constructionism" (5).

As Strathern points out, social constructivism is "auto-proved."[27] This is also the position of the Friends of Mårup Church: the church could be saved if a decision is made to do so. However, "merographic" flexibility and its attending politicization of "nature" and "culture" makes it more and more difficult to hide the hybridization of discourses and entities. This difficulty impinges on the possibility of constructing credible narratives from within an idiom of choice that imagines decisions as independent. For example, it is clear that the positing of the historical authenticity of Mårup Church and its surroundings, while a rhetorically strong weapon in the hands of the Friends of Mårup Church, also has drawbacks. These have to do with the possibility of historical deconstruction, which makes explicit the constructedness of narrat-

ing the church as authentic. Thus, the church could also easily be seen as distributed in time and space, as in the conception of the Forest and Nature Agency.

In a post-plural world such difficulties come as no surprise, perhaps, but they nevertheless constitute a debilitating feature in a political climate that relies heavily on the idiom of choice. These problems become particularly vivid in thinking about the case as a history of assemblages that are continually evolving as more human and nonhuman agents are combined. The approach proposes that "choices" are generated within specific ontological formations and make sense only as part of these formations. Choices come to be seen as preconfigured rather than independent; an insight lucidly formulated by François Jullien: "We cannot help wondering *whether in effect it ever happens* that, engaged as we are in all the complexity of situations still in the process of evolving, we are ever in a position to 'choose' means that are sufficiently clear and distinct, like (Descartes') ideas, and whose future effects it is possible to foresee in order to compare them and 'deliberate' upon them" (2004, 38).

Performative Representations

We view the analyses offered here as posthumanist. But what does "posthumanist" mean, and what are its consequences? In these final sections we clarify our position by offering a set of comments on the interpretation of posthumanism, material agency, and their implications as offered by Andrew Pickering and other contributors in this book.

In *The Mangle of Practice* (1995) Pickering refers to a contrast between what he calls representational and performative idioms, and he places his own work in the latter. His criticism of representation-based humanism is that its focus remains exclusively on the level of words and talk while never sufficiently bearing in mind material agency. In an act of "rebalancing," his posthumanism therefore emphasizes such nonhuman capacities, and as our case shows his point is well taken (7). However, "rebalancing" is a difficult act to maneuver, since too much of it equals a lack of balance in the opposite direction. The balancing act must therefore be carried out while bearing in mind that "material agency" is no more capable of *simply* determining the outcome of a situation than is "human representation." In fact, posthumanism allows one rather to refuse the *difference in kind* between presumptive representations (letters, statements, or reports) and other material agencies, since they are

viewed instead as specific *examples* of material agencies with manifest capacities for action. The controversy over Mårup Church makes this case.

It is clear that many arguments have been used in order to support coast and church protection, just as they have been used to argue for the geological uniqueness of the area. It is also obvious that the church does not stand *solely* due to such discursive intervention. Rather, "discourse" only becomes effective in complex conjunctions with other materials—a point that the drainage pipes make well.

On the other hand, the situation seems no different on the side of "material agency." The church remains on the cliff, yet we have no chance of knowing why, except as participants in incompatible ontological dramas that enact this outcome in terms of either drainage pipes or mild winters. This argument is explicitly made by the Forest and Nature Agency, whose current strategy for dealing with the case is based on its conviction that the church will fall when severe weather returns to the west coast.

Interestingly, the agency's strategy is arguably formulated from within an idiom of performativity and becoming. It suggests that drainage pipes can be seen as the sole relevant choice for dealing with coastal transformation only if the present moment, in which the church does not move, is abstracted from the temporal flow, as instantiated by modulating weather patterns. The virtual futures imagined by the agency are thus made available to it only as part of an ontological constellation, in which this organization is linked to a specific version of the capacities of the weather in western Jutland (see Jensen 2005).

Mårup, Mississippi, and the Politics of Hybridization

What makes us posthumanist? Following Pickering and Asplen's analyses we can suggest that posthumanism relates to the *stance* of the researcher in relation to ontological transformation and the flow of becoming. But what exactly are the implications of this idea? In his chapter in this book, "New Ontologies," Pickering offers the movement of the Mississippi River as an interesting socio-environmental case for thinking about the issue. The Mississippi, it turns out, would flood frequently were it not for the building of levees to keep it contained. In a "dance of agency" the river has continued rising, which has resulted in the construction of ever-higher levees. Since these have

been deemed ineffective, more aggressive measures were taken: "In 1963 a massive 250,000-ton sill or weir was set in place to control the runoff from the Mississippi into the Atchafalaya and to prevent it exceeding its prior rate of around 30 percent. In the floods of 1972 and 1973, the control structure held—but just barely. If it had failed, the Mississippi would have changed course irrevocably. After the flood, inspections revealed that the structure had suffered massive damage . . . [so] a new auxiliary structure consisting of six gates, each 62 feet wide and together weighing 2,600 tons, was added at a cost of $300 million. . . . An engineer on the new project [was quoted] as saying at the time 'I hope it works.' "

What consequences can be drawn from this example? Pickering suggests that a number of basic "ontological morals" are available for considering the case. One could be careful with change and development, as advised by the precautionary principle.[28] Alternatively, one might conclude that "we need more science, and we need to trust it less."[29] In marked contrast with these responses is Pickering's own provocative suggestion: "The Corps of Engineers should stop fighting the river and let New Orleans go. The inhabitants of New Orleans might not like to hear this, but, in fact, the idea is not as crazy as it sounds. It seems unlikely that even the Corps of Engineers can stop time forever. The Mississippi is going to flow into the Atchafalaya sooner or later. It can either do it amid death and destruction in the so-called hundred-year flood . . . or we could let it happen at a time of our own choosing—a time of drought, say, when the water level is low, and when the inhabitants of the region have prepared themselves for it." This suggestion to take change or becoming seriously as a reality and a possibility certainly stresses that entities become open-endedly and unpredictably into the future. However, its conclusion seems predicated on what we referred to above as "too much rebalancing."[30] Thus, the Mississippi should be allowed to follow its natural inclinations, while the population of New Orleans should cease to resist. Transferring this point to Mårup, the argument would be in support of free coastal transformation, and the church ought therefore to fall. This kind of moral depends on a dualistic framework according to which the normative baseline is located in "first nature," and related to which cultural "second nature" is merely derivative. Natural capacities (ought to) prevail, and culture and human representation (ought to) fail. Far from posthumanist, this idea seems rather classical and,

indeed, romantic.[31] The lesson we take from posthumanism is quite different. It is rather that no abstract resource will allow us to determine which course of action is beneficial in any particular case, because what is beneficial can only be considered with specific reference to the agents and configurations that are being explored. What follows is that while there may be good reasons for supporting or opposing the movement of the Danish coastline, these have nothing special to do with a theory of becoming, for such a theory merely says that all activities can be helpfully seen as part of ontological constellations that are under continual transformation. In this understanding of posthumanism, therefore, there can be no *general reason* for supporting the emergent capacities of the coastline to the detriment of the church-dependent cultural milieu in Mårup. Neither position, that is to say, is more becoming.

Using Heideggerian language (via Carol Steiner) it is easy to imagine a grand struggle against technological dehumanization and natural degradation, but, as Pickering argues, strategies of domination have rarely worked well in practice, and the world has continued to confound rational, technocratic expectations. This important reminder compels us to formulate new questions, and perhaps answer them in a rather different way from those made available when one quickly buys into a discourse of being *for* or *against* Mårup Church, as one seems required to do within the normative horizon of choice. Posthumanist, mangle-ish analyses, as we see it, are interesting precisely because they do not articulate intellectual engagement and participation on the classically moralistic level of obligations (*should*) but rather on the open-ended level of virtual futures (*could*).[32]

However, in "New Ontologies" and in other contributions to this book a single "should" remains: namely, the "should" of becoming. For example, Pickering suggests that we should "draw back the veil and live in the presence of decentered becoming," and that "we should aim to bolster de Kooning to the extent that the world becomes sufficiently full of explicitly and self-consciously decentered practices." Likewise, Lisa Asplen, in "Going with the Flow," argues that the use of new initiatives in environmental management "is most definitely the mangle of practice, but it is a *self-conscious* mangling" and proposes that "adaptive management, then, can be, and among practitioners is, seen as a self-conscious negotiation of human and nonhuman agency in response to open-ended emergence *in both the social and the material realms*."

To us, the obligation to self-consciously locate oneself within the flow of becoming is paradoxical, as if one could choose to "enter becoming" through a process of deliberation. Going back to the examples, we would want to stress that *whether* or not Mårup Church and New Orleans stand or fall, they do so *as part of* the flow of becoming. Since there is no duality (becoming versus stasis) the idea that one outcome is naturally better than another is problematic. In fact, it seems to us that these outcomes, rather than being simply better or worse, are just *different* in their various ways of enabling and disabling new paths for ontological transformation (and politics).

It is therefore not at all obvious that one "mangles" better because one intends to do so. It is notable that Asplen's "mangle-ish" approach to environmental management emerged from the (unpromising, nonmangle-ish) legacy of older control and domination theories. On the other hand, while Heideggerian thought may have affinities with the mangle of practice, at least Steiner argues as much, we know that this (promising, mangle-ish) starting point did not in fact lead to benign results in terms of Heidegger's own political practice. There is a shared insight in these examples: in the flow of becoming initial conditions and good intentions do not effectively determine outcomes—political, practical, or otherwise.

To give a constructive meaning to the "embrace of becoming," it therefore seems to us important to stay away from any "should" discourse, with its implied normative high ground and also its (implicit or explicit) argument that one can *choose to become* (indeed, one shudders at the prospect of "best practices" or "guidelines for becoming"). Intellectual responsibility in a world of becoming may instead be formulated in the mode of "could." "Could," as we have learned also from *The Mangle of Practice*, does not imply an unwillingness to make any commitment but rather a willingness to stay attuned to the many-sided requirements of practices, as they learn to live with and in transformation. "Could" might therefore be seen as a productive stance, precisely if one wants to treat "policies and projects as *experiments*." For example, Asplen's wonderful chapter shows how one might engage questions of environmental management if human and natural capacities are carefully articulated *with* each other rather than seen as in contradistinction.

Similarly, such an experimental attitude has allowed us to find many unexpected connections in the Mårup case. It has allowed us to discern surprising

relationships that would have remained hidden to the extent that we approached the case as a human-centered matter of choice between unequivocal normative options. Rather than taking on the burden of making such choices, or attempting to evaluate proper becoming, science and technology studies of empirical ontology and politics might enable us to become more sensitive and responsive to the possibilities and difficulties of socio-material processes of change, and thereby to "make the most of the situation as it unfolds" (Jullien 2004, 39). In this process such studies might also facilitate the development of more refined conceptualizations of the increasingly hybridized relationships between "nature" and "culture" or "the environmental" and "the political."

NOTES

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1. The quotations here are taken from T. Worsøe, "Havet kan man ikke styre" (One cannot control the ocean), *Natur & Miljø* 4, 1993, 18–21; J. Steens, "Dramaet ved afgrundens rand" (Drama at the edge of the abyss), *Kristeligt Dagblad*, September 25, 1998; and H. Gården, "Mennesket, havet og kulturen i Lønstrup" (People, ocean and culture in Lønstrup), *Berlingske Tidende*, January 9, 1993.
2. Here the notion of the Janus-face is taken from Latour's *Science in Action* where it functioned as a major trope for his investigation on "how to follow scientists and engineers through society" (1987, 4).
3. We restrict our analysis to the written material on the case. The main sources are newspaper articles; the Web site of the Danish Energy and Environmental Agency; the Web site of the Danish Forest and Nature Agency (which includes parliamentary debates, laws, etc.); and the Web site of the Friends of Mårup Church (Mårups Venner). All materials are available as printed-out Web pages on file with the authors.

4. For scholarly responses to these developments see, for instance, Strathern 1992; Braun and Castree 1998; Macnaghten and Urry 1998; and Hajer 1995.
5. Unless indicated otherwise, all quotes by the Friends of Mårup Church are from our visits to their Web site in 2001. All materials are available as printed-out Web pages on file with the authors.
6. Marquardsen is quoted in J. Steens, "Dramaet ved afgrundens rand" (Drama at the edge of the abyss), *Kristeligt Dagblad*, September 25, 1998.
7. Web site of the Danish Forest and Nature Agency (site visited in 1998; material is available as printed-out Web pages on file with the authors).
8. See the Web site of the Danish Ministry of the Environment (site visited in 2001; material is available as printed-out Web pages on file with the authors).
9. Web site of the Danish Ministry of the Environment (site visited in 2001; material is available as printed-out Web pages on file with the authors).
10. Web site of the Danish Ministry of the Environment (site visited in 2001; material is available as printed-out Web pages on file with the authors).
11. Web site of the Danish Ministry of the Environment (site visited in 2001; material is available as printed-out Web pages on file with the authors).
12. E. J. Clausen, "Derfor er Mårup Kirke unik" (Why Mårup Church Is Unique), Jyllands Posten, October 4, 1997.
13. "The Crescent's glorværdige sejr gemt af vejen i Museumskælder" ("The Glorious Victory of 'The Crescent' Stored in a Museum Basement"), *Dansk Fiskeri Tidende*, December 19, 1985.
14. Web site of Halvorsminde Ungdomsskole (site visited in 2001; material is available as printed-out Web pages on file with the authors).
15. J. Steens, "Dramaet ved afgrundens rand" (Drama at the edge of the abyss), *Kristeligt Dagblad*, September 25, 1998.
16. This point is made in Giedion 1969. It may be argued that the relationship between culture and nature implied by the discourse of choice adds to this "concealment effect" by considering nature as a set of manageable parameters.
17. G. Korsgaard, "Kirke på afgrundens rand" (Church at the edge of the abyss), *Kristeligt Dagblad*, August 4, 1994.
18. R. Geckler, "Grillbyerne" ("The Grill-Towns"), *Det Fri Aktuelt*, June 16, 1990.
19. Web site of the Danish Forest and Nature Agency (site visited in 2001; material is available as printed-out Web pages on file with the authors).
20. See, for instance, the headline "Mårup Kirkes historie" (The history of Mårup church) on the Web site of Mårup Kirkes Venner (The Friends of Mårup Church),

http://www.maarupkirke.dk (site visited in 2001; material is available as printed-out Web pages on file with the authors).

21. Web site of the Danish Ministry of the Environment (site visited in 2001; material is available as printed-out Web pages on file with the authors).
22. Web site of the Skagen Innovation Center (site visited in 2001; material is available as printed-out Web pages on file with the authors).
23. Although this is conjectural, it is worth noting that northwestern Jutland has traditionally been strong a supporter of the political party of this new minister. At the same time, the current right-wing government has been involved in controversies with Danish environmental groups, notably after appointing the notorious political scientist Bjørn Lomborg as head of its Environmental Assessment Institute.
24. P. Nielsen, "Trouble with Magical Pipes," Web site of the Coastal Engineering Research Group at the University of Queensland, Australia (site visited in 2002; material is available as printed-out Web pages on file with the authors).
25. Web site of the Danish Ministry of the Environment (site visited in 2001; material is available as printed-out Web pages on file with the authors).
26. Web site of the Danish Forest and Nature Agency (site visited in 1998; material is available as printed-out Web pages on file with the authors).
27. See also Velody and Williams 1998; as well as, in particular, Hacking 1998; Turner 1998; and Lynch 1998.
28. This position seems to be close to what is espoused in Latour 1999.
29. This conclusion is in a number of respects similar to Latour's argument in *The Politics of Nature* (2004).
30. As Carol Steiner has Heidegger remark: "I think you are onto Callon's and Latour's (1992) trickery of pleading semiotic equivalence between [material and human realms], but I think you are too much a creature of your time to really maintain the difference between people and things." We think, perhaps as creatures of our time, that Pickering's demarcation between human agency and material agency is too clear cut and fails to take "semiotic equivalence" (and the principle of generalized symmetry) quite seriously enough.
31. As John Dewey said with reference to Henri Bergson and an earlier generation of process thinkers: "We are here in the presence of prescription, not description. Romanticism is an evangel in the garb of metaphysics. It sidesteps the painful, toilsome labor of understanding and of control which change sets us, by glorify-

ing it for its own sake. Flux is made something to revere, something profoundly akin to what is best within ourselves, will and creative energy. It is not, as it is in experience, a call to effort, a challenge to investigation, a potential doom of disaster and death" (1959, 51).

32. The normative entailments of discourses relying on *could* and *should* are discussed in Singleton (1996) and in her response (1998) to Radder (1998).

PART TWO REFLEXIVITY

Going with the Flow

Living the Mangle through Environmental Management Practice

LISA ASPLEN

In recent years, scholars of the environment have become increasingly aware of the limitations imposed by the preservation of a fundamental ontological distinction between what is human or social (culture) and physical or environmental (nature) for both understanding and responding to the variety of complex phenomena brought together under the label of "environmental problems."[1] Drawing heavily from posthumanist movements in the area of science and technology studies (STS), efforts are being made, as Noel Castree notes, "to see that 'environmental' and 'non-environmental' entities are so thoroughly co-implicated that it is simply misconceived to study them in isolation" (2002, 357). These approaches espouse a shift to a decentered framework emphasizing the relations and interactions between elements on both sides of the traditional divide in order to develop a more complete picture of what is happening within the time and space of particular environmental problems.

In this chapter I extend this largely theoretical discussion through an examination of environmental management policies and practices as conceptual and material sites of the production of hybrid "naturecultures" (Haraway 2003a, 255). Following the STS contributions of the actor-network theory (ANT) and Pickering's *The Mangle of Practice* (1995), I argue that analyzing the work of environmental managers "in the thick of things" (Pickering 2002b, 7) provides a potent space for mapping the interrelationships and mutually constitutive interplay between "agents" on both sides of the traditional divide between nature and culture.[2]

Further, I draw upon several recent movements in U.S. environmental management to argue that a decentered ontology has itself emerged as a self-conscious directive informing how managers approach their engagements with the material world. In the past, environmental management policies were dominated by a fundamentally dualist "command and control" impetus that attempted to impose static, socially defined outcomes on the natural environment (Ludwig 2001; LaChapelle et al. 2003). However, as I will demonstrate below, these efforts rarely achieved such aims in practice and thereby motivated a reconceptualization among environmental managers of the relationship between human and nonhuman agencies. Through the examination of two important movements in environmental management—adaptive management and ecological restoration—I demonstrate how these practitioners provide, at least in part, a model for purposive and reflective action within a posthuman ontological framework.[3]

From Modern to Posthumanist Theories of Environment and Management

Much of mainstream social science research addressing environmental issues has progressed within the tradition of a modernist divide between nature and culture that posits alternative realist explanations for environmental problems grounded in either ecocentric discussions of the natural environment or in strict constructionist analyses of "ideologies" or "discourses" of nature (Castree 2001, 12).[4] Within the former mode, environmental problems are seen as resulting from an incompatibility between social actions and the inherent properties and processes of the natural environment, with "surprises" occuring as humans fail to fully appreciate or understand the complex nature of the environment they are foolishly attempting to manipulate (Ehrlich and Ehrlich 1998; Dunlap and Catton 1994). Alternatively, socially centered constructivist approaches cast environmental problems not as crises of disruption to the intrinsic properties of the physical world, but rather as crises of meaning within socially determined or negotiated representations of a culturally defined "nature" (Hannigan 1995; Bell 1998).

Although these two approaches (along with iterative variations between the two extremes) remain the most common in environmental analysis, a growing number of scholars have attempted to problematize the nature/culture

distinction and develop an alternative conceptual framework. Bruno Latour in his book *The Politics of Nature* (2004) challenges the ontological commitments espoused by environmental movements as fundamentally handicapped by a rhetorical and philosophical conception of an essentialized nature.[5] Rather than attempting to reify a naturalized version of the physical environment, he insists that these movements could, and, importantly, *in practice already do*, achieve greater success by "speak[ing] of countless imbroglios that always presuppose human participation" (20). That is, instead of drawing attention to "real" ecological crises, these movements are actually politicizing fundamentally hybrid objects, processes, and practices, "shift[ing] from *certainty* about the production of risk-free objects (with their clear separation between things and people) to *uncertainty* about the relations whose unintended consequences threaten to disrupt all orderings, all plans, all impacts" (25).

This explicit extension of the relational perspective developed within the ANT tradition to environmental issues provides an important framework for moving beyond the problematic nature/culture dualism in discussions of the environment, highlighting both the hybrid nature of environmental assemblages and foregrounding the processes through which different elements or "actants" (Latour 1987) are brought into relation with one another.[6] However, ANT does not point toward an operative vision of how specific "socio-environmental" networks *emerge and evolve* in a particular time and space—a key analytical dimension for my interest in environmental management practices. In addition, the strict symmetrical treatment of human and nonhuman agency adopted by the ANT framework proves problematic in the analysis of management practice, in which the intentions and goals that motivate particular environmental interventions (and how these shift, adapt, or naively persist over time) are particularly important in following environmental managers in practice.

To expand the ontological displacement provided by ANT, I draw upon another important contribution from STS through a consideration of two frameworks presented within the work of Andrew Pickering: the "mangle of practice" (1995) and the "ontology of becoming" (see Pickering, this volume; see also Jensen and Markussen, this volume).[7] The performative orientation of the mangle is particularly useful in an attempt to understand the dynamic interplay between environmental systems and human or social

interventions, both intentional and unintentional, through the projects of environmental management. First, it directs us to situate the analysis within the time and space of particular material environmental transformations, rather than assessing management, as is commonly done, in terms of "success" or "failure" in achieving socially defined goals such as environmental "health" or "sustainability" (see Macnaghten and Urry 1998, chapter 7). In addition, the dialectic engagement between human and material agency through "tuning" is also important for thinking about how environmental managers act upon and respond or adapt to the physical objects of their technoscientific practices.

Pickering's "ontology of becoming" also offers a provocative alternative for recasting our conceptions of "the environment" and "society" in a mutually constitutive, coevolutionary framework. Through the real-time dynamic coupling of intentional human management actions and unforeseeable ecological responses, it is possible to conceive of "the environment" as a conjointly physical and conceptual terrain of decentered becoming, with no single force, social or natural, directing the changes and no means of predetermining specific future states. This has important implications for the traditional logic of management that I will outline below, as well as offering a new way of understanding the radically different environmental management approaches that are beginning to take shape.

Following these important theoretical (and, by extension, methodological) shifts, I am ready to consider the environment not as physical nature and not as a social construction but rather as an emergent phenomenon produced, reproduced, and evolving in time through human experiences within hybrid spaces. In the following sections, I turn to environmental management practices as a key process through which such hybrid assemblages are produced. I begin with a discussion of traditional "command and control" management practices that are rooted intellectually in the modern dualist ontology but are decidedly nonmodern in their practical outcomes. I then push this analysis a step further with a consideration of two less-traditional approaches to environmental management currently gaining support from academics and practitioners. These approaches, I argue, are *self-consciously "mangle-ish"*; that is, they reflect an explicit recognition and sensitivity to the posthumanist perspectives outlined above through a fundamentally decentered and open-ended approach to environmental management practice.

Traditional Environmental Management

Although significant variations in policies and practices can be found within the history of U.S. environmental management, most have fallen within the category that C. S. Holling and Gary K. Meffe call "command and control." Such strategies seek to "move human or ecosystem behavior to a predetermined, predictable state" (1996, 329) through regulatory and technological interventions. Rooted in modernist ideologies of economism, scientism, and technocracy (Ludwig 2001), or more specifically the "technocentric utilitarianism" that characterized Progressive Era politics in the United States (LaChapelle et al. 2003, 474), managers have approached environmental problems as if they were "well-bounded, clearly defined, relatively simple, and generally linear with respect to cause and effect" (Holling and Meffe 1996, 329). The result has been primarily top-down, rigidly prescriptive practices that seek to "impose . . . a detached and timeless human conception" (Pickering 2002b, 5) of how the environment should look and behave.

Predictably, at least from a posthumanist perspective, the practice of command and control management has faced (and created) a variety of problems and challenges.[8] Environmental managers, in their orientation toward the environment with an expectation of certainty and predictability, inevitably have faced surprises and, from their perspective, crises as the material world resisted their control in unanticipated ways.[9] Rather than developing sensitivity to this unpredictability, command and control managers have generally attempted to impose even more control in attempting to "reduce natural bounds of variation" (Holling and Meffe 1996) by escalating the scale, scope, and intensity of managerial practices. The result, documented through countless examples in myriad scientific and policy journals,[10] has been a virtual arms race between managers and the environment, with environmental problems proliferating rather than diminishing and control efforts expanding in proportion.

Two brief examples of common command and control techniques will illustrate these ideas further, as well as set up the alternative management case studies discussed in the following sections. One common environmental management practice, particularly throughout the western and southwestern regions of the United States, has been the "stabilization of flows by dams in previously wildly flooding or 'flashy' . . . rivers" (Holling and Meffe 1996,

330). The management logic behind a dam is the complete control of riverine dynamics through purposeful regulation of the movement of water, sediment, and even migratory aquatic species. Rivers have responded to dams in a variety of ways, from the slow and steady degradation of physical and ecological characteristics to active resistances in the form of flash floods and sediment buildup that have challenged (and in some instances, destroyed) the structural integrity of dams (Holling and Meffe 1996). In the section below on adaptive management, I present a discussion of how traditional command and control approaches to dam operations are being modified to be more flexible and responsive to the liveliness and dynamism of riverine systems.

A second command and control strategy commonly employed in parks, forests, and other publicly managed lands has been the suppression of wildfires. In order to preserve a specific image of "wilderness" or "nature," generally for aesthetic more than ecological reasons, environmental managers have attempted to take control of naturally occurring fires. However, fire-adapted communities have changed dramatically in the absence of periodic "cleansing" blazes, resulting in changes in habitat and species composition and the buildup of brush that often increases the size and severity of fires beyond managerial control (Holling and Meffe 1996). The case study in ecological restoration described below begins with fire-suppressed ecosystems that have been dramatically altered in ways not planned for or anticipated by environmental managers, and then continues by documenting efforts to develop a new managerial impetus that is responsive to the open-ended becoming of environmental assemblages. With this understanding of traditional management in mind, it is now possible to turn to the alternative strategies that are bringing posthumanist theories to bear on environmental policies and practices.

Alternative Management Approaches: Toward a Posthumanist Environmentalism?

In this section, I examine two important trends that have emerged in the management of environmental systems: adaptive management and ecological restoration. Both approaches have come about in response to persistent and often catastrophic failures of "traditional" management strategies in addressing the complex, dynamic, and, I would add, hybrid systems that com-

prise the conceptual and material spaces we call "the environment." Through an analysis of the theories and practices embodied within each strategy, as well as brief case study examples of these management styles in action, I hope to highlight how both of these perspectives have embraced, at least in part, an explicitly decentered and open-ended perspective toward the environment and, more important, how they have developed models for purposive action from within this framework.

Adaptive Management

In emerging from academic circles primarily based in scientific and policy studies, adaptive management was first proposed within the context of fisheries and forest management with the primary objective of bringing scientific knowledge and practices into managerial decisionmaking (Holling 1978).[11] At its most basic level, adaptive management can be understood as "treating management strategies and policies as *experiments* that are conducted to learn more about the ecosystem's processes and structures" (Bosch et al. 2003, 110). Rather than designing policies for the production of a particular static outcome, adaptive management strategies are imagined and intentionally designed as reflective tools for learning about the dynamics of complex systems and how they respond to human interventions. Ideally, an improved understanding of how systems "resist" or "accommodate" a specific policy action would then be fed back into social decisionmaking through the reevaluation of goals and practices (Lee 1993).

Katherine N. Irvine and Stephen Kaplan present adaptive management primarily as a self-conscious strategy for addressing uncertainty. The manager within this framework "accepts as given the reality of incomplete knowledge" and "focuses on building opportunities to learn into the design and implementation of policies" (2001, 720). Instead of treating management policies as mechanisms for control and viewing environmental outcomes as static and predictable, adaptive management embraces both the hybrid co-constitution of the social and the material and the open-endedness of such assemblages. Managers know that their interventions will have an effect on the system with which they are engaged, but they accept that this effect could be very different from their initial intentions and expectations. It is therefore necessary to develop a way to engage with these ever-changing systems that appreciates both the capacity of the social to influence and of the material to surprise.

The key step toward such a decentered, open-ended environmental management proposed by adaptive management is the treatment of policies and projects as *experiments*. Latour describes an experiment as " 'passing through' a trial and 'coming out of it' in order to draw its lessons," thus offering an "intermediary between knowledge and ignorance" (2004, 195). Further, a "good experiment" is "not one that offers some definitive knowledge, but one that has allowed the researcher to trace the *critical path* along which it will be necessary to pass so that the following iteration will not be carried out in vain" (196). This conceptualization of experimentation resonates strongly with the vision presented within the discourse of adaptive management. In order to move forward productively in the management of complex environmental systems, it is necessary to test the tools and find out what resistances and what accommodations emerge along the way. This is most definitely the mangle of practice, but it is a *self-conscious* mangling.

This reflexivity is made explicit in adaptive management through the coupling of policy experimentation with the notion of social learning. Amanda C. Graham and Linda E. Kruger characterize the "mantra" or "guiding principle" of adaptive management with the phrase "learn to manage and manage to learn" (2002, 3). The type of learning envisioned within adaptive management is referred to as "emergent social learning" and conceived as "not a passive, exclusively psychological or cognitive process in this perspective; rather, it develops as people are engaged in some practical activity" (7). Rather than the "spermatic mind" criticized by Donna Haraway (1991) that projects its own images on its physical surroundings, learning in this conception takes on a situated, experiential character that is generated through practical engagements and openness to unexpected outcomes.

Although conceptually influenced by Western experimental scientific culture, advocates of adaptive management have actively framed the approach as representing a fundamentally different kind of science (Graham and Kruger 2002). Science and scientific practices are not brought into management to provide a neutral voice speaking for the material world or definitive knowledge about how the environment works and, by extension, how it can be managed (or controlled). Rather, the design and execution of adaptive management experiments are intended to be responsive to both the material environment and social goals, thus "coupling science and management so that each responds to the needs and information of the other" (Meretsky, Wegner,

and Stevens 2000, 580). As experiments are carried out, the material environment changes in anticipated and unanticipated ways, observations of which are fed back into the design of management strategies to shape the direction of further material engagements as well as social goals and objectives. Adaptive management, then, can be, and among practitioners is, seen as a self-conscious negotiation of human and nonhuman agency in response to open-ended emergence *in both the social and the material realms.*

In order to appreciate the promise of adaptive management as a self-consciously posthumanist strategy, I present in the next section an example of its use in the experimental operation of a dam. One of the most prominent adaptive management experiments in the United States was carried out, appropriately enough, at one of the nation's most famous "national treasures": Grand Canyon National Park. Drawing on a narrative history written for *Scientific American* by three participating scientists (Collier, Webb, and Andrews 1997), as well as subsequent articles detailing the project,[12] in the following section I examine adaptive management in practice to highlight the recognizably and self-consciously posthumanist perspective that accompanies this conceptual framework in action.

Experimentation in Adaptive Management: The Intentional Flooding of Glen Canyon

Glen Canyon Dam was constructed in 1963 under the direction of the U.S. Bureau of Reclamation. In the process the "environment" known as Lake Powell was created behind the structure and the flow of the Colorado River was held above the Grand Canyon (National Research Council 1996). The downstream impacts of "replac[ing] the Colorado's natural pattern of forceful summer flooding with a gentle daily ebb dictated entirely by the electrical power demands of distant cities" (Collier, Webb, and Andrews 1997, 82) were for the most part unanticipated at the time of construction but have since become a popular topic of scientific investigation (and speculation).

Within the first few years of the operation of the dam, scientists and recreationists began to notice physical and ecological changes to the Colorado as it passed through the Grand Canyon area. In addition to blocking and regulating the flow of water, it turned out that the dam traps the upstream supply of sediment to the lower reaches of the river (Rubin, Nelson, and Topping 1998). Also, with the elimination of episodic flooding, the river channel lost

much of its hydrologic power to migrate into the immediate floodplain. This allowed for the encroachment of "exotic flora" populations along the Colorado's banks, which had previously been kept in check by the periodic floods. Further, the detainment of upstream sediments and elimination of scouring floods eventually led to the disappearance of sandbars and beaches within and along the river's course. At the same time, "coarse debris" from the surrounding canyons created obstructions to navigation because the "bridled river did not have sufficient power to clear away the boulder filled deposits" (Collier, Webb, and Andrews 1997, 83).

In 1982, the U.S. Bureau of Reclamation, as part of its regular evaluation and maintenance program at Glen Canyon, announced plans to increase the efficiency of its hydroelectric generation operations through technological upgrades, which were projected to alter the daily and maximum water flows through the dam. This proposal generated active opposition from environmental and recreational groups concerned about the potential downstream effects from these changes in water flows. In response to these concerns, the Bureau of Reclamation established an ongoing scientific project called the Glen Canyon Environmental Studies (GCES) to monitor and assess the downstream ecosystem effects of dam operations (Patten et al. 2001). It is this project that I want to focus on here.

The timing of this scientific monitoring program proved favorable in highlighting the downstream impacts of the dam. In June 1983, temperatures spiked and triggered an early and rapid snowmelt that led to a flood surge in the Colorado upstream of the dam. The buildup of water behind Glen Canyon Dam led the Bureau of Reclamation to increase the discharge of water to more than five times its normal range (from 300–500 cubic meters per second to 2,750 cubic meters per second). In addition to structural damages to the dam, the 1983 flood generated significant physical and ecological transformations downstream. Depleted beaches were replenished, exotic vegetation was killed along the riverbanks, and previously degraded animal habitats were re-created (Collier, Webb, and Andrews 1997).

The 1983 flood, and the subsequent GCES observations of the erosion of the flood-created beaches and habitats in the years that followed, set in motion discussions among scientists and managers about the potential benefits of "intentional flooding" below the Glen Canyon Dam (Andrews and Pizzi

2000). Inspired by the baseline observations of flood response and a growing push toward adaptive management in environmental policy circles, the second phase of the GCES, initiated in 1989, included what were referred to as "research flows," whereby dam operations were experimentally varied over a two-week period along the following dimensions: the magnitude of high and low discharge rates; the size of daily fluctuations; and the rate at which releases were varied to meet peak electrical demands (the ramping rate) (Patten et al. 2001; Meretsky, Wegner, and Stevens 2000). The results of these research flows, detailed in the 1994 Draft Environmental Impact Statement (EIS) for Glen Canyon operations, provided baseline observations of the significant downstream impacts of regulated flows and, more significantly, lent credibility to the idea that dam operations could be manipulated as a tool for environmental management (Patten et al. 2001).

Learning from these small-scale manipulations of dam operations, scientists within and outside of the GCES began advocating an "experimental flood" that would mimic the summer scouring floods that had been eliminated by the dam. The fundamental hypothesis, according to Duncan T. Patten and his colleagues, was that "the dynamic nature of fluvial landforms and aquatic and terrestrial habitats can be wholly or partially restored by short-duration dam releases substantially greater than power-plant capacity" (2001, 639). In addition to basic observations about the "essential geomorphic and ecological processes during flood passage and recession" (639), this experimental flood would allow dam managers the chance to evaluate the technical capacity, economic cost, and social desirability of this type of management practice.

Despite a growing consensus among scientists that an intentional flood would be "more beneficial than harmful" (Collier, Webb, and Andrews 1997, 84), there remained vocal opposition to the project because of the uncertainty of its outcomes, including the impacts on several endangered species within the ecosystem, popular recreation sites, and hydroelectric operations. Even among those who favored the flooding, disagreements arose about the appropriate timing, duration, and magnitude of the flood. Eventually, a compromise design was reached. The timing the flood was set not during the summer (when such events historically occurred) but in the early spring in order to minimize the threat to an endangered snail (the Kanab ambersnail) and

to coincide with a period of relatively low energy demand (Patten et al. 2001). In addition, the maximum size of discharge through the dam was capped at less than half of historic peak flows in order to prevent damages to the structure and as a precaution against potential negative downstream impacts of the flood (Collier, Webb, and Andrews 1997).

At 6:20 AM on March 26, 1996, the Bureau of Reclamation launched this "bold experiment" (Collier, Webb, and Andrews 1997, 83) in environmental management by increasing the water passage through the Glen Canyon Dam to a peak rate of 1,270 cubic meters per second, thereby releasing over 900 million cubic meters to the downstream reaches of the Colorado in a flood that lasted one week. A near army of government and university scientists descended upon the area to assist the bureau in testing myriad hypotheses about the geophysical and ecological behavior of the downstream system under flooding conditions.

The results turned out to be a mixed bag of expected and unexpected outcomes based on the scientific models that informed the design of the flood.[13] The hydrological models developed to simulate the event "accurately predicted the progress of the flood," and they accounted for the acceleration of water velocity through the Grand Canyon that created such a force that "the first crest reached Lake Mead at the downstream end of the canyon almost a day before the actual waters of the flood arrived" (Collier, Webb, and Andrews 1997, 85). Similarly, as expected by at least some of the scientists, a "fan-shaped" bank created by debris flows from the surrounding canyon was flushed, thereby clearing out nearly one-third of a constriction that had narrowed the river from its "normal" width of about fifty meters to a width of around twenty meters at a site three hundred kilometers south of the dam (Collier, Webb, and Andrews 1997).

In addition to these expected outcomes, scientists and managers were faced with several surprising findings. In tracing sand deposition at over thirty sites along the river, several scientific groups found that, despite the initial expected depositions within the first two days of the flood, most of the sites began to slowly lose sand as the floodwaters continued through the week-long test period.[14] The floodwaters, it was eventually concluded, were acting both as an accreting force and an erosive one, producing sandbars that were "higher, not wider" (Patten et al. 2001, 641), thus allowing sand along the bar edges to be brought back into the main channel as the waters subsided. One

group was so surprised by this behavior that they ended up "watch[ing] as $70,000 worth of borrowed equipment was first buried, then excavated and finally carried away" (Collier, Webb, and Andrews 1997, 87).

In addition to providing scientists with data to support and improve their understandings of the downstream system, the experimental flood provided managers with important information to guide the design of future dam operations. Although at the time of this writing no further intentional floods have been carried out through Glen Canyon, efforts continue to attempt to incorporate a wide variety of hydrological, geological, and biological-ecological information generated by the experimental flood in the operational parameters of the dam and the design specifications for future intentional floods. From this experiment, managers learned that the flood duration can be shortened without losing downstream benefits and that even a moderately sized event can yield significant positive results downstream (Collier, Webb, and Andrews 1997).

What can we take away from this example beyond the specific lessons learned about the hydrology and geology of the Colorado under particular flooding conditions? First, the project itself represents a dramatic shift in the nature of environmental management strategies in the United States. In this case a dam, long a signal of command and control managerialism at its most obtrusive, has become the site for intentional environmental interventions aimed at both mitigating the effects of the dam's operations and positively constructing new knowledge and procedures for operating the dam responsively in the future. Through the practical experience of this flood, we can observe a truly open-ended becoming, not only within the river itself or through the understandings and beliefs of scientists, but also in conceptual and material practices of the dam, and by extension the social institutions through which it is operated.

Second, the process through which the experimental flood was conceived, designed, and executed was not open-ended simply in its outcomes. It also exemplifies a self-conscious, intentional engagement in an open-ended managerial process. The 1983 flood illustrates the unpredictability of material agency as the river "fought back" against the dam, posing both challenges and opportunities to the managers who were paying close attention to the environmental space (through the GCES). If it had not been for this "natural" flood, then scientists and managers may not have recognized and pursued

intentional, experimental flooding as a viable managerial strategy. Together, the river and the dam, with input from managers, scientists, and other active social interests, engaged in a negotiated becoming for the Colorado, one that was necessarily open-ended. Through thoughtful and reflective adaptation, however, management at Glen Canyon is being continually readjusted to actively avoid, or at least minimize, negative social and environmental outcomes. Environmental managers may not know exactly where their actions are headed, but they are actively engaged in charting a reflexive and responsive course.

Ecological Restoration

While adaptive management represents a specific strategy for approaching the process and outcomes of environmental management, a second emerging movement, ecological restoration, encompasses a more specific set of practical engagements with the physical environment. The Society for Ecological Restoration (SER) defines ecological restoration as "the process of assisting the recovery and management of ecological integrity" (Swart, van der Windt, and Keulartz. 2001, 230). This baseline definition is subject to significant variation in the literature, but nonetheless it offers three important insights into the conceptual and practical foundations of ecological restoration.[15] First, the notion of ecological integrity represents the concern of taking a natural environment that has been recognized as "degraded" and returning it to some prior, healthier state, characterized not by a few instrumental goals or objectives but by some measure of the overall health of the system. Second, there is an explicit recognition of and responsiveness to material agency in the casting of the human managerial role as that of "assisting" the recovery processes that occur through the dynamics of "undisturbed" or "unmanaged" ecosystems. Finally, the management of ecological systems is fundamentally linked to the proactive interventions of human agency.

Ecological restoration distinguishes itself from traditional command and control management approaches through its focus on "ecological integrity." Rather than attempting to manage a system for a particular static objective, ecological integrity focuses attention on the production (or reproduction) of "whole, intact systems" and "integrates . . . many different characteristics of an ecosystem, which, taken together, describe an ecosystem's ability to maintain its organization" (Higgs 2003, 122). In turn, conditions of ecologi-

cal integrity are to be discovered through "historical reconstructions" of how a particular system looked and behaved prior to "human disturbance" (Doppelt et al. 1993). The most common "reference conditions" used in the design of ecological restoration projects in the United States look back to the period before European settlement. Ignoring the centuries of reciprocal interactions between indigenous communities and their natural environments, ecological restorationists believe that the intensive declines in species diversity, ecosystem dynamics, and other indicators of "environmental health" make this precolonial reference point an ethically appropriate target for restoration efforts (Helford 1999; Doppelt et al. 1993).

At face value, this discourse of restoring ecosystems to "natural" or "predisturbance" states appears antithetical to the decentering advocated within the posthumanist frameworks outlined above. Recognizing that environmental systems coevolve in a dynamic and open-ended interaction with social activities and interventions, how can we even think about trying to "restore" them to a preconceived "pristine" state? It is at this point that I invoke the directives of Pickering (1995) and Latour (2004) by looking past the "ideal image" toward which ecological restorationists strive and instead focusing on what it is that they actually do in practice. By understanding that the view of restoring ecosystems to an imagined past of pristine nature is an idealized fantasy, it is necessary to understand the real ontological orientation embodied within restoration practice.

In addition to the standard qualitative assessments used within discourses of environmental health ("degraded," "polluted," "healthy"), there are a variety of terms employed by ecological restorationists focused on the nature of ecosystem *processes* that gesture toward a more "lively" image of material agency and its role in shaping environmental and managerial outcomes. Within the discourse of "ecological integrity," the term "resilience" is used to describe the power of ecological systems to withstand or adjust to "external" (both social and environmental) shocks by its own agency (Higgs 2003; Holling and Meffe 1996). In addition, terms like "dynamic" and "recovering" point to a conceptual orientation within restoration practice that takes seriously the fact that environmental systems are not just passive receptors of social regulation but in fact "do things" that are critically important.

Although much of the debate surrounding ecological restoration still hinges on the selection of appropriate "natural" conditions on which to

focus, some restorationists have consciously attempted to transcend this concern in favor of a more open-ended approach to restoration practice. In the book *Nature by Design* Eric Higgs, a founding member of the SER, admits that "*restoration* is an awkward term for what we do under the banner of ecological restoration" (2003, 118; emphasis original). Given that the intended "objects" of restoration, ecosystems, are "in constant motion" and subject to "stochastic processes [that] make the precise trajectory . . . unpredictable," restoration projects are left with no guarantees as to how their efforts will "play out over time" (119). Rather than attempting to characterize the goals of ecological restoration as the reproduction of previously identified "natural" properties of the ecosystem, appropriate restoration goals are envisioned through careful reference to historical *ranges of variability* in physical processes and biological composition (i.e., diversity) (119). Understanding, to the extent possible, the historical range of variability demonstrated by a system allows restorationists to work with a "moving target" and avoid the motivation to automatically "correct" or reengineer systems that do not exactly adhere to a specific vision of the "pristine" past.

Higgs further suggests that restoration offers an opportunity to fundamentally rethink the role of both humans and natural systems in the process of environmental management. On one hand, he argues that command and control managers who assume they have full control over natural systems ultimately fail because of "overdetermination and artificiality." Alternatively, environmentalists who "hold that ecological processes are endlessly adaptable and do not require management are simply avoiding a hard lesson" (118). Some systems, he argues, are so irreparably damaged that sustained human interventions are necessary in order to achieve any semblance of a functioning system. As advocated by most ecological restorationists,[16] achieving a balance between human interventions and letting an ecosystem "do what it will" is, according to Higgs, the fundamental promise of ecological restoration.

Ecological restoration is said to achieve this balance in practice through what Higgs characterizes as an extended "conversation" between restorationists and ecological processes.[17] This conversation can be observed in the real-time, open-ended interventions of restorationists "working in conjunction with ecological processes" (118) and "tak[ing] the time to know a site on the site's terms, and as much as possible . . . let[ting] the vernacular conditions shape the project" (285–86). This conversation metaphor firmly em-

braces the spirit of open-endedness, hybridity, and "the dance of agency" that characterize the posthumanist perspective. With this image of ecological restoration in mind, I turn to a case study to illustrate how these ideas actually play out in practice.

Through a partially participatory and partially ethnographic study of ecological restoration projects carried out by the Nature Conservancy, one of the most prominent nonprofit environmental organizations in the United States, Reid Helford (1999) provides an insightful account of ecological restoration in practice in his examination of oak savanna restoration in Illinois. Although I put aside some of his social constructivist analysis and supplement it with primary accounts,[18] I draw upon Helford's study in order to display ecological restoration as an active and self-consciously posthumanist environmental management strategy.

Restoration and the "Discovery" of the Oak Savanna

When the Illinois chapter of the Nature Conservancy began its ecological restoration activities in the 1980s, the focus was primarily on the removal of "nonnative" vegetation and animals (mostly deer), where "nonnative" was defined as "not present on the Illinois landscape prior to European settlement" (Helford 1999, 61). This was followed with the "introduction and facilitation of the growth of 'native' Illinois plants and animal species" (61). The overarching goal of these restoration projects was to reestablish the two ecosystems believed to have characterized the precolonial landscape of the state: prairie in the west and oak forests in the east. The nonnatives had gained hold in areas throughout Illinois and the Midwest in general through a variety of means, but they were primarily supported by the active suppression of wildfires. Fire is especially important in prairie and other grassland ecosystems where it returns nutrients to the soil and prevents the establishment of taller overgrowth communities. According to one prominent ecological restorationist, without fire "prairie groves sicken and deteriorate" (Packard 1988, 15).

With these targets in mind, the restoration groups overseen by Stephen Packard, the director of science and stewardship at the Illinois Nature Conservancy, set out to restore prairie ecosystems at many sites throughout the state.[19] Beginning in 1977, the groups started with seven degraded prairie sites in Cook County, although they eventually spread to different areas throughout the state. In these early projects, the only techniques used were the pulling

and clearing of nonnative species and the planting of indigenous prairie seeds. After five years of active observation and maintenance, the results varied significantly between areas that were predominantly grassy to begin with and those located along the edges of forest stands. The prairie seeds "failed to produce viable plants in the shade of the trees" (Packard 1988, 62).

By 1984, Packard and his colleagues responded to these mediocre results with a new strategy: controlled burning. In recognizing the importance of fire, the restorations sought to re-create the natural conditions that they understood had historically shaped prairie ecosystems. Two years later, however, prairie still failed to thrive along the forest edges, with the exception of one site—an area called Miami Woods. Here, the group had grown optimistic about the burning strategies as the grasses began to thrive. However, upon closer examination Packard discovered that this new grassland was not composed of the species that he and his group had planted. In fact, three distinct grass species flourished that were not a part of either the prairie or forest ecosystems as the restorationists "knew" them, nor were they to be found on the list of recognized "nonnative" or "invasive" species that they sought to eradicate.

In attempting to understand what he was finding "in the field," Packard turned to the scientific literature, particularly historical records, for some corroboration of the species he encountered. Through the failed experience of prairie restoration, Packard and his associates uncovered evidence of what they came to recognize as a third distinct ecosystem—the oak savanna. Prior to these efforts, scientists and the Nature Conservancy itself had viewed oak savanna as an intermediate "ecotone" or transitional phase between the prairie and the forest. It was not, however, considered a "restoration priority" because it was believed to provide no additional biological or ecosystemic diversity beyond what could be supported separately by forests and prairies. However, through the actual field restoration experiences the oak savanna rose in status in the vision of the Nature Conservancy restorationists and became a target for future active restoration activities.

Many elements of this example illustrate a distinctive posthumanist perspective in the approach by restorationists to environmental management. First, material agency is afforded a very important and active role in guiding restoration decisions in the descriptions of the restorationists' experiences in the field. Helford characterizes the view of the restorationists as follows: "Nature is not being made to speak by the manipulations of restorationists, it

is simply being listened to" (1999, 62). For Packard, restoration is not about imposing and maintaining a particular static image of nature on the landscape. Rather, restoration actions are tentative attempts to engage with the material world, which, depending on how the projects turn out, "tells us if we've got it right" (quoted in Helford 1999, 62). Clearly, this is a shift from the traditional managerial impetus that seeks to control or, at the very least, direct environmental systems to a predetermined target condition. As in the case of adaptive management, restorationists are attempting to reflectively adapt their activities based on feedback they get through monitoring changes and responses in the material environment.

One final observation to be drawn from this case comes from the characterization of restoration practice as a "science" and how such claims are met by more "traditional" scientific disciplines.[20] Like Higgs, Packard characterizes restoration as the production of knowledge through the practical engagement, or conversation, with the physical environment. To Packard, restoration science is "learning by a trial and error process using hundreds of varying uncontrolled restoration experiments" (quoted in Helford 1999, 66). But Helford also indicates significant resistance on the part of "mainstream" science to recognize the experiential findings of the restorationists. Packard and his team were accused of doing "bad" and "dangerous" science by carrying out restoration projects using "untested species" in misguided attempts to create a scientifically unverified ecosystem (66).

Here we can see how far restoration science has departed from the modern, dualist ontology of "traditional" science that presumes the existence of real and knowable nature to be discovered through rigorous scientific inquiry. Alternatively, restoration science, at least as described by Packard, represents a self-reflexive "alchemical" view of scientific practice as described by Pickering (2001). Through the dirty, hands-on "learning and doing from within the ecosystem" (Helford 1999, 67), ecological restorationists self-consciously engage in a "mutual becoming" (Pickering 2001) through which their own knowledge, practices, and identities as restorationists emerge in time through the active engagements with similarly emerging natural-cultural environments. This distinctly nonmodern vision of environmental management offers, I think, a promising departure from traditional approaches, as well as a guidepost for scholars and practitioners interested in a self-consciously posthuman way of taking purposive action.

Conclusion

As I have demonstrated in this chapter, environmental issues and the activities by which societies have responded to them represent a fruitful avenue through which to examine and challenge modern dualist conceptions of nature and culture. With the examples of ecological restoration and adaptive management, I hope to have shown not only how decentered, posthumanist insights from STS provide a framework for discussing such endeavors, but, more importantly, how these insights have actually *emerged independently* as a self-conscious understanding informing the actions of environmental managers. These understandings and practices, in turn, can provide further direction for both scholars and practitioners in conceptualizing and reforming socio-environmental relationships.

By focusing on the practices of environmental managers, scholars of the environment have the opportunity to transcend the increasingly less productive debates between environmental realism and constructivism by following what is really going on "in the thick of things." In exploring and taking cues from the extended negotiations between managers and the environment over time, it may be possible to embrace a more productive ontology (and epistemology) that is sensitive to the fundamental hybridity and open-ended emergence of environmental problems, values, and relations. Similarly, these insights from environmental management practice can easily be examined within the context of numerous other sociotechnical problems and practices in order to conceptualize more flexible and self-conscious strategies for intentional social actions in a complex, inextricably hybrid, and open-ended world.

NOTES

1. See, for example, Castree and Braun 1998, 2001; Cronon 1996; Demeritt 2001; Freudenburg, Frickel, and Gramling 1995; and Goldman and Schurman 2000.
2. See, for example, Lee and Roth 2001, which demonstrates how environmental activists "engineer" a healthy stream through a connected and mutually constituting series of discursive representations and material actions.
3. This project complements the work of Pickering and of Marick (this volume) to demonstrate social actions that self-consciously adopt the ontological perspective of *The Mangle of Practice.*

4. For a review of realist versus constructivist debates in environmental sociology, see Burningham and Cooper 1999; Buttel 1996; Dunlap and Catton 1994; and Lidskog 2001.
5. Latour refers to this collective effort of environmental movements as "political ecology" (2004, 1). In American academia, however, political ecology represents a particular scholarly movement to situate environmental resource struggles within local and transnational political and economic contexts (see Peet and Watts 1996). Therefore, I choose to avoid this term and use "environmental movements" instead.
6. Rather than thinking about human-nature relationships in terms of unidirectional (or even dialectical/reciprocal) causes and effects, ANT suggests a *relational* view of multiple heterogeneous elements networked through complex "chains of connection" (Castree and MacMillan 2001, 211; see also Whatmore 1999).
7. Steiner (this volume) provides further discussion on the philosophical dimensions and implications of the "ontology of becoming."
8. For a detailed exploration of the "mangle-ish" outcomes of such command and control approaches, see Coppin's discussion of the evolution of the hog-farming industry in the United States (this volume).
9. Environmental and natural resource scholars use the terms "wicked" (Ludwig 2001) and "messy" (LaChapelle et al. 2003) to refer to ecosystems that are particularly resistant to command and control management strategies. These systems are said to ultimately defy any prescribed management action because they are comprised of too many elements and processes that are in constant flux and interaction (see, for example, Light et al. 1995).
10. See the journals *Ecosystems*, *Conservation Biology*, *Society and Natural Resources*, *Ecological Applications*, and *Environmental Management*, to name a few.
11. Beyond the initial and ongoing work of Holling, the most influential representation of adaptive management, particularly within environmental policy circles, was Kai Lee's *Compass and Gyroscope* (1993), which casts science as the compass that checks and guides the course of environmental management policies and "democracy" (i.e., competition of interests) as the gyroscope that allows us to "maintain our bearing through turbulent seas" (6).
12. Details of the history, details, and scientific findings of the Glen Canyon experimental flood can be found in Andrews and Pizzi 2000; Meretsky et al. 2000; Patten et al. 2001; and Rubin et al. 1998.
13. For a detailed account of the scientific findings, see *Ecological Applications* 11:13 (2001)—a special issue dedicated to the Glen Canyon flood.

14. Sandbar formation has been found to occur primarily at sites along the river where the main channel passes by eddies, or at sites cut along the embankment where water has begun moving upstream (i.e., opposite the river flow). Sediment carrying water moves in and is slowed at these sites, thereby allowing for the deposition and accretion of sand (Collier et al. 1997).
15. For a comprehensive discussion of how ecological restoration has been conceptualized and defined, see Higgs 2003, chapter 3.
16. A distinction is commonly drawn between what are known as "active" and "passive" forms of restoration. Active restoration refers to the attempt to artificially engineer or reproduce impaired or lost aspects of the natural structure or function of an ecosystem (Wissmar and Beschta 1998). In contrast, passive or "natural" restoration aims primarily to remove particular anthropogenic disturbances to ecological systems to allow them to recover on their own (Kauffman et al. 1996). Active restoration is the most common strategy and is generally what is described by the term "ecological restoration."
17. This conversation metaphor resonates with the "conversation theory" of the British cybernetician Gordon Pask. According to Pickering, Pask presented a "posthuman image of 'conversation'—between people and things or between people and people" (2002a, 429).
18. Helford's analysis rests primarily on "the making of a natural fact as a social process" (1999, 75) by focusing on how restorationists came to classify or represent the oak savanna as a distinct ecosystem, as well as how these claims were met by both more traditional scientific communities and other interests (e.g., animal rights activist groups). Helford highlights the inherently social and political nature of such classificatory efforts. I take the analysis in a different direction by focusing less on how restorationists *represent* their environments and more how they *experience* and *act* on them.
19. Packard provides detailed descriptions and interpretations of his ecological restoration experiences through a series of articles in the professional journal *Restoration and Management Notes* (1988, 1990, 1993, 1994).
20. For an illustration of debates over the "science" of ecological restoration, see Mendelson et al. 1992; and Packard 1993.

A Manglish Way of Working

Agile Software Development

BRIAN MARICK

In the first decade of this century, a style of software development called "Agile" moved from being an underground practice to one sufficiently respectable to be written up in the mainstream business press. From my perspective as an insider in that movement and as a dilettante in science studies, I claim that the Agile style of work is readily and satisfyingly described by the terminology of Andrew Pickering's *The Mangle of Practice* (1995). But making this claim is not the only point of this chapter. The reason I am an Agile advocate is that a mangle-ish style of work suits certain people, and Agile projects allow those people to be happy at work instead of bitter, cynical, and discouraged. I hope that those who would like to work in a mangle-ish style will benefit from learning how we software developers get away with it.

A *mangle-ish story* is one that highlights a trajectory in time during which a prolonged interplay of resistance, accommodation, and chance leads to results that could not reasonably have been predicted from the story's initial conditions. It is, moreover, one in which everything is up for revision during that trajectory.

Until recently, no one told such stories about the development of software products. Instead, the story of a software project was supposed to follow this template:

1. Work begins by producing a complete list of requirements that the product must meet. A requirement is a truth-valued statement about the next-released version of the product. Once all requirements have been met, the product has, by definition, solved the problem that prompted its creation.

2. Work continues with a specification of the product's interface. It describes everything that anyone with minimal qualifications would need to know to predict how the product would behave when given an arbitrary input. The specification also meets all of the requirements.

3. The next step is an abstract design of the product's internals (often called the "architectural design"). This design, when realized, implements the specification.

4. There follows some number of progressively less abstract designs. Each one realizes the one before it.

5. Written last, the actual code (instructions to the computer) realizes the least abstract level of design and thus, transitively, satisfies the requirements.

The standard texts have asserted that completing steps like these in the sequence given is the ideal way to develop software.[1] These texts concede that developers err and that they overlook requirements. They write requirements ambiguously, thereby causing later writers to produce the wrong design. They think a design implements the specification when it does not. And so on. Practitioners thus have been instructed to take failure into account, mainly by putting in place measures to detect and correct it as soon as possible.

However, these deviations from the story line have been deemed inessential and uninteresting. Consider David Lorge Parnas's and Paul C. Clements's widely cited "A Rational Design Process: How and Why to Fake It" (1986). In this essay, they advocate removing all traces of the historical trajectory from the write-up of a software product's design. For example, suppose a requirement were ambiguous. Parnas and Clements would have us revisit the requirements document and rewrite it to remove the ambiguity. We should then propagate the consequences of that change to all of the other documents. The resulting document set describes the product's history as a logical progression rather than actions in time—that is, the authors note, as if "we derive[d] our programs from a statement of requirements in the same sense that theorems are derived from axioms in a published proof" (251). The error can now be forgotten.

This is effaced history. There is no mention of emergence; no agency except that of the designer. It is not mangle-ish.

Agile Software Development

Agile projects run differently from those espoused in the standard texts.[2] The programmers are guided not by documents but by a person who knows well a *domain* like bond trading or nursing. I call this person the *product director*. The project progresses through a series of *iterations*, each from one week to one month long. At the beginning of each iteration, the product director tells a team of programmers and other technologists about the most important features currently missing from the product. The team responds with estimates of how long it would take to add each feature, and the product director selects a set of features that can be finished within the iteration. The team immediately begins writing code to implement those features, asking questions of the product director along the way. Design consists of conversations, moving 3x5 cards around on tables (Beck and Cunningham 1989), and scribbling on whiteboards. Few, if any, design decisions are recorded, except in the code. At the end of the iteration, the team delivers a *potentially shippable* product containing the new features. The product director could conceivably stop the project at the end of any iteration, with no advance warning, and ship the product to end users.[3]

According to conventional thinking, such a project is doomed. After the first iteration, the team will have code that supports only the first set of features. In the second iteration, they will have to implement features they had not anticipated. Because they had not planned for them, they'll find those features hard to wedge into the existing code. They will be able to do it, but they will inevitably leave some of the code worse than before—thus making iteration three harder still. Over time, the product will decay into what Brian Foote and Joseph Yoder (2000) call "a big ball of mud." At that point, it will take a heroic and lengthy effort to add even a single feature. According to the standard texts, the Agile project is like the hare in the fable: it will look productive at first, but a properly run project will, like the tortoise, win the race.

Proponents of Agile, in contrast, believe that decay is not inevitable. It is possible to make software truly *soft*, but you can't do it by designing for predicted changes. Instead, you should treat each change—predicted or not—as a prod to work the software into a form more accommodating of change, thereby gradually producing a design tuned to the kind of changes that have

actually been called for. Acting on supposed knowledge of the future is more a hindrance than a help.[4]

Even though the design is created opportunistically and not "top down" (in a logical progression from requirements to code), it does not follow that a good design happens without effort or skill. Agile programmers work with certain rules that are believed to lead emergently ("bottom-up") to good software design. Ron Jeffries, one of the three individuals most responsible for developing and popularizing Extreme Programming (Beck 1999), puts it this way:

> Beck [another of the three] has . . . rules for properly factored code: [It] 1) runs all the tests, 2) contains no duplication, 3) expresses every idea you want to express, 4) [contains the] minimal number of classes and methods. When you work with these rules, you pay attention *only* to micro-design matters.
>
> When I used to watch Beck do this, I was *sure* he was really doing macro design "in his head" and just not talking about it, because you can see the design taking shape, but he never seems to be doing anything directed to the design. So I started trying it. What I experience is that I am never doing anything directed to macro design or architecture: just making small changes, removing duplication, improving the expressiveness of little patches of code. Yet the overall design of the system improves. I swear I'm not doing it.[5]

Agile programmers also rely on constant communication. To reduce barriers to communication, teams typically work in bullpens instead of offices or cubicles. Most have daily meetings intended to tell each other what they did yesterday, what they plan to do today, and what help they need (Schwaber and Beedle 2001; Beck 1999). It is also common for programmers to program in pairs (Williams and Kessler 2002). Each programmer might rotate through all parts of the product, pairing with a new person each day thus gaining a generalist's knowledge of the whole rather than a specialist's knowledge of a part.

An Example

People in Agile projects err just as often as those in conventional projects, but their attitude toward error is quite different. Error leads to correction, correction is a change, and any change is a chance for something novel to emerge.

I will illustrate this attitude with a story from Ward Cunningham, one of the founding figures of Agile software development.[6] This story is about the objects that came to be called Advancers. It is one in which a new concept emerged over a series of iterations through what some programmers term a conversation with the code, and what Pickering would call episodes of resistance and accommodation.

Cunningham's team was working on a bond-trading application called WyCash, which was planned to have two advantages over its competition. First, it would be faster and more pleasant for bond traders to work with—an important feature for a high-pressure environment. Second, users would be able to generate reports on a position (a collection of holdings) as of any date—a feature that the competition lacked.

As the team worked on features requiring them to track financial positions over time, parts of the code became increasingly messy and difficult to work with. The team was taking longer to produce features and they created more bugs.

Much of this problem was due to a particular *method.* We can think of a method as an imperative sentence in the formal language used to construct a program. In a bond-trading application, there might be methods like "buy bond" or "alert the user when the price reaches *x.*" The subject of the sentence is a named bundle of data called an *object.* So a complete instruction in a program might be "Hey! You, position! Add this bond to yourself." Before a method can be used, it has to be defined in terms of other methods. So "buy bond" might be defined as something like "Bond, what's your price? Money market account, remove that number of euros from yourself. Brokerage, add this number of euros to yourself, noting that it's for this bond." For the WyCash method in question, the definition was of Heideggerian opaqueness.

At some point, Cunningham's team made a concerted effort to simplify the method. Programmers often approach such tasks by applying *refactorings.* A refactoring is a change to the code that doesn't change its behavior (just as factoring out the variable x from $ax + bx$ by turning it into $(a + b)x$ doesn't change the meaning of the equation).[7] Cunningham's team converted the troublesome method into a *method object.* A method object is a newly named bundle of data that responds to only one imperative sentence: "Do whatever it is that you do." For technical reasons that are not of concern here, method objects are useful when modifying overly complex code. They are often an

intermediate step—a programmer converts a bad method into a method object, cleans it up by splitting it into smaller methods, then moves those to the objects where they really belong. This team, however, left the method object in the program. The reasons are lost. Perhaps, as is often the case, the right way to split it up wasn't apparent.

Leaving a temporary object in a program turns a casual decision into a more serious one. Each kind of object must have its own name. The name of a temporary object can be meaningless. But the name of a permanent object that other programmers will encounter should communicate something to them.

Names might also need to be meaningful to nonprogrammers. Some of the objects that programmers use have nothing to do with the world outside the program. But some of them do, in which case programmers try to use names that make sense to domain experts. WyCash, for example, had Position and Portfolio objects. Although "position" means a different thing to a bond trader than it does to a programmer, the word allows them to coordinate their actions to each of their benefits. This use of nouns (object names) and verbs (method names) is commonly called the project's "ubiquitous language" (Evans 2003). It nicely matches Peter Galison's (1997) claim that communication between different work traditions is akin to the use of simplified creole languages by different cultures who meet to trade.

The temporary name for the new object was "Advancer" because it was formed from a method that advanced Positions. When the programmers asked the domain experts for a better name, they didn't have one. "Advancer" wasn't an idea that bond traders used. So the programmers kept the name and continued to figure out what the object meant by seeing how it participated in program changes.

Advancers turned out, by accident, to be broadly useful. As the project dealt with the normal stream of changes, the programmers found they could get an intellectual grip on them by thinking about how to change existing Advancers or create new ones. They wrote better code faster.

For example, the program calculated tax reports. The government wanted reports described in terms of positions and portfolios, so the programmers implemented the calculations in Position and Portfolio objects. But there were always nagging bugs: someone would run a report on a novel portfolio, only to find that some of the numbers were wrong. Some time after Ad-

vancers came on the scene, the team realized they were the right place for the calculations: it happened that Advancers contained exactly the information needed. Switching to Advancers made tax reports tractable. This was another gain in the team's capability, and a further understanding of what Advancers were about.

It was only years later that Cunningham realized why tax calculations had been so troublesome. The government and traders had different interests. The traders cared most about their positions, whereas the government cared most about how the traders came to have them. It is this latter idea, one that the experts did not know how to express, that Advancers capture. And once the idea is captured, the complexities of tax calculations collapse into (relative) simplicity. But at no point in the story did the programmers specifically set out to invent something new in the language of bond trading. They were only trying to generate the required reports while obeying rules of code cleanliness.

To summarize:

1. An unending stream of unanticipated changes caused programmers to revisit an area of code again and again, iteration after iteration, each time changing the area.

2. As is often the case, the code resisted change. A particular technology—refactoring—was used to make the code more accepting of change. Refactoring is a mostly mechanical process of moving bits of code around without changing the program's external behavior. Its goals have nothing to do with the world outside the program.

3. Nevertheless, some of those moving bits of code coalesced into an abstraction that was strikingly useful when programmers were given unanticipated business problems to solve.

4. Computer programs require that abstractions have names. Something so useful in solving business problems *ought* to be something business people have a name for. It appeared they did not. But once the team picked a name, it became radically easier to think about certain business problems.

5. Advancers presented themselves incrementally and emergently ("bottom up") without anyone at any point saying "We need a large conceptual leap to solve this constellation of business problems." But, after the fact, they were in fact a large

conceptual leap, discovered through a process I find strikingly similar to Pickering's (1995) story of Hamilton and quaternions.

Agile and the Mangle

The story of Advancers is mangle-ish. I can think of no good way to tell it except as a trajectory through time. That trajectory was affected by chance and contingency; had it not happened that there was particular messy code to clean up, no one might ever have thought of Advancers.

Further, the Advancers story illustrates how Agile programming work is performative and not representative. A programmer tries something, the program resists or not, in one way or another, and the programmer accommodates that resistance. Certainly representations and abstractions are created—Advancer is one such case—but for many programmers they are more likely to follow performance than to precede and drive it. As the programmer Bill Caputo states:

> So, I don't start with a story like "The game has Squares." I start with something like: "Player can place a piece on a square." . . .
>
> What I am not doing is worrying about overall game design. . . . [Ideally], I let the design emerge.[8]

There is also what seems to me a decentering of agency. When programmers encounter resistance, it is not uncommon for them to say "The code is trying to tell us something. Let's try it" (Beck 1996). Note also how the quote above by Jeffries ends with "I swear I'm not doing it"—though he is, of course, doing *some* of it. The code doesn't change itself. I see a dance of agency among four agents: Ron Jeffries, the code, the rules that Ron follows and interprets, and the flow of requirements coming from the product director.[9]

I even claim that material agency plays a role. It seems absurd to talk about it: computer code is hardly material, being nothing but patterns of electrical charges. But let me contrast three quotes. The first is from Pickering (1995, 6):

> The world, I want to say, is continually *doing things*, things that bear upon us not as observation statements upon disembodied intellects but as forces upon material beings.

The second is from a programmer, J. B. Rainsberger (2005, 28). The moment he describes is midway through a development session:

> In the process of writing these tests, I felt a familiar twinge that usually indicates the onset of a design problem.

And, finally, we have Kent Beck and Martin Fowler, who popularized the now-ubiquitous phrase "code smells" in Fowler's *Refactoring* (1999, 75):

> If it stinks, change it.—Grandma Beck, discussing child-rearing philosophy

What sensations are closest to "forces upon material beings"? Pain and smell. We do not stand back, disembodied, and observe them. Instead, it feels as if they act upon us. A hot stove *makes* our hand jerk back. A foul stench from rotting food *makes* us retch at the thought of eating it. Using this sensory jargon helps train programmers to fix code without hesitation or second-guessing. It moves right action from the intellectual plane to the plane of reflex.[10]

So we have a dance of agency, where humans accommodate the resistance of code and, by doing so, tune themselves and the code so that they can make requested changes predictably and cheaply. But when it comes to interactive stability, there is something different from Pickering's stories. In those stories, the stable point is the one at which the bubble chamber can be used to observe the tracks of new particles; the free quark experiments can be performed to the experimenter's satisfaction; and Hamilton has a tool that can be used to solve mathematical problems (albeit not the one he started with). It is a point at which people can use a created object as a reliable enough tool. But in an Agile project, the product is supposed to be usable throughout. Even after very early iterations, users could get some value from it. That value increases with each new iteration. It increases the iteration before the product is released, and it increases in the iteration after (the first iteration building toward the next release). Is that steady pace compatible with Pickering's concept of interactive stability?

I believe it is, once two perspective shifts are made. The first is that the dance of agency's result is not the product code. Rather, what we should analyze is the resulting assemblage of programmers + code + product director. In the course of the project, they become tuned to each other such that none

of them can be easily replaced. If one of them is replaced, performance will drop drastically until all three components retune to each other.

The second shift is to forget that the word "stability" implies a lack of movement. There is an active or dynamic stability that I associate with someone balancing a broom during a mild earthquake on a fitfully windy day. The stability is a consistent (stable) *capacity to adjust swiftly and appropriately to a world full of chance.* It is this kind of interactive stability that, it seems to me, Agile projects have. They have arrived at that capacity by tuning themselves to a constant stream of deliberately unexpected change requests, explicitly assuming that the dance of resistance and accommodation will never end. Reflecting this back to one of Pickering's case studies, it is as if Glaser's bubble chamber were worthy of a Nobel Prize not because he enabled experimentalists to create particle tracks they never could before, but because the existence of the bubble chamber made yet more experimental instruments strikingly easier to create.[11]

Getting Away with It

I've completed my argument that Agile projects are intentionally mangle-ish. Project members choose the mangle because they enjoy it. I'm not surprised when I hear programmers and product directors refer to an Agile project as the best one they've ever worked on. But how do they get away with it? The business world doesn't leap to mind as the most fertile ground for mangle-ish behavior.

The two key moves, it seems to me, are to become a personalized black box and to reinforce the base ontology.[12] I'll explain the adjectives "personalized" and "base" later, but first let me give a thumbnail sketch of the base ontology. In it, businesses are machines for converting money into more money. A business is composed of three parts:

1. The part named *planning* balances predictions of the external world's future and the abilities of the company. Given this moment's understanding of possible futures, which use of today's surplus money will produce products that yield the highest risk-adjusted expected return? I'm lumping into planning corporate executives, the *product sponsor* (who perhaps proposed the project to the executives, is

the keeper of the budget, and will be held responsible if the project fails), and the product director (who often works for the sponsor).

2. *Development* converts money, time, and the desire for products with particular new features into actual products.

3. *Delivery* moves products into the hands of people who will give money in return. (I include here advertising and sales as well as order fulfillment.)

Planning can consider development a black box if the latter has three properties:

1. It can answer the question "How much would this new or changed feature cost?"

2. The answer must often be much less than the feature's value, and

3. The answer is almost always close to right.

Given these properties, what happens within the black box to produce the answer and build the software is of no interest to planning, so those within the box can arrange its interior however they like.

The problem with conventional software development is that the answer that development provides is almost always wrong: it is asked to estimate all of the project tasks at the moment of least knowledge—the beginning of the project. Agile teams, in contrast, make firm estimates for only the next iteration's tasks and only just before it begins. At that moment, they can bring to bear what they've learned in previous iterations.

Traditional development's inaccuracy means that the outside must break open the black box and meddle with the workings to make it more reliable. Planning still wants a black box, so the work is delegated to a new entity that is not part of the base ontology. That entity is management, whose job is to be an interface between planning and development, presenting the three key properties to the former and directing the latter.

This approach doesn't usually work either, but the Taylorist command and control doctrine in business is so strong that it is hard to conceive of an alternative. Management is taken to be as fundamental a thing in the world as features, money, the future, planning, and development. But it is actually

a logically derivative role. *In order to* make the business a money-generating machine, management is needed. Were there an alternative, business would happily exist without it, but management wouldn't exist if the base ontology were rejected. It is that sense in which I call that ontology "base."

One way that Agile projects get away with being mangle-ish is to "route around" management. Here, development's explicit message to planning is that the role of the mediating manager is not needed. The business can run better without it. Planning should view the team as a reliable tool easily wielded. "Reliable" here means that it is a black box with the three properties above. "Easily wielded" emphasizes the second of the three. As noted, planning is concerned with the predicted best use of money *at this moment.* One month after a project starts, it is likely that the best use of the unspent money will seem different from what it did at the start. The world will have changed in some unexpected way or planning will have learned something new. The business would be a better machine if planning could redirect development at any moment. Conventional projects have great inertia, so the answer to the question "Can you change this planned capability now?" is very often more than the change is worth. Agile projects promise that it will seldom be.

But making promises is easy. The hard part is getting the listener to believe. Agile projects use two mechanisms to signal to planning that they are worthy of the planners' trust. They are exhibitionist panopticism and the adoption of the planner's ontology.

Progress is demonstrated in a special way: it is visible, tactile, and frequent. When a feature is done, the product director most likely tries it out. Many Agile projects have an end-of-iteration ritual in which they show that iteration's advances to anyone they can convince to watch, most particularly the product sponsor and salespeople (Schwaber and Beedle 2001). But events of visibility are more frequent than once every few weeks. If you walk into an Agile bullpen at any moment, you are likely see what Jeffries (2004a) calls "big visible charts" and Cockburn (2001) calls "information radiators." Among them will be a graph that tracks expected progress against actual progress and a bulletin board studded with index cards, each of which represents one of the current iteration's tasks. Some of the cards will have been crossed out with a thick marker stroke, meaning that the task is done. Someone who casually wanders past the bullpen will be able to see both short-term and long-term progress at a glance. Some projects set up a computer display that allows any-

one who happens by to browse the product's automated tests and run whichever they please. A passed test means that more recent changes haven't broken some earlier feature, and so it continues to have its business value.

In fact, it is common for projects to solve purely internal problems by devising a chart that demonstrates the problem, putting it up on the wall of the bullpen, and then relying on everyone's desire to improve the chart. I call this method "exhibitionist panopticism." Like the panopticism described in Michel Foucault's *Discipline and Punish* (1977), it serves to create a subject. Agile programmers become the kind of programmer who makes the right decisions without being nudged by a chart. It is exhibitionist in that the subjects are actively choosing what the outside can view *and* also choosing to show more than anyone outside asks for.[13] By so doing, they simultaneously make the walls transparent and make the project more of a black box. The constant availability of information reduces the business's desire to meddle with the project, and thus the team retains autonomy to be mangle-ish in the domain of programming.

The fact that Agile teams honor and incorporate the outside ontology is also significant. When I first became involved in Agile development, the most surprising thing to me was how intent the team members were about pleasing their clients. There is a long tradition of programmers being scornful of them. These feelings of scorn sometimes represented the artisan's scorn for no measure of value other than "filthy lucre" and at other times the belief that they know what the market desires as well as do those in the planning category. But when Agile programmers talk about "delivering business value," they don't speak with a cynical or ironic inflection. Committed proponents of Agile are *extremely* reluctant to work on tasks that they cannot tie directly to a visible result that the product director has deemed of value.

This view doesn't diminish their artisan's values; in fact, it appears to me those values are as strong or stronger in Agile projects than in conventional ones. It is just that the most reliable way to be allowed to exercise their values is to honor the business ontology. And the best way to honor it is to incorporate it in addition to artisanal and mangle-ish values.

Incorporation is especially important because of the prevalence of close, frequent, informal contact with the product director. Businesses are not machines, and teams are composed of people. In an ideal project using Extreme Programming (Beck 1999), the product director's main physical location is in the bullpen with the programmers. Although product directors are

typically nominally part of planning, to the programmers they are members of the team. Directors can tell whether talk of business value is pro forma or sincere. For example, the programmers might start a conversation about how a feature could be simplified to reduce its cost. If the conversation starts and ends with what bits of the feature can be lopped off to save time, the programmers have not incorporated the base ontology. If instead the conversation begins with careful quizzing about the sources of value in the feature and only then moves on to how 80 percent of the value can be gotten for 20 percent of the effort (as often seems possible), the product director can feel confident in the team.

Thus, the output of the black box is not just visible, tactile, and frequent new product capability; it is visible, tactile, and frequent new capability *accompanied by a planner* who can vouch for the mangle-ish people inside the box. It is that personal contact and trust, together with the drumbeat of progress, that gives license to the odd behavior of the team: the untidy bullpen, the constant chatter, the strange names (Extreme Programming; Scrum Master), and the crude profusion of whiteboards, sticky notes, and index cards.[14]

The Stirring Conclusion

Agile software development has made surprising inroads in the six years since the phrase was coined. It is an example of a group of people deliberately working in ways that can be readily mapped onto Pickering's model, as well as being successful enough in doing it that they find tolerance and even support from an unexpected quarter—the business world. I am sure that the ways in which Agility gains support do not apply to all mangle-ish ways of working. Nevertheless, I hope this chapter suggests some promising directions for one next step in "mangle-ish studies"—namely, to develop an analytical framework that goes beyond the descriptive to the performative and helps those with a mangle-ish bent to change their world.

NOTES

My thanks to Johannes Brodwall, Bob Corrick, Steve Freeman, Keith Guzik, and Ron Jeffries for their helpful comments on an earlier draft. Special thanks to Keith Guzik for pushing me to think about what really gets interactively stabilized on an Agile team.

1. Two of the most popular texts have been Pressman's *Software Engineering: A Practitioner's Approach* (2004) and Sommerville's *Software Engineering* (2004). Note that the older editions show the conventional ideal in a purer form, whereas the newer ones contain ever-increasing admixtures of Agile and other unconventional thinking.
2. For a description of the Agile methods in general, see Cockburn, *Agile Software Development* (2001). The general approach has many variants. The two most documented (and probably most common) are Extreme Programming and Scrum. For Extreme Programming, see Beck, *Extreme Programming Explained: Embrace Change* (1999), Shore and Warden, *The Art of Agile Development* (2007), and Jeffries et al., *Extreme Programming Installed* (2000). For Scrum, see Schwaber and Beedle, *Agile Software Development with Scrum* (2001) and Schwaber, *Agile Project Management with Scrum* (2004).
3. I've known of two cases where the project was in fact stopped right in the middle, with very little warning, and the product was shipped. Many products do need a little time at the end to put things in final order. For example, screen images have to be collected and put into manuals.
4. Not everyone agrees that one should anticipate *nothing*. Many believe that certain changes are best planned for. What makes those people still Agile is their commitment to making that set as small as possible.
5. Ron Jeffries, Agile Manifesto authors' mailing list, July 19, 2001.
6. I base this story on conversations with Ward in 2003 and 2004. But see also the wiki page titled "What Is an Advancer" at the Web site of Cunningham and Cunningham, Inc. (visited November 2, 2004).
7. Fowler's *Refactoring* (1999) is the canonical text on how to make code better without changing its behavior. There is an entire craft of refactoring. *Refactoring* talks of it, as do Wake's *Refactoring Workbook* (2003) and Kerievsky's *Refactoring to Patterns* (2004).
8. William Caputo, testdrivendevelopment, Yahoogroups mailing list, March 9, 2003.
9. See Jeffries's *Extreme Programming Adventures in C#* (2004a) for a book-length example of decentered agency.
10. There are many examples of Agile projects that rely on perception to cause—or at least reinforce—right behavior. Here is one of my favorite examples. Agile teams typically rebuild the product at very frequent intervals so that incorrect

code changes will be discovered quickly. One team uses two lava lamps to signal the state of the build. While "the build is good," a green lava lamp bubbles. When "the build breaks," the green lava lamp turns off and a red one turns on. It takes about twenty minutes for bubbles to start rising in a lava lamp, so the instant the red lamp goes on, the race is on to fix the problem before the bubbles start. Although this is an arbitrary deadline, it sidesteps any thinking about whether fixing the build is the most important to do. Everyone can see it is. The lava lamp story is given in more detail in Clark's *Pragmatic Project Automation* (2004).

11. Glaser and the bubble chamber might very well have accomplished this by contributing to the experimentalist tradition in particle physics (Galison 1997). And I imagine the invention of quaternions allowed new mathematics to appear. But I suspect that neither Glaser nor Hamilton gave much thought to whether solving their current problem would make the currently unknown *next* problem easier to solve. Agile projects do have that aim.
12. I use "black box" in Latour's sense: "The word black box is used by cyberneticians whenever a piece of machinery . . . is too complex. In its place, they draw a box around which they need to know nothing but its input and output" (1988, 2–3). "[Once a composite object has been assembled into a black box], it is made up of many *more* parts and it is handled by a much *more* complex commercial network, but it acts as one piece" (131).
13. The exhibitionism isn't restricted to outsiders. Programmers are traditionally protective of "their" code (though it legally belongs to their employer). I've found as a consultant that many programmers are reluctant to show their code to anyone else. They know it isn't as good as it should be. But pair programming, especially when pairs rotate, brings all code into everyone's view. That disciplines programmers to write code "they could show to their mother."
14. The Scrum Master is Scrum's equivalent of a project manager. The twist is that she or he is a master of *Scrum*, not of the team. Indeed, one of the Scrum Master's hardest jobs is to keep her or his mouth shut and let the team figure out their own solutions (Ken Schwaber, personal communication, January 2003). The Scrum Master's role is supportive, not directive. One story, possibly apocryphal, is that a team was not allowed to work in a bullpen because the company standard was to use cubicles. The team said they needed a bullpen to work effectively, so the Scrum Master came in one weekend and personally moved the cubicle walls, desks, and equipment. On Monday, he said he would resign if

the bullpen were taken away. It stayed. Apocryphal or not, that story exemplifies the attitude a Scrum Master is supposed to have. Generally, the role of a manager in Agile projects includes removing impediments in the path of the team, facilitating agreement (rather than dictating it), retaining the formal authority to eject people from the team, and advocating career growth and skill development.

The Docile Body of the Scientist

YIANNIS KOUTALOS

Objects of scientific knowledge, from electrons to genes, have become integral parts of contemporary life. We tend to focus on these objects when we consider the effects of modern science on everyday life and pay less attention to another product of scientific activity, the knowing subjects themselves. It takes appropriately trained subjects, working in carefully organized environments and with specialized equipment, to know, discover, or create scientific objects. As bodily practices mediate our engagement with the world, I approach this process of subject formation by focusing on the role of the body of the scientist in the production of scientific knowledge. Indeed, as recent work in science studies has shown, bodily practices, along with the skills and the material settings associated with them, form an essential part of scientific knowledge. Andrew Pickering (1995, 104–9), for example, follows Otto Sibum (1995) in exploring the bodily and material disciplines that evolved as part of Joule's nineteenth-century determination of the mechanical equivalent of heat. Harry Collins's (1985) description of the intricacies of laser building brings forth the relevance of skills and material settings for scientific practice, while from early on Ludwig Fleck (1979) emphasized the importance of a community of competent practitioners in the development of the Wassermann reaction in testing for syphilis.[1]

Different scientific fields employ different skills, equipment, or settings, which in turn would imply different bodily roles. However, a general feature of scientific activity appears to be the separation between knowledge and body and the relegation of the body to a secondary role. Scientific knowledge does not explicitly address the bodily performance required for its production. This deletion of the body in the production of scientific knowledge is

achieved through several practices that are common to a variety of scientific fields. Publications reporting on the results of scientific research consign bodily performance and material settings to a separate "materials and methods" section. At the same time, a physical separation between office and laboratory is quite common, while the evaluation of applications for research funding emphasizes the emergence of knowledge through the testing of hypotheses about the world. Through these practices, the scientist emerges as an evaluator of hypotheses, whose body is expected to perform as necessary and in silence. Pickering (2001, 197–98) discusses this split between the scientist's body and knowledge as a "practical dualism" involving the production of "free-standing machines" and as a separation of human and nonhuman agencies. Steven Shapin (1998), on the other hand, has related the portrayal of a special status for the body of the knower, of the "disembodied truth-lover," to the promotion of a distinctive status for the produced knowledge—a knowledge dissociated from the earthly interests of embodied agents. My approach follows Pickering's (1995) emphasis on the dynamics of local practice and focuses on the impact of the practices that achieve this split on the individual practitioner and on possibilities for doing things differently. My perspective is related to that of Brian Rotman (1993), who analyzes mathematics as an activity carried out by embodied agents and then goes on to consider the implications for the formulation of mathematics.

Something Does Not Feel Right

Salamanders are easy to kill. They are about eight inches long and one to two inches wide; they are slippery, but other than that they are easy to grab and hold. They have no teeth or nails, and their only means of resistance are to try to slip away or to flap their tail. I have killed thousands of them over the years. My colleagues and I use a sharp knife or a small guillotine to swiftly cut off their head and then we destroy the brain and the spinal cord with a long needle. We kill salamanders for their eyes—specifically for the light-sensitive cells of their eyes. Salamanders have tiny eyes, about two millimeters in diameter, but their light-sensitive cells are huge, about ten times the size of those of a human or other mammals. The large size of the salamander cells makes them easy to work with. After killing the animal we remove the eyes, cut them

open, and excise the retina, the part of the eye that contains the light-sensitive cells. Then we use a razor blade to chop the retina into small pieces to free the light-sensitive cells. We do everything, including the killing, under dim red or infrared light so that the light-sensitive cells are not affected. In order to see under infrared light we use infrared image converters—devices that have sensors to convert the infrared light to a dim green, giving us a green and white view of the surroundings.

There are different types of light-sensitive cells, some of which are very sensitive to light and others much less so. At one point we decided to study the less-sensitive cells, the cones, which are responsible for color vision. To do so we used ground squirrels because their eyes have cone-rich retinas. Ground squirrels have sharp teeth and nails, are much more aggressive, dangerous, and difficult to handle than salamanders, especially under infrared light, so we constructed a special cage to use for experiments. The cage was designed to allow us to push the animal into a corner and immobilize it. In our standard preparation for an experiment we put the squirrel in the cage under regular room light, and keep it in a dark cabinet for a few hours. We then switch off the room light, bring the cage out under infrared light, using image converters to see, and then push and immobilize the squirrel in the cage. Through a small hole in the cage, we inject a paralytic drug into the animal's leg. After a minute or so we take the paralyzed animal out, kill it with an overdose of an anesthetic, and subsequently excise the eyes.

One day I was struck by the image we presented in performing this activity. My colleague and I enter the dark room in our white coats, armed with the image converters and the syringes filled with drugs. We take out the cage with the squirrel. I see the animal in the greenish image of the converter: it is sniffing around, unable to see, and running around in fear. Our technological gadgets—the cage, the converter, and the syringes with the drugs—will soon take away its life. I begin to get the impression that the animal is the only living creature in the room.

Simply put, I do not like killing animals. Although I have had this aversion for years, during my work with animals I never took any specific action to deal with it in a direct fashion. Instead, whenever possible I have tried to avoid being the one to kill the animal. Also, I was not the only one who felt bad about killing animals. Some colleagues openly expressed misgivings, others were obviously nervous or even apologized to the animals they were preparing to kill. In short, killing animals was a stressful situation for the scientists involved.

Scientific research often has stressful aspects: working many hours, often at odd times and in dark rooms; trying to publish the research results; worrying about securing project funding, funding on which several people depend for their jobs. One way to alleviate this stressful situation would be to quit the job of scientific research. Or one could change one's field in order to work better hours, with fewer worries, and avoid killing animals.[2] Of course, this approach is not simple. There are practical difficulties in changing jobs and especially in changing research fields, for example, needing to relocate, learn new skills, and make new professional connections. In addition, the work of laboratory research is rewarding in ways that are intimately associated with the stress of the job, including the killing of animals. For example, I enjoy working with light-sensitive cells, asking questions, doing experiments, and obtaining and interpreting results. I am elated when something novel emerges, especially after long periods of failure or the routine accumulation of data. When a new idea comes about, I am overtaken by the excitement of it; I am anxious to kill the animal, obtain the cells, and do the experiment. The killing of the animal is interwoven with the creative excitement associated with carrying out the research activity.[3] Among scientists there are many instances of this type of reaction; for example, I have colleagues who have described similar feelings of excitement associated with the development of animal mutants that also mean a lot of suffering for these animals.[4] Finally, there are broader implications of the knowledge produced by scientific research—notably that it can function as the basis for improving human health.[5] In this sense, using the term "sacrifice" for the killing of animals in scientific research is quite apt.

To summarize, an aversion to killing animals exists in a complicated context, and there is no clear stance or path to action regarding it. Scientific research, like every human activity, entails stressful situations for the individuals engaged in it. In handling stress, different people may choose different directions or solutions to balance feelings of aversion, morality issues, lifestyle demands, creative pleasures, or social responsibility. However, this balancing act is not part of the scientific discourse. It is not officially articulated because it is not dealt with in scientific publications.[6] This is a strange and problematic state of affairs: actual human beings, consisting of material bodies, carry out scientific research.[7] These bodies have to move around in specialized laboratory spaces, kill animals, carry out fine manual tasks, handle dangerous chemicals,

expertly use arcane pieces of equipment, and think, write, and talk about what they are doing. These aspects of their performance play an accepted role in scientific discourse and provide a necessary part of scientific publications. At the same time, these bodies carry desires, hopes, and disappointments and are shaped by their experiences and by their very performance of scientific research. But scientific discourse does not allow this kind of voice to the experiences of the performing bodies. The body of the scientist is in a concrete sense censored. Its experiences are carefully edited before becoming part of the scientific knowledge.

Omnipresence of the Body

Scientific research is carried out by human bodies, and thus bodily performance and material setting are essential parts of scientific knowledge. Indeed, bodily performance and the material setting in which it takes place both receive serious attention in the published reports of scientific research, in which they are usually referred to as "procedures" or "materials and methods." The major emphasis in published reports is on the reproducibility of the results, and scientific journals instruct authors to "describe procedures in sufficient detail so that the work can be repeated."[8] These procedures are also given appropriate attention during scientific training. Science students routinely present the research of published reports as part of their training. A typical question asked during such presentations is *how* something was done, the answer to which typically appears in the "materials and methods" section of the report under discussion. By following and analyzing this material, students learn to associate the knowledge claims of the reports with the procedures they are based upon.

The bodies that are carrying out scientific research are not just any kind of human bodies. They are supposed to be trained, skilled at what they do, and operate within an accepted framework of procedures. The *Journal of Biological Chemistry* instructs that descriptions of experimental procedures "permit a *qualified* reader to repeat the experiments reported [emphasis added]," while "only truly new procedures should be described in detail" and "modifications of previously published procedures not given in detail except when necessary to repeat the work." Similarly, *Nature* requests that "descriptions of methods already published should be avoided; a reference number can be provided to

save space, with the new addition or variation briefly stated."[9] The production of scientific knowledge thus requires skilful and knowledgeable bodies performing within specified traditions of research procedures. The skill and training of scientists are also explicitly considered in the scientific review of grant applications and other forms of research funding. Reviewers of grant applications to the National Institutes of Health in the United States are instructed to evaluate the "investigators" of the proposed research: "Are the investigators appropriately trained and well suited to carry out this work? Is the work proposed appropriate to the experience level of the principal investigator and other researchers?"[10] In the same vein, the U.S. National Science Foundation includes in its review criteria of research grant applications the question "How well qualified is the proposer (individual or team) to conduct the project?" Funding agencies also pay explicit attention to the material setting of the research within which the bodies of scientists move and operate, including laboratory space, facilities, and equipment, as well as the presence of suitable scientific colleagues. For example, a review criterion for grant applications to the National Institutes of Health states: "Does the scientific environment in which the work will be done contribute to the probability of success?"[11]

This emphasis on skills, training, and research environment is not surprising. It is the *disciplined* bodies of scientists acting within highly structured environments that ensure the reproducibility of results—a cornerstone of scientific knowledge.[12] The continued production of trained, disciplined bodies aimed at maintaining scientific traditions is important to funding organizations. The National Institutes of Health provides funding for training scientists at the graduate and postgraduate levels, as well as for the career development of junior investigators.[13] At the same time, the National Science Foundation offers graduate research fellowships in order "to ensure the vitality of the human resource base of science, mathematics, and engineering in the United States."[14] Private organizations also share the goal of maintaining the human resource base for their research programs, and they offer training fellowships as well.[15]

Silencing the Body

Although the production and the performance of the body of the researcher is of significance to science educators, scientific journals, and funding agencies,

the body itself is not expected to speak. Its voice does not appear in scientific discourse, and there is no textual space for its experience to be presented. The disappearance of this potential space for expression is achieved through the separation of the body's activities from what is considered as scientific knowledge. Scientific reports separate the "methods" section describing material setting and procedures from the section on "results" that presents the *findings* of the research, usually documented in figures and tables. A similar separation occurs in grant applications, with experimental procedures separated from the design of the proposed research, where the projections for new knowledge are presented. For either journal reports or grant applications, what passes as scientific knowledge does not include the experience of the practicing scientist. Knowledge is conceived in a textual form and is generally considered to result from testing *hypotheses.* For example, *Investigative Ophthalmology and Visual Science*, the official journal of the Association for Research in Vision and Ophthalmology, looks for "original contributions that emphasize clinical and laboratory hypothesis-based research." The National Institutes of Health places a similar emphasis on hypothesis-driven research. The National Cancer Institute provides a guide for grant applications that asks the applicant to "state the hypothesis clearly" and "make sure that it is . . . testable." The National Institute of Allergy and Infectious Diseases provides a tutorial titled "How to Plan a Grant Application," which advises its users to "develop a solid hypothesis."[16] Problems with the formulation of the hypothesis are cited by grant reviewers as one of the more common reasons for the failure of an application to obtain funding.

There is, of course, research that is explicitly recognized as scientific and does not consist in hypothesis testing,[17] and there are journals that focus on the publication of experimental procedures. Although the emphasis on hypothesis-driven research is quite widespread in the biomedical field, the main point appears to be an emphasis on research that will provide information regardless of the actual—and unpredictable—experimental outcome. For a grant proposal to be successful, it has to ensure at the outset that information will be obtained and that this information will be deemed interesting and important. This kind of emphasis shapes the kind of research that is funded and promotes a view of knowledge as answers to properly asked questions. For research projects to be funded, they have to contribute to the stock of knowledge.[18] Apart from eliminating the space for the expression of the ex-

perience of the body, this view of knowledge has another important implication: it discourages a view of experimental activity as an open-ended process of search and exploration through which humans and the world they live in are mutually transformed.[19]

The emphasis on knowledge as findings produced through the testing of hypotheses, or more generally as clear answers to appropriate questions, is also evident in the downplaying of the information presented in the "methods" section. *Science* magazine "requests that, in general, authors place the bulk of their description of materials and methods online as supporting material, providing only as much methods description in the print manuscript as is necessary to follow the logic of the text," while *Nature* instructs its contributors to keep the methods section short—that is, eight hundred words or fewer. It is rather telling that in several scientific journals, the text in the methods section is printed in a font smaller than that used in the rest of the text. The presentation of procedures in grant applications is much the same as that given in journal reports.

In this context, the handling of the description of the killing of animals is quite instructive. Journals as well as funding agencies are very sensitive to the procedures employed in killing animals. There are legal requirements pertaining to animal welfare and institutional guidelines for the killing of animals. Journal and funding agency instructions deal at some length with animal use. Research grant applications to the National Institutes of Health include specific sections that deal with the use of animals in the proposed research. The applicant is required to justify the use of animals, provide a detailed description of their proposed use in the research, minimize pain and suffering, and describe the method of killing (euthanasia) to be used and the reasons for its selection. The applicant has to state whether the method is consistent with the recommendations of the Panel on Euthanasia of the American Veterinary Medical Association, and if it is not consistent then explain why. Moreover, the policy followed by the National Institutes of Health requires approval from the applicant's institution for the proposed use of animals—approval that is granted by an Institutional Animal Care and Use Committee (IACUC). A grant will not be awarded without such approval. Journals have similar requirements for the justification and description of animal use and killing, assurances of minimized pain and suffering, and compliance with legal requirements. Journals also require the research to be approved by the

appropriate institutional review board (for example, IACUC).[20] Therefore, although the use of animals in research is considered an important issue, the emphasis is on animal welfare and compliance with institutional regulations. No space is available for the individual scientist's responses, thus separating the killing of animals from the human experience. The body is again silenced.

The separation of the body's performance from the knowledge it produces is also reflected in the increased separation of scientific laboratory and office spaces. Such separation implies that knowledge is put together in the office where bodies pore over data brought over from the laboratory, while the laboratory is where the well-arranged encounter with the material world has taken place. The separation is not complete, of course, as junior research personnel typically have their desks in corners of the laboratory. However, there is a trend toward the clear-cut separation of spaces, with new building designs showing demarcated office cubicles where, in some cases, the offices and laboratories are placed in different sections of the floor plan.[21]

The Docile Body

The elaborate production of trained, disciplined bodies is a widespread feature of contemporary societies. After all, the body appears everywhere and is a constitutive part of every interaction, experience, or activity; it provides the material means through which meanings and values become associated with different social structures and functions.[22] The control of the materiality of the body is therefore of primary social importance.[23] In this context, the disciplinary fields that control the materiality of the bodies of scientists echo the broader technologies and discourses that historically have provided the institutional framework for the control of bodies. Michel Foucault has argued that the emergence of the disciplines involved in external control included the manufacture of novel spaces for the segregation of bodies. Thus, new dimensions of corporeality were constructed through the separation of bodies into asylums for the insane, prisons for the criminals, hospitals for the ill, and schools for the children. Other disciplinary technologies addressed the regulation of behavior on the basis of internalized codes, such as techniques implicated in the development of self-government or the self-regulation of behavior. Self-governing bodies rely on the internalization of disciplines, which provide the basis for governing the body by the self.

In the case of science, the creation and maintenance of the trained, skilled bodies of researchers is necessary for the production and reproducibility of scientific knowledge. The creation of trained bodies is part and parcel of the control and manipulation of nature—of the rendering of nature into what Martin Heidegger (1977a) has called *standing-reserve*. But, although the body of the scientist is shaped along with the scientific knowledge it produces, scientific discourse excludes this from consideration and confines the reporting of bodily experience along particular channels crystallized in the guidelines and policies of scientific journals and funding agencies. The silencing of these knowing bodies reduces them to standing-reserve as well, to a resource available and ready for manipulation. This state of affairs is not limited to science but is a widespread feature of contemporary life that has been deplored by many and that has led to calls simply to let go of our "grim and desperate projects of domination and control" (see Pickering, this volume).[24]

Steven Shapin and Simon Schaffer (1985, 77, 344) have linked the disappearance of the body from scientific discourse to the attempts by the founders of modern science to claim a special status for scientific knowledge. As they argue, eliminating from the discourse the role of the body detaches the knowledge from the human activity that produced it and achieves the appearance of matters of fact as given; it places knowledge beyond criticism. The view I have advanced in this chapter is that apart from its rhetorical uses the disappearance of the body from the discourse amounts to a blind spot for scientific knowledge. It deprives the practitioners of science, and the society at large, of the means by which to reflect on the effects of scientific knowledge on the knowers, ourselves.[25] This reduces and lessens us and takes away a piece of our humanity; we are material beings and what we do makes us what we are.[26] Silencing the body wipes out an important dimension of our lives.

Does It Have to Be This Way?

During the course of the many years that I have been practicing experimental bioscience, I have been trying to find ways to address and come to terms with the lack of reflexivity in scientific discourse: How do I go about my scientific practice to bring the body, an integral part of scientific practice, out of the blind spot and to the fore?[27] One direction I took was to examine approaches that do not ignore the body of the knower in the way that modern science

does. One such example was the striving by early Christians to know God, in which the body was at the forefront of their concerns.[28] The Desert Fathers, the early Christian ascetics of the Egyptian desert, saw the body as a tool through which they strove to achieve transformation and salvation. The body was "a field to cultivate." They paid close attention to the needs of their bodies for food and sex, and they used the intensity of their desires—manifested, for example, in sexual fantasies and night emissions—to judge how far they were along the road toward God. Origen, an early Christian theologian, also taught that the body should be heeded. He felt that because the body was not under the complete control of the will, it was an important source of resistance to a virtuous Christian life. Without such resistance, the pursuit of a virtuous life would have been meaningless. Moreover, he perceived the body to be closely connected with the soul and in tune with its particular needs. The body was the essential counterpart through which the soul adjusted to its specific material environment. In contrast to the pagan views of that period, Origen saw the body as a temple of God, and that the mission of the faithful was to build their bodies into temples of God.

Another approach to knowledge is that of the alchemists.[29] According to the alchemical worldview, there is a parallel between the body and the universe that is expressed in an analogy between the microcosm of the body and the macrocosm of the universe. Thus, the way to understand the workings of the human body is through understanding the workings of the larger world. In this manner, alchemists linked the understanding of nature to the understanding of the body. The alchemists placed further emphasis on the body by holding that the knowledge of nature had an intuitive and experiential basis; knowledge of the powers of nature could not be transmitted by words but rather expressed only through action. Whereas words were inadequate to express this imaginative, experiential grasp of reality, knowledge was specific to the individual and inarticulable. This approach is in contrast to that of modern science, which, though it recognizes the importance of the body of the knower, emphasizes the aspects of knowledge that can be communicated.

In these two examples of different approaches to knowledge, the body of the knower not only plays a central role but also occupies a prominent position. The knowledge that emerges through such approaches may be so tied to the individual that its intersubjectivity is severely compromised, and one

might reasonably argue that it is only proper that the body is censored in modern scientific discourse.

Perhaps not surprisingly, I have found neither the approach of the Christian ascetics nor that of the alchemists amenable for incorporation into scientific discourse or for guiding my daily practice. My own tack instead has been to conceptualize my scientific practice in terms of material performances and, as much as possible, try to describe my activities in terms of everyday life. This has allowed me a grasp of the activity of the body and the associated experiences outside of the grid provided by the scientific discourse of my field. The description of my research activities in common terms also has what I consider the benefit of making it possible to discuss with nonexpert friends and acquaintances what I do and why. This recasting of my scientific activity and my ability to discuss it with nonexperts led me to question its significance for everyday life, including life outside the laboratory. As a result, and over a period of several years, I undertook a gradual but important shift in my research interests and priorities. This shift included embracing experimental techniques that looked toward problems that I considered closely relevant to people outside science and that could be communicated to them in plain terms. To give a simple example, I shifted from studying the details of the conversion of light to an electrical signal by light-sensitive cells to examining the toxicity of the molecules involved in the conversion.[30]

Along the lines of trying to relate my research activity with life outside the laboratory, more recently I have had regular opportunities to interact with individuals and groups of nonspecialists interested in my research. The majority of these people are members of volunteer organizations supportive of the research activities at my institution, as well as high school students, and the interactions consist mainly of my show-and-tell informal presentations in the laboratory accompanied by discussion. Talking to nonspecialists onsite in the laboratory aids in explaining the material performances and spaces associated with the research, and makes evident the special challenges of working in the dark in a small room crowded with equipment. Issues regarding the use of animals for research have not come up in these encounters; the visitors seem to take it for granted and it is not at the top of their concerns. Their concerns center on eye problems and how my research relates to them. Sometimes their questions are quite unrelated to my research: for example, my research deals with light-sensitive cells in the retina, but someone might

wonder how it relates to cataracts or nearsightedness. At other times, the discussion moves toward the relation between eye health and lifestyle issues like diet and exercise. In some cases, visitors have zeroed in on the stated goals of my research and asked pointed questions regarding the stage of the research vis-à-vis final outcomes and human relevance. For example, my research centers on toxicity in light-sensitive cells and my own scientific research interests revolve around the biological processes responsible for such toxicity; but the visitors ask me very specifically what kinds of potential therapeutic agents I have tried that can limit the toxicity and what results I have obtained.

I have found that the conceptualization of my research in terms of bodily performances and making the research activity accessible to nonspecialists has allowed the understanding of my activities within a larger context and added an important component of reflexivity that is generally lacking in scientific discourse. Such an opening chips away at the boundaries that separate the social spaces of scientific practice from society at large (see Shapin and Schaffer 1985, 113, 283) and would allow the more direct participation of the public in the process (Latour 1999). Public input can provide an impetus for developing a reflexive dimension in scientific discourse, as the broader consequences of our modes of engagement with the material world come under examination by outsiders. Such public input could extend to suggestions of research directions to be undertaken and perhaps play a role in the resolution of scientific controversies. Although there are no general institutional frameworks for opening up scientific research to nonspecialist input by the public, patient and citizen groups have provided and continue to provide input and as such they could form the nuclei for broader networks in the future.[31]

NOTES

1. See also Pickering's discussion of Fleck in *The Mangle of Practice* (1995, 16).
2. Whenever I have brought up the stressful aspects of scientific research, and especially the killing of animals, friends outside science have simply told me to quit and do something else. I know of at least two colleagues who have intentionally directed their biomedical research away from the use of animals for obtaining their biological material. Instead, they use cultured cells.

3. This link between killing and excitement happens not only in research but also in learning and teaching. I learned medical physiology, and also taught it, using anesthetized animals, and I found it exciting and rewarding to directly experience textbook concepts of anatomy and physiology. Over the years, however, my excitement subsided and the gruesome aspects of the anesthetized animal teaching exercise became overwhelming.
4. Examining the lists of the different kinds of genetically modified animals and their associated defects is deeply disturbing. However, I encountered a different perspective during the visit of a seminar speaker whose laboratory had produced one particular kind of genetically modified mouse. These mice were modified to lack a protein involved in the regulation of nerve cell activity, and as a result they had frequent, almost continuous epileptic fits. A film showing the animals having such fits was shown during the seminar. I was not the only one disturbed by the presentation, and later in the day several colleagues asked the speaker directly how she felt about creating living things that suffered so much. Instead of an answer, she told them about the researcher in the laboratory who developed the genetically modified mice. Creating a genetically modified mouse is elaborate and difficult, and the researcher had devoted several years to the process. One of the happiest moments in her life was when she had seen the newborn pups having epileptic fits, as it showed that not only had the modification procedure worked but that the protein they had eliminated played an important role in the regulation of nervous system excitability.
5. This is not a superficial, facile justification. Virtually everyone knows people with serious health problems, so a personal interest in health and disease is not an abstract one. Science researchers want to work on important problems and health is one of them.
6. The stresses of scientific life that I have referred to, including the killing of animals, are not a secret. They are well known and discussed openly among scientists. My colleagues do not find anything novel or profound regarding the concerns I have expressed in the text above. Nonetheless, these concerns are not part of scientific discourse.
7. I use the term "body" instead of "person," "body of a person," etc. because it is bodies that move about, carry out procedures, think, talk, write, and so on. I find this single term helpful for the following reasons: its use avoids using different terms according to the activities the scientist is engaged in; it emphasizes that the scientist is a *single* material being engaged in different activities; it draws

attention to scientific research as a material practice; and it encompasses the unarticulated aspects of this material practice—or what is referred to as *tacit knowledge* (see Polanyi 1966).

8. This statement is from the "information for authors" section for submitting manuscripts to *The Proceedings of the National Academy of Sciences USA*, as found at the journal's Web site. *The Journal of Physiology*, which has a narrower scientific focus, states under its instructions to authors that "details should be sufficient to allow the work to be repeated by others." Although my own experience is mostly with biomedical research, there do not seem to be significant differences among journals regarding the format requirements for submitted manuscripts.
9. The statements here and below are taken, respectively, from the 2006 instructions for contributors given on the Web sites of each journal or funding organization.
10. Research grant applications to the National Institutes of Health are required to include the résumés, with lists of publications, of the applicant and the research personnel so that the skills and training of the investigators can be ascertained. The reviewers' personal knowledge of the investigators also plays an important role.
11. This comment is from the resources page of the Public Health Service form 398 (PHS 398, the grant application form), which provides information for the reviewers. The attention to investigator skills and training and to the research environment is standard for grant applications to funding agencies. I have used the National Institutes of Health and National Science Foundation guidelines as typical examples.
12. The discipline of the bodies is taken even further through the introduction of specialized equipment that reifies bodily performance through the automation of certain procedures. The performance of the bodies has to be coordinated with the performance of the equipment, and human activity is structured alongside the equipment.
13. For example, see the Web site of the National Institutes of Health for a variety of training grants, including National Research Service Awards training grants and fellowships and Career Development Awards.
14. The National Science Foundation explicitly promotes the integration of research and education, and an additional consideration in the evaluation of grant proposals to the National Science Foundation is expressed in the following question: "How well does the activity advance discovery and understanding while promoting teaching, training, and learning?"

15. These include, for example, the Juvenile Diabetes Research Foundation postdoctoral fellowships and the IBM research fellowships.
16. The tutorial also cautions the prospective applicant as follows: "Don't confuse your hypothesis with your methods. Methods are the means for performing your experiments. Your experimental results will prove or disprove your hypothesis."
17. The guidelines for reviewers of applications to the National Institutes of Health specifically state: "Do not insist on a hypothesis-driven approach if the research is sound and will move the field forward."
18. Heidegger (1977a, 298–99, 301–5), in his discussion about technology, draws special attention to this process of *enframing* that approaches and *reveals* nature as *standing-reserve*.
19. I thank Andrew Pickering for pointing out to me this critical implication. In *The Mangle of Practice*, Pickering has extensively documented and explored mutual entanglement and transformation—that is, the mangling of things and people that takes place as new knowledge is developed. The view of research as "hypothesis testing" and of knowledge as "answers to properly asked questions" turns a blind eye to this character of knowledge and discourages the search for novel modes of being in the world.
20. "Authors must specify that the work conformed with their *named* national or local scrutineering body" (*Journal of Physiology*); see also the statements in *Investigative Ophthalmology and Visual Science*.
21. I personally find such separations counterintuitive and uncomfortable, and several of my colleagues have expressed the same feelings.
22. See Bourdieu 1990. The body is the medium through which fundamental social choices become *naturalized*; it is the material basis for the constitution of the system of structured and structuring dispositions comprising what Bourdieu calls the *habitus*.
23. Turner (1984) traced to Christian asceticism this notion of control in contemporary Western societies. In approaching the effect of the social order on the body, Turner argues that society is confronted with four tasks: the reproduction of populations in time; the regulation of bodies in space; the restraint of the "interior" body through disciplines; and the representation of the "exterior" body in social space. Weber (1976) argues that asceticism is also in the origins of the rationalization that underlies the coordinated regulation of the social and physical bodies.

24. See also the discussion of the relation between the ideas of Heidegger and those of Pickering in Carol Steiner's "Ontological Dance: A Dialogue between Heidegger and Pickering" (this volume).
25. Latour (1999) makes essentially the same point with regard to the body politic when he discusses Plato's dialogue *Gorgias*: with his disdain for the open procedures of the *agora*, Socrates effectively denies the body politic the means by which to know itself.
26. See, for example, the following statement by Marx and Engels: "As individuals express their life, so they are. What they are, therefore, coincides with their production, both with *what* they produce and with *how* they produce. The nature of individuals thus depends on the material conditions determining their production" (1970, 42).
27. This question is essentially posed in Pickering's terms: How should local scientific practice be changed to take seriously the presence of the body?
28. My understanding and presentation of some of the early Christian attitudes toward the body is based mostly on Brown 1988.
29. I have followed Hannaway 1975 for the following discussion on the alchemists.
30. The research interests and priorities of scientists change for all kinds of reasons, some of which are scientific and some are not. In my case, my preoccupation with the erasure of the body from scientific discourse has played a central role in shaping my scientific interests and priorities.
31. In no way do I envisage public input to be part of a harmonious process. After all, public controversies such as that regarding stem cell research attest to a range of values, aspirations, and expectations held by the public. In my view, such conflicts suggest that the public engagement with and input on scientific research is vital.

PART THREE THEORY

The Mangle of Practice or the Empire of Signs?

Toward a Dialogue between Science Studies and Soviet Semiotics

MAXIM WALDSTEIN

Why does science studies need to engage in a dialogue with semiotics, especially the somewhat enigmatic "Soviet semiotics"? And what would such a dialogue involve? Dialogue is good for intellectual innovation. This might sound banal, but it is not at all unusual to encounter students of the same empirical phenomena who fail to communicate with each other because of their affiliations with different disciplines and fields of research; for example, it is by no means rare to learn that a research field has invented a bicycle that already is a common means of transportation in a neighboring field. The way we get jobs, get published, and build our careers has a lot to do with this self-enclosure within our respective fields and traditions.

Furthermore, the emphatically hybrid, multidisciplinary and a-disciplinary fields such as science and technology studies (STS) can be expected a priori to be open to building bridges across empirical domains, intellectual lineages, and national traditions. Science studies should be especially alert to the potential existence of the resonant, if different, paradigms that are also in the business of transcending the nature versus society dichotomy and conceptualizing diverse objects and processes in terms of their emergent properties, self-organization, and unpredictability.

In fact, there is no lack of such cross-boundary engagements on the part of the leaders of the field. Over the last fifteen years, Bruno Latour's (1993, 1999) work has been marked by his deep interventions into social theory, ecological philosophy, and even patristic theology. Andrew Pickering (2002, 2004a)

is engaged in the long-term project of recovering the forgotten potential of cybernetics. In his *Mangle of Practice* (1995, 33), he issued a call for an "anti-disciplinary synthesis" of ideas convergent with his posthumanist idiom.

In this chapter I argue that in the context of these outreaches beyond the realm of science and existing genealogies of science studies the alliance and dialogue with semiotics, a science of signs, is one of the most obvious choices to make. Indeed, semiotics—especially in its European, specifically French, version—has been one of the most powerful intellectual influences on science studies at the initial stages of its development. Even Pickering, the least semiotically minded leader of the field, admits that semiotics "teaches us how to think symmetrically about human and nonhuman agents" (1995, 12). In this context, the dialogue with semiotics might serve as a kind of reflexive "return to the roots" in an effort to rethink the conceptual foundations of, and historical lineages behind, contemporary science studies. In essence, this is analogous to what Pickering does in his project of rehabilitating cybernetics.

Of course, the main obstacle for the dialogue I propose is that contemporary STS defines itself largely in contrast to language- and text-oriented semiotics. Although Latour originally revolutionized the field of science studies by introducing the ideas and practices of ethnomethodology and semiotics, he later pronounced semiotics to be inadequate "because it persists in considering only texts and symbols instead of also dealing with 'things in themselves'" (1988, 183)—that is, with the machines and practices of making science. Pickering has developed his idea of the "mangle of practice" as an even more radical departure from both structuralist and poststructuralist roots of science studies.

I will consider this critique in more detail in what follows. Yet my argument is that this critique may not apply to the variety of traditions and trends covered by the label of "semiotics." It may apply to French *semiology*, which is associated with French structuralism and poststructuralism and which undoubtedly influenced Latour. Yet, as I am about to demonstrate, some of the theories and research programs associated with "Soviet semiotics" have a lot of points in common with the mangle-inspired research within contemporary STS. In particular, I am thinking about the literary and cultural theories produced by Iurii (Yuri) Lotman, the leader of what Western semioticians and Russianists know as the Tartu (-Moscow) School of Semiotics (TSS).[1]

Iurii Mikhailovich Lotman (1922–1993) was a Russian Jewish literary scholar and cultural historian, a student of the leading formalists Boris Eikhenbaum and Vladimir Propp. Because of the anti-Semitic campaign against "cosmopolitans" in the early 1950s, Lotman was forced to seek an academic position in the university town of Tartu in Soviet-occupied Estonia instead of in his native Leningrad. This forced relocation later proved to be a great asset, and Lotman made full use of it by turning Tartu into an international center of cutting-edge humanistic research and a gravitation point for many unorthodox scholars searching for a niche within Soviet, presumably Marxist, academia. Despite the relative isolation of Soviet science, the TSS, founded by Lotman in 1964, put Soviet humanities on the international map along with the newly discovered work of the Russian formalists of the 1920s and 1930s and Mikhail Bakhtin (see Andrews 2003; Kupovykh 2005; Schönle 2001; Seyffert 1983; Shukman 1977).

In their close association with Roman Jakobson, the TSS and Lotman in particular have had some modest impact in the West (see Eagleton 1996; Jameson 1988). In the early 1970s, the TSS was riding the wave of considerable interest in structuralism and its Russian roots. Yet, by the 1980s, its influence was largely eclipsed by the advent of French poststructuralism. The empirical focus by Soviet semioticians on Russian high and folk culture, their emphatic scientism, and their desire to build bridges with the hard sciences, especially cybernetics and information theory, were among the distinctive features of the TSS and the reasons for its failure to attract more attention in the West.

In what follows, I argue that the aura of scientism and structuralism around the TSS did not allow, for many years, an alternative trend within the TSS to be seen. I demonstrate that since the early 1970s Iurii Lotman was gradually constructing an original synthesis of formalist, structuralist, and even poststructuralist intellectual strategies on the basis of what might be called a "materialistic" and "historicist" understanding of literature, art, and culture as a whole. I further argue that this understanding is remarkably resonant with the ontology developed by Latour and Pickering at the turn of the century. Both traditions tend to consider their respective fields, culture and science, in terms of complexity, self-organization, unpredictability, and temporal emergence, and both see their respective objects in symmetrical terms, as "simultaneously real, discursive, and social" (Latour 1993, 64).

Finally, I argue that the dialogue between STS and the TSS is not only possible but also potentially fruitful for both the development of STS and the advancement of Pickering's "anti-disciplinary synthesis." In particular, the TSS shows an unexplored potential of the idiom presumably transcended by STS. This should lead to the reevaluation of the identity of STS with respect to its semiotic and even structuralist "roots" and to the realization that all of these traditions have more in common than is usually presumed. Furthermore, as I am about to demonstrate, the dialogue with the TSS helps to problematize the negative assumptions held by STS adherents about the heuristic potential of "text" as a key category for understanding human culture, and of literature and the arts as models for constructivist theorizing and research. Without such problematization, the students of science may be tempted to accomplish the anti-disciplinary synthesis that Pickering calls for by means of the imperialistic imposition of the STS idioms on the neighboring fields of social and cultural studies. Instead of this "imperialism," the virtual encounter between STS and the TSS orchestrated in this chapter offers a more dialogic model for unifying the efforts of diverse disciplines and fields around what Pickering calls "the ontology of becoming."

The Mangle of Practice versus Semiotics

It is by no means an accident that semiotics (or *semiology* in the French tradition, which dates back to Ferdinand de Saussure) is responsible for some of the foundational insights on which the body of contemporary STS is built. Science studies and semiotics share the common agenda that Latour summarized as an objective to "give mediators their dignity—mediators that are no longer simple intermediaries or simple vehicles conveying meaning from Nature to Speakers, or vice versa" (1993, 63). What is the nature of this agenda? And how have STS adherents ended up unsatisfied with the way semiotics has pursued this agenda?

According to Latour, mediators—languages, texts, instruments, machines, and translators—lost their dignity, charm, mystery, and power in the course of the process of purification accomplished by the moderns. Over the last five centuries, modern philosophers, moralists, scientists, and politicians have been occupied with purifying the muddle of interconnections, mediations, and hybrids by separating, crystallizing, and stabilizing the reified entities

like society and nature, subject and object, mind and body, internal and external. The point of this effort was to make the world and other humans an object of "control" and "mastery" by (selected few) humans. In this process, mediators were reduced to the role of more or less efficient but purely technical intermediaries in the "asymmetrical" relationship between human agents and the passive natural world (Latour 1993).

Twentieth-century semiotics emerged as an attempt to systematize and generalize the alternative to this purification idiom, the alternative proposed within structuralist linguistics, formalist poetics, and other branches of the "linguistic turn" in the humanities. The battle cry of this movement was to return dignity and agency to media—notably to words. As Jakobson put it, "The word [should be] perceived as a word and not merely a proxy for the denoted object or an outburst of emotion" (quoted in Erlich 1981, 183).

What I have just cited as a slogan was actually Jakobson's definition of poetry. Indeed, poetry and the arts in general have been consistently resistant to purification—that is, their reduction to a mere reflection of reality or an expression of the artist's inner life. By asserting its ability to form and transform whatever is fed into it, art has become a powerful inspiration—and even a model—for semiotics and other "symmetrical" perspectives on the interrelations between the humans and the world.

By translating the "author" and his or her real-life material into the textual functions and the nodes in the network of signifying relations, literary semiotics provided an explicit model for a symmetrical description of human and nonhuman agency, the description in which both are mutually constitutive. By seizing the middle ground between subject and object as well as society and nature, semiotics challenged modernist distinctions and foregrounded what was invisible, the work of mediation. By calling into question the very language of our culture and science, semioticians opened a way for analyzing how not only artistic works but also scientific facts and "true" theories are in fact constructed linguistically and communicatively.

Latour and his colleagues took up this hint in their original assault on the positivistic conception of scientific knowledge. The problem facing science studies was, and still is, that this positivism is rooted in the very nature of the scientific enterprise. The erasure of "any trace of ownership, construction, time and place" is a defining aspect of the processes of which this enterprise is composed (Latour 1987, 23). The more successful this erasure, the more

"factual" is the fact and the more "reliable" is the theory. Yet, here is where semiotics enters the scene. Its methodology allowed Latour and Woolgar to see this "erasure" as a kind of literary device and the solidity of a scientific fact as a kind of literary achievement. Their semiotically informed gaze allowed them to see a space composed of texts behind the visible solidity of a scientific fact: "There is nothing but a wall of archives, labels, protocol books, figures, and papers . . . between scientists and chaos" (1986, 245). The impression semiotics made on early STS studies was such that Michel Callon came to the conclusion that "sociology [including the sociology of science] is simply an extension of the science of inscriptions [that is, semiotics]" (quoted in Pickering 1995, 13).

However, this honeymoon between semiotics and science studies did not last. Very soon, science studies started to fashion its agenda in opposition to the legacy of the linguistic turn—semiotics in particular. By the end of the 1980s, Latour was arguing that the reduction of scientific facts and theories to the inscriptions left behind by the communications among scientists was a necessary but by no means sufficient stage in the work of opening the "black box" of science and understanding its inner workings (1988, 183). In his essay "We Have Never Been Modern," Latour argued that by seizing the middle ground between subjects and objects French sociologists ended up locking themselves in the domain of media and representations. They reduced material and human agency to textual effects—the effects of "a text that is writing itself, . . . a play of signifiers without signifieds" (1993, 64). Latour's key point is that semiotics, or semiology, may have liberated language and writing from its invisibility but it did so at the cost of disenfranchising other agencies in the network.

It is Pickering who offers the most consistent anti- and nonsemiotic perspective within STS (1995, 2001). In his conception of the mangle of practice, he proclaims the radical epistemological shift from observations and texts to machines and practices. He makes this point by opposing the *representational* and *performative* idioms in science studies. According to Pickering, the former reduces scientific practice to making observations and recording, storing, and interpreting them through existing theories and narratives, as well as challenging them on the basis of other texts. It is no surprise that this approach may afford a solipsistic image of the "empire of signs" in which humans and things are represented as "functional equivalents" and thus as

"shadows of themselves" (1995, 6; cf. Barthes 1982). The performative idiom, on the contrary, embeds these textual, semiotic, or representational chains in observable, palpable practices of coping with material agency, constructing machines, making experiments, and engaging in other risky enterprises "in the thick of things." In short, the performative idiom portrays science as something that "does things" rather than simply represents or stands for them.

Here, Pickering sets his realism and materialism in opposition to the idealism and textualism of semiotics and semiotics-inspired STS. Of course, this is not classical humanistic and naive realism. For Pickering, nature does not simply exist "out there" to be discovered and represented by human actors; on the contrary, "the world makes us in one and the same process as we make the world" (1995, 24). This means that the "truth" of our scientific knowledge does not exist independently of the practices in which it is established. For a realist Pickering, just as for Latour, facts are still produced, or manufactured, not discovered.

This posthumanist and "pragmatic" realism may not seem very different from poststructuralist semiotics inspired by the works of later Barthes, Derrida, Kristeva, and others. Yet along with the obvious similarities there is a clear difference. For instance, it is one thing to think symmetrically by proclaiming "the death of the author" and "the infinite deferral of the signified" and to consider humans, machines, papers, plans, concepts, and things such as microbes as simply nodes in the continuous network of signifying relations, mediations, translations, and negotiations of meaning (see Barthes 1979, 76; Foucault 1979b, 159). It is quite another thing, though, to see these actors as materially different, even incommensurable, forces engaged in practical, material interactions in which they are variously engaged, captured, adjusted, transformed, brought apart, reassembled, tinkered with, and tuned together without a guarantee of "perfect tuning" (see Pickering 1995, 53).

Thus, instead of the image, implied by poststructuralists, of a self-writing, self-referential text, Pickering offers another image—that of "a kind of machine built from radically heterogeneous parts, a supercyborg" of sorts (1995, 183). This idiomatic shift has immediate consequences for the methodology and practice of science studies. Instead of focusing on texts behind facts, Pickering focuses his research on machines and instruments as paradigmatic mediators between human and material agency. Instead of dealing only with

the discursive construction of science, he pays close attention to how instruments and machines "capture" and frame human and nonhuman agency in laboratories and other academic settings in an effort to stabilize the resultant assemblages of forces into scientific facts and tenable theories.

Pickering's "machines" are not just mechanical intermediaries programmed to transmit information without distortions or perform any other operation needed for humans. This is what so-called "free-standing machines" have been expected to do.[2] Cybernetic machines like the homeostat provide a much better model for Pickering's conceptualization of what he calls "machinic agency." These kinds of machines are manifestly designed to do the things that the operations of other machines tend to conceal: they adapt to the environment, learn from preceding interactions, and change their own behavior and the behavior of other agencies such as the goals and interests of experimenters and other humans involved. Furthermore, unlike poststructuralist "discourses" Pickering's machines cannot treat their environments as pliable putty for control and mastering. The kind of translations in which they serve as mediators takes place not in the airless realm of discourse but in real space and time.

At this point we reach another crucial dimension of Pickering's framework—temporality and "historicism." To be sure, with respect to the theme of time and history STS adherents cannot claim a total rupture with semiotics. When French structuralists insist on the multiplicity of temporalities that cannot be integrated within one master narrative of history, STS does not have any problem with this idea. When poststructuralists, following Derrida, announce something like "history not only passes but transforms" (Latour 1999, 306), STS has nothing to do but agree.

Pickering argues, however, that the differences are more pronounced on the level of research practice. For instance, cultural studies as inspired by poststructuralism does not know real historicity; rather, it "can only register correlations and alignments between multiple elements and strata, but, in default of tracking the details of cultural evolution, the temptation is to unreflectively assign explanatory priority to some subset of these elements" (1995, 223). That is, by avoiding time and history cultural studies risks exaggerating the plasticity of some cultural elements and assigns to others—such as power apparatuses—the ability to be non-emergent "unmoved movers" of the emergent transformations within human practice.

In contrast, in Pickering's view, "scientific culture has to be seen as intrinsically historical, in that its specific contents are a function of the temporally emergent contingencies of its production" (1995, 209). In his framework, historicity and materiality hang together. "History transforms" precisely because scientists recurrently run into *resistances* to their plans and goals on the part of not only other humans but also institutions, machines, and things. In response, scientists revise their plans, theories, interpretations, and conditions of the experiment or machines involved—that is, they perform *accommodations* toward resistances they meet. This patterned alternation of passive and active stances, or a "dance of agency," behind brute contingency and open-endedness of the performative process of translation and modeling in scientific practice is what Pickering calls "the mangle or practice" (1995, 22).[3]

Pickering insists that there is no "unmoved mover" that preexists the mangle and defines its course and consequences. He opposes evolutionary theories that postulate the state of equilibrium, or the perfect adaptation between the organism and the environment. Nothing like this happens in scientific practice or any other human practice. Scientific theories and the world, as well as machinic and human agencies, are never perfectly tuned together. At best, they are "interactively stabilized" in the turn-taking sequences of resistances and accommodations. These stabilizations may produce "disciplines"—that is, relatively robust practices such as algebra or imprisonment (1995, 145; cf. Foucault 1977). Yet even disciplines can be unmade. Ultimately, the mangle-ish mechanism of human practice implies that its every aspect is produced in the incessant interplay between various agencies.

Overall, although Latour and Pickering acknowledge the significance of semiotics in promoting the posthumanist and constructivist idiom in the studies of science and culture, they also underline the limitations of purely textual constructivism. Their criticisms can be reduced to two moments: semiotic framework is idealistic (or textualist) and often ahistorical. Pickering's "cybernetic" theory of the mangle is, to an extent, an attempt to go beyond semiotics on these two accounts.

Texts and Things: Toward Materialistic Semiotics

Does this criticism of semiotics mean that thinking in terms of texts, codes, symbols, and meanings has lost its use value for the purposes of constructing

not only a "theory of scientific practice" but also a theory of human practice as a whole? This seems to be what Pickering (1995) is saying. However, this conclusion is based on a number of erroneous assumptions.

Adherents of STS often consider literature and art—the primary objects of semiotics and the models for many of its broader theoretical constructions—inadequate as sources of inspiration for constructivist scholarship. Latour (1987, 61) sets in opposition the artistic text as "a place for a leisurely stay" to the scientific fact as a bastion "made for attack and defense." However, this is not the only understanding of the relationship between texts and facts that is possible. The same applies to Latour and Pickering's identification of semiotics with textualism and idealism. This identification is not necessary, and thus the category of "text" does not inevitably lead into an enclosure in the empire of signs. Last but not least, the critics of semiotics implicitly share the assumption that it is possible to accomplish anti-disciplinary synthesis by means of exporting STS ideas into neighboring fields, without regard for the existing frameworks used by the practitioners of these fields. Pickering's postulate of the scale invariance of the mangle may serve to justify this imperialism of sorts (1995, 234).

In the remainder of this chapter I elaborate on aspects of an alternative strategy of anti-disciplinary synthesis. In short, this strategy consists in seeking a dialogue with the existing theories of arts and culture that share a basic ontology with Latour's and Pickering's STS. The possibility of such a dialogue is based on the idea that art, and literature in particular, and the category of text has not yet lost its ability to provide an instructive model for a constructivist but nonidealistic understanding of human practice.

Due to its strong reputation of being a stronghold of "old-fashioned" structuralism, the TSS seems to be a rather unlikely partner in the dialogue with science studies. Mikhail Bakhtin, another important Russian cultural theorist who gained a much broader recognition in the West in the 1980s, contributed to this reputation. In the early 1970s, he formulated a now-classical criticism of Tartu semiotics by stating that it "deals with the transmission of a ready-made communication using a ready-made code" (1986, 147). In his manuscripts he also confessed that he was bothered by the "enclosure [of the TSS] within the text"—its preference for spatial mapping of meaning and its apparent inability to comprehend the passage of time.

As observers have started to notice only recently, however, these descriptions apply better to Jakobson and his Russian admirers, many of them TSS members, than to Lotman. In fact, starting in the early 1970s Lotman independently developed some of the major tenets of postructuralist paradigm in the framework of Tartu semiotics (Emerson 2003; Schönle 2001). To this, I have to add that Lotman and some of his colleagues did more than this; notably, they went a long way in creating a materialistic and historicist cultural theory based on a concept of "text" compatible and even interchangeable with "machine" as understood by science studies. In what follows, I outline some of the major tenets of Lotman's text semiotics insofar as they are relevant to the comparison and possible dialogue with science studies.

I will start with Lotman's "poststructuralism." Even in his early works on the structure of poetic texts Lotman challenged not only naive realist orthodoxies but also formalist and structuralist ones by developing ideas of the "complexity of a text." Instead of treating a literary text as a sum total of artistic devices or a result of "recoding" or repackaging an already existing message from one code (language) to another, Lotman conceived of a text as a "complexly constructed meaning" (1972, 38).

A text is complex when it cannot be restated in a compressed form without a significant loss of information (Lotman 1964). Here, Lotman follows Andrei Kolmogorov's version of information theory. More original is his portrayal of the mechanism of complexity (1972, 1990, 1998 [1970]). A text's complex texture is "woven" (see the Latin term *textum*) out of a multiplicity of "codes" including genres and styles, meter and rhyme, rhetoric techniques, and ideologies and other texts. For instance, a poetic text can be seen as the superimposition of a supplementary order—meter, rhythm, repetitive sequence, or a distinctive graphic pattern—on a piece of ordinary discourse. In effect, ordinarily unconnected words, sentences, and even morphemes (such as endings or roots) appear to be connected in new and unexpected ways. Both the "what" and "how" of the text in question appear to bear a distinctive "semantic load"; and, as Lotman states, "any element, including misprints, may turn out to be significant" (1990, 48). This leads to "stifling the primary semantic connections" (28–30), and the act of communication loses its fluency and turns onto itself. In other words, the unlikely juxtaposition of the fragments of various discourses challenges the naturalness and familiarity of the link

between the signifier and the signified, and thus makes it a matter of conscious choice rather than that of "automatism," to use a formalist phrase.

Indeed, this description of the mechanism of irreducible complexity is a version of the Russian formalist idea of defamiliarization, where art snatches ordinary things out of the context of their habitual associations and makes them look "strange"—as if seen for the first time (see Erlich 1981, 76). Yet in contrast to the early formalists, Lotman's work in the 1980s no longer limited textual complexity to sophisticated literature and art. Like Barthes and his *Tel Quel* colleagues, Lotman finds it anywhere in human culture—in such diverse areas as mythology, fashion, cooking, politics, and everyday behavior (1990, 33). Art retains the status of activity in which the interaction between irreconcilable discourses is an explicit factor in the author's composition and the reader's reception of the text. This convergence with French theorists has been difficult to notice considering that Lotman's subjects are usually historical and Russian.

Other notable convergences include those between the poststructuralist and Lotman's understandings of "translation," "play," and "intertextuality." Lotman's "text" is as much a message as it is a medium. Yet, it is not an intermediary that simply conveys messages that can equally be conveyed otherwise. A text also "translates" in a sense shared by STS adherents and poststructuralists; in Latour's words, translation is "displacement, drift, invention, mediation, the creation of a link that did not exist before and that to some degree modifies the original two" (1999, 179). According to Lotman (1990, 28), the interactions in the textual plane create "new, relationary meanings" irreducible to, and unpredictable from, the original expectations.

This sense of unpredictability, open-endedness, contingency, and emergence leads Lotman to introduce "play" as central to his text semiotics. Even in his early writings the concept of "play" refers to the situations in which rules (codes, genre conventions, etc.) are not fixed in advance: "Rules are established in the course of playing" (1964, 174). Later, Lotman repeatedly argued that the course of the textual play is not bound by any preliminary expectations or meanings. Thus understood, textual play involves "an acute awareness of the possibility of other meanings" (1998 [1970], 77).

Finally, in contrast to many of his structuralist colleagues and to his portrayal by Bakhtin, Lotman opens up his notion of "text" to the outside social world. He argues that each word in a poem is perceived by a reader, and thus

should be explicitly understood by a researcher, not only against the background of other words in the poem but also against the background of other poetic and non-poetic uses of this word in literary tradition and everyday life (see Gasparov 1994, 12). In Lotman's commentary on Aleksandr Pushkin's *Eugene Onegin* (1980) he demonstrated to what extent it is impossible to understand the complex, subtle, and playful structure of the poem outside of the network of intertextual and social relations that constituted the everyday life of the Russian gentry in the early nineteenth-century. Far from assuming that the internal text structure reflects social reality somehow, Lotman showed how both texts *reflect upon* the "extratextual reality" and this reality sometimes *models* itself on texts (1980, 8, 11, 371).

These remarks reveal both Lotman's structuralist roots and his ability to go beyond structuralism. Yet, Lotman did not simply reinvent poststructuralism under Soviet conditions. Instead he went in a rather different direction, which incidentally anticipated, on a number of accounts, the performative, posthumanist and realist idiom developed by Latour and especially by Pickering. In short, he did in the 1970s and 1980s what STS adherents claim to be doing today: he turned contemporary semiotics on its head and thus put literary and cultural theory on its feet.

There are two major aspects of this "revolution": Lotman's materialism and historicism. Before I turn to Lotman's account of temporal emergence in textual construction, let me discuss how materialistic semiotics is possible. As noted above, according to Pickering this is an oxymoron: either you are trapped in the world of "shadows" or representations, or you deal with "things themselves." However, this quasi-Platonic vision prevents us from seeing that texts are things—and in the STS sense of the word, too.

Lotman's texts are "things" in a number of ways. He demonstrates that the way texts are constructed and do things in the world cannot be understood only in terms of the infinite games of purified signifiers, the materiality of which is constantly deferred. In Lotman's account, semiosis, a meaning-making process, involves both signifiers and signified, soul and body, richly polyphonic cultural objects (symbols, other texts) and "asemantic" sights and sounds of the material world—a drumbeat, the rhythm of the train wheels, the material texture of the canvas, a sunrise in the Grand Canyon, or an accidental wax stain on an unfinished painting (Lotman 1990, 20–35).[4] In STS terms, Lotman's "text" is a heterogeneous and posthuman space,

or a "surface of emergence," in which various human, nonhuman, social, and material elements enter into a set of unpredictable and performative interactions.

Thus portrayed, literary, artistic, and broader cultural texts are much more like STS's scientific facts than Latour and Pickering would want to admit. They are made out of resisting matter rather than out of malleable putty in the "hands" of discourse. As one of Lotman's colleagues pointed out, it is a "deconstructionist" theorist who inhabits "a comfortable apartment in which he enjoys an opportunity to move furniture from here to there" (Gasparov 2000, 237). Actual writers, artists and students of culture have to tackle with "the chaos of resisting things" (237). Just like some facts and theories in science, many texts may disappear in the fissures of expanding intertextuality, while others are able to "withstand the assaults of a hostile environment" (Latour 1987, 45). Incidentally, this implies that the process of production and diffusion of scientific knowledge and, for example, literary classics may have more in common than is generally thought.

As if to underline this convergence, Lotman introduces a battery of idioms that reminds us more of Pickering's mangle than of Barthes's play of signifiers. If metaphors of "conflict" and "rupture" can be traced to Marxism and late formalism, then the idioms of "flickering," experimentation, and machinic analogy have a distinctively STS taste to them. For instance, Lotman frequently points out that literary texts, especially poetic ones, produce their "consciousness-expanding" effect on readers by the mechanism of pulsation, or flickering (*mertsanie*), of different discourses, plot lines, rhythmic patterns, and graphic setups of the text. He also often adds that the "flickering" between forgetting and not forgetting when one is confronted by an imaginary happening is the essence of the "work" accomplished by the work of art. Lotman shows how this flickering effect helps to transform the text in the reader's perception from a mere transmitter of information into a generator of meaning, a partner in the dialogue, and an initiator of the reader's "self-discovery and auto-psychotherapy" (1990, 29). The way that Lotman describes this process is quite similar to the way that the brain physiologist and cybernetician Grey Walter described the effect of visual flicker on the brain: "At certain frequencies the rhythmic series of flashes appeared to be breaking down some of the psychological barriers between different regions of the brain" (1953, 91; cf. Pickering 2004c).

Indeed, this similarity is not an accident: Lotman was quite fascinated by the analogy between text and machine. In mature versions of his theory, his image of a text (and later a culture) as a "thinking machine" is not reminiscent of an earlier structuralist image of a stable, closed, and deterministic system. Rather, the "thinking machine" is portrayed as an open system far from equilibrium; a system in the process of incessant mutual adjustments with the environment and among its constitutive structures (codes, texts, humans)—a process of "learning" and meaning making (see Lotman 1992 [1983]). The similarity of this imagery to Pickering's "cybernetic" model of machinic agency can be underscored by the fact that Lotman was at one point seriously proposing an idea of "artonics," that is, the cybernetics of the artistic text (2000, 112–15).

In a similarly STS manner, Lotman specifies this machinic process as "experimentation." Art is an ongoing experiment with reality (1992, 232). In contrast to a daily relationship to things, art is an engagement aimed at awakening the potentialities dormant or repressed within them. Any art is the art of expanding the limits of the possible. Even the most realistic artwork is a kind of laboratory in which we do not necessarily "break with everyday reality (*bytovaia dannost'*), but rather remove the crust from its surface. . . . It is a reconstitution (*perestroika*) of the established and a recombination of the fixed. And therefore, it is a kind of ripping life open (*vsparyvanie zhizni*) from within" (2003, 271).

As a result of the open-ended experimentation "in the thick of things," a literary text is analogous to a scientific fact. The major difference is that the fact is such only upon the demise of the scientific text: the artificiality of texts is not compatible with the "naturality" of facts. Therefore, an STS scholar has to "quit the text and enter the laboratory," in Latour's words (1987, 61). In contrast, the artistic text is itself a laboratory and a fact of culture. It endures in time not due to the successful transformation of the possible into the necessary but by keeping the options open and variants multiple. This openness leads us to another aspect of Lotman's text semiotics, his "historicism."

Text Generation and Temporal Emergence: Lotman's "Mangle"

In searching for allies for his project of extending the mangle of practice beyond scientific practices, Pickering (1995, 223) points to Anglo-American

cultural studies. Pickering's interest is understandable considering that he is particularly indebted to early cultural studies, especially to E. P. Thompson's classical study of the open-ended historical transformation of English social structure in the course of industrialization. Yet, simultaneously, Pickering hardly hides his reservations about the direction in which cultural studies has developed after being profoundly influenced by French poststructuralism. As we have seen, he is weary of the tendency of contemporary cultural studies to focus on "synchronous mapping"—that is to ignore history and to overemphasize the plasticity of cultural resources (1995, 118, 222).

Lotman, on the other hand, does not encounter these problems—despite his reputation of a traditional structuralist. His framework allows him not only to recombine realism with textuality but also to bring together the "synchronous mapping" of the cultural landscape with the account of its transformation in time. In Lotman's latest (1990) theory of art and culture, these are simply two compatible perspectives on the same dynamics of "unpredictable self-development" constitutive of the reality of artistic and cultural texts.

Lotman's semiotics is deeply historicist but not in the sense of the old historicism, which TSS scholars call "Hegelism."[5] In Lotman's words, the Hegelian historicism "teaches us to have reverence for the realized facts," while the Tartu historicism is interested in "what might have happened but did not become reality" (1992, 96). If the old historicism takes the situation *after* the historical choice was made and projects this choice into the past in a search for "origins,"[6] the new historicism explores the cultural controversy *before* it was settled and when it was both "a continuum of potential possibilities" and an "irreversible (unbalanced) process" (1990, 230–33).

In his latest books (1990, 1992), Lotman uses the language of Ilya Prigogine's synergetics to give Tartu historicism its final shape. More specifically, he provides a broad outline of the mechanism of cultural evolution as a cascade of the moments of serendipity, or "explosions" (*vzryvy*). Lotman argues that human history proceeds through a series of points of bifurcation, or situations when preceding states of the system do not determine the outcomes. These are crossroads where decisions on where to go next have to be made under the conditions of the highest unpredictability. These moments lead to ruptures in continuity, or explosions, and the emergence of new "paths" out of the continuum of virtually "equiprobable" outcomes.

In Lotman's definition, culture is "a continuum of potential possibilities with chance serving as the starter mechanism" (1992, 232).

Although Lotman's historicist conception of "explosive evolution" is provided with a mature formulation only in his last books, it can be found in his earlier essays where it is often aimed at narrower matters (e.g., Lotman 1992 [1983]). Within the realm of art, these are his—and his colleagues' and students'—painstaking historical reconstructions of the details of the transformations that various texts undergo in the course of their writing and reading.

In what follows, I will summarize Lotman's (1990, 75–78) account of the history of writing of Fedor Dostoevsky's *The Devils*. This example is interesting not only because it is exemplary within the field of Russian literary studies but also because it reveals the striking commonalities between Lotman's historicism and Pickering's idea of the mangle of practice. As I will try to show, Lotman's dialectics of "symbolic" and "linear" stages in text writing is analogous to Pickering's dialectics of resistances and accommodations. Simultaneously, this microcase allows us to see the differences between two perspectives and the particularities of Lotman's synthesis between synchronic and historical analysis.

The point of departure for Lotman's analysis of "text generation" is his colleagues' mechanistic and structuralist account of this process. This is how Lotman provides a setup for his perspective: "We cannot envisage the generation of a literary text as an automatic working of a single, set algorithm. The creative process is an irreversible process, and hence the passage from one stage to another must involve the elements of randomness and unpredictability. Consequently, . . . if we 'roll up' the text in the reverse direction we will not arrive at the original theme" (1990, 74). Lotman starts his analysis with describing a bundle of "ideas," projects, plot sketches, headings, and potential epigraphs that can be found in Dostoevsky's sketchbooks. This raw material contains a number of "primary symbols," or emotionally and semantically charged clusters of associations brought together by strong personal experiences and social currents, like the populist terror in 1870s Russia. Examples of such symbols in Dostoevsky's sketchbook are "envy," the slap (a recurrent symbol of utter humiliation), and the little red spider. These symbols encompass a range of potential plot developments but they do not define what

happens next. Everything the analyzer can do at this stage, according to Lotman, is to trace the processes of how the writer gradually channels a huge amount of primary symbolic material into a number of episodes characterized by linear narrative structure. Here, intention is being transformed into narration, the creative activity is channeled into existing genre frameworks that "speak by" the writer (Lotman 1990, 74).[7]

Yet, "as soon as this tendency to exposition or narrative construction can be observed, we are witness also to a growing inner opposition to this tendency" (75). Dostoevsky's imagination, his writing, and his thematic *resist* the push for linearity. In effect, the attempt to reduce textual complexity leads to the activation of new associations, links, and possible plot lines: "The syntagmatic construction is replaced by a multi-dimensional space of plot potentialities" (75). What happens at this stage is familiar to anyone who writes: a freshly printed first draft starts to be covered with remarks and even whole paragraphs "written in different handwriting and in different sizes, at different angles. . . . Many of the jottings are not texts, but mnemonic abbreviations of the texts preserved in the author's mind" (75–76).

The next stage singled out by Lotman is, in Pickering's words, "accommodation," or the extraction of the linear elements out of the multidimensionality of the work drafts. And so it goes: through the stages of active planning, sketching, and writing and on up to the stages when the writer becomes "passive" in the face of established disciplines of writing and thinking—until a text achieves a certain closure in the form of the published novel. In Pickering's terms, a text is generated in the course of "interactive stabilizations" through a chain of "free" and "forced" moves (1995, 116).

These analogies are so striking that it is easy to overlook important differences. While Lotman emphasizes the simultaneity of active and passive, or sending and receiving, moves, Pickering primarily tracks their temporal sequence. By emphasizing simultaneity, Lotman wishes to make a point that the writer may be at one and the same moment active and "receiving." That is, he can resist the demands of the reading public or established genres and simultaneously accommodate them selectively within a new textual construction.

This is not a return to "paleostructuralism." Simply, for Lotman, there is no conflict between the synchronous mapping of the textual space and tracking its real-time transformation and extension. What can be seen as a turn-

taking process of resistances and accommodations can also be seen as a tension, struggle, interplay, or "flickering" between two polar but coexisting tendencies and even spaces—activity and passivity, unity and dispersion, continuity and "explosion," as well as center and periphery—within a certain text or another cultural object, from the oeuvre of an author to the culture of the Russian gentry or Russian national literary tradition (see Lotman 1990, 143–50).

In the framework of Lotman's statements in his later years, the languages of spatial mapping and temporal emergence are not only compatible but also interchangeable. For instance, the creative interplay between a narrative discourse and a rhyme in the textual space of a poem can also be rendered as a *process* in which the "original" (*materinskii*) discourse is "invaded" by some "alien semiosis" and produces more or less profound shifts in meaning and performance of the text (1990, 28).

These spatial and temporal renditions are not contradictory for Lotman because they point to different aspects of the processes of self-organization and "self-development" in art and culture. The concept of "unpredictable self-development" is the culmination of Lotman's historicism. This category implies that "cultural texts"—from Dostoevsky's novels to "the Petersburg text" continuously written in words and stone—are complex adaptive systems analogous in principle to their counterparts from the nonhuman world (see Kauffman 1995). Texts, as well as humans and cultures, constitute themselves in mutually adaptive interactions with the outside world of other texts, humans, cultures, machines, and things.

Here, "adaptation" does not mean fitting oneself into the ready-made environment; rather, it has a character of performance and play. Lotman could easily join the Russian physiologist Nikolai Bernstein (Bernshtein) in his telling image of the organism in the environment: "To use a metaphor, we might say that the organism is constantly playing a game with its environment, a game where the rules are not defined and the moves planned by the opponent are not known" (quoted in Gerovitch 2002, 359). Overall, in his theory of unpredictable self-development Lotman breaches the gap between the structuralist methodology of cultural mapping and the historicist study of cultural practices in time. Furthermore, by bridging between culture and life, as well as cultural and biological evolution, Lotman firmly anchors his empire of signs in the material world.

Conclusion

In the *Mangle of Practice* Pickering issued a call for an anti-disciplinary synthesis, yet he did not specify clearly how to achieve it. Two possible strategies of such synthesis come to mind. One is a strategy of imperialistic expansion: by appealing to the "scale invariance" of the mechanisms they study, STS adherents impose their idiom on the neighboring fields of social and cultural studies and largely ignore the categorical and theoretical apparatuses already present in these fields. The second strategy is that of dialogue with existing paradigms beyond science studies in an attempt to find theoretical and methodological convergences. The former, I believe, is more risky than promising and thus should be avoided. Conversely, the latter can be quite fruitful especially if it focuses on idioms whose impact on other fields is hard to overestimate. Semiotics is definitely one such idiom: acknowledged or not, it has furnished contemporary studies of culture with many of its current categories and analytical tools. Yet, as it is commonly understood, semiotics appears to many STS adherents as yesterday's news of limited theoretical and practical value. The objective of this chapter has been to change this impression and to demonstrate the possibility and the fruitfulness of a dialogue with the particular brand of literary and cultural semiotics personified by Iurii Lotman.

Are we now closer to the anti-disciplinary synthesis Pickering is talking about? Time will show. Here it suffices to mention a few immediate benefits of introducing Lotman's ideas to the science studies community. First, due to Lotman's semiotics, art and literature may once more be considered as possible sources of insights into the nature of science and human practice, as they once were. After Lotman, we can no longer set in opposition the artistic text as "a place for a leisurely stay" to the scientific fact as a bastion "made for attack and defense," as Latour (1987, 61) once did. However brilliant, this metaphorical opposition presumes the fiction—shared, ironically, by both common sense and poststructuralists—that art is some dematerialized space for play with symbols without the consideration for these symbols' history and materiality. In contrast, Lotman's semiotics urges us to bring art back to where it belongs—to the chaos of the resisting world.

Second, Lotman's semiotics suggests the compatibility of the historicist perspective on temporal emergence with the synchronous mapping of "transverse cuts through cultural webs" (Pickering 1995, 222). If Latour, Pickering,

and their colleagues accept this idea, this acceptance should lead to a substantial rethinking of the relationships between science studies and structuralist tradition and thus to rewriting the historical genealogy of contemporary science studies.

The third, but probably most important, benefit of the dialogue with Lotman's semiotics consists in the rehabilitation of the category of "text" for use by STS. Lotman removes the stigma of idealism and solipsism from this category by giving it a materialistic and historicist interpretation. In this interpretation, "textuality" provides an adequate medium for translating the mechanism of mangling from the realm of science to other realms of human practice. In effect, Lotman's interpretation allows us to avoid the imperialistic strategy of expansion and suggests a scenario of a more "organic" synthesis of the varied idioms that deal with the mechanisms of self-organization, emergence, and unpredictability in various domains of social life and material world.

In exchange for these contributions, it is only fair to give Soviet semiotics and Lotman's cultural theory one more chance to be considered in all seriousness by the Western academic community.

NOTES

1. I retain the 1970s term "Soviet semiotics" for a number of reasons. First, to differentiate the intellectual idiom of the TSS from "Russian semiotics"—the designation usually applied to the ideas of Mikhail Bakhtin and his circle in the 1920s. Second, to underline the multiethnic membership and the transnational location of the School: Tartu, Estonia, was a Soviet town, not Russian.
2. In Pickering's words, modern "purified discourses emerged as a part and parcel of new regimes of production and destruction dependent upon the use of free-standing machines: cannons, for example" (1995, 4).
3. The mangle "conjures up the image of the unpredictable transformations worked upon whatever gets fed into the old-fashioned device of the same name used to squeeze the water out of the washing" (1995, 23).
4. The last example comes from Leo Tolstoy's *Anna Karenina*: instead of ruining an unfinished painting, the wax stain gave the painter a new idea on how to continue his long-abandoned project. Here, this asemantic, or simply meaningless,

phenomenon acquires a double significance of both a code and a sign upon entering simultaneously Tolstoy's novel and the painting in it.

5. Among unorthodox Soviet intellectuals, "Hegelism" often served as a euphemism for Soviet Marxism.
6. That is, for an old-style historicist, history is "a cultivated forest where all trees converge on [him]" (Lotman and Tsiv'ian 1994, 31–32).
7. Cf. Pickering 1995, 22–23, on the dialectics of passivity and activity.

Ontological Dance

A Dialogue between Heidegger and Pickering*

CAROL J. STEINER

MODERATOR: Today we have a rare opportunity to eavesdrop on a philosophical dialogue between two thinkers, neither of whom considers himself a philosopher, at least not in conventional terms. Martin Heidegger is a thinker about being and the father of his own brand of phenomenology, and Andrew Pickering is a thinker about science practice and the father of the notion of the mangle.

We've come together today for something of a debate—one that was prompted by Professor Pickering's confident claim in his chapter "New Ontologies" (this volume) that Professor Heidegger was wrong in his assertions about science and what Professor Heidegger called "the enframing."

The aim of this dialogue is to bring to light the different perspectives from which both scholars view the intersection between science and life. Their views represent two different generations of thinking about science, although Professor Heidegger was probably considerably ahead of his time

*This imaginary dialogue consists mostly of quotes drawn from Heidegger's various texts and from Pickering's *The Mangle of Practice* (1995) and his chapter "New Ontologies" in this book. In the dialogue, their original words are shown in standard type while all words inserted by me are in italics, except when I speak as the moderator. Where quotes come from *Being and Time*, the Stambaugh (1996) translation is used, but page references for the Macquarrie and Robinson (1962) translation are also shown. Martin Heidegger was a twentieth-century German philosopher who wrote extensively about science and technology but is best known for his analysis of being (ontology). He died in 1976.

and not representative of his generation's thinking about science. His views in many ways are echoed in Professor Pickering's account of the mangle. But they differ on whether or not there still is a singular way of practicing science. Is it, as Professor Heidegger argues, a unitary scientific culture and practice? Or, as Professor Pickering claims, do postmodern forms of science, founded on cybernetics and similar complex systems, represent a multifarious flowering of new scientific ontologies?

Let's begin on common ground by asking Professor Heidegger what he finds appealing about Professor Pickering's work on the mangle. Professor Heidegger, I would have thought you would accuse Professor Pickering of being concerned with beings rather than being—that is, of working in ontic rather than ontological mode.

PROFESSOR HEIDEGGER: The roots of existential analysis . . . are ontic. Only when philosophical research and inquiry themselves are grasped *ontically* . . . does it become possible at all . . . to get hold of a sufficiently grounded set of ontological problems. (Heidegger 1996, 14; 1962, 34)

MODERATOR: So Professor Pickering is on the right track?

PROFESSOR HEIDEGGER: *He is more than on the right track. There are* three basic components of phenomenological method: reduction, construction, *and* destruction. *Destruction is a* critical process in which the traditional concepts, which at first must necessarily be employed, are deconstructed down to the sources from which they were drawn. *The mangle takes us to the sources from which scientific concepts and machines emerge, from the culture and practice of science.* (*Heidegger 1988, 23*)

MODERATOR: Let's begin by looking at how each of you view science.

Ontology of the Mangle and the Phenomenal World

PROFESSOR HEIDEGGER: *In a 1938 lecture I suggested that* the essence of what we call science is research . . . *I saw the essence of research as* the fact that knowing establishes itself as a procedure within some realm of what is, in nature or in history. Procedure does not mean here merely method or methodology. For every procedure already requires an open sphere in which it moves. And it is precisely the opening up of such a sphere that is the fundamental event of research. *That opened sphere becomes the culture in which science is done.* (*Heidegger 1977a, 118*)

PROFESSOR PICKERING: I take culture in the broad sense, to denote the made things of science, in which I include skills and social relations, machines and instruments, as well as scientific facts and theories. (Pickering 1995, 3)

PROFESSOR HEIDEGGER: *Indeed. And all those things get extended through employment of what I called* a fixed ground plan of natural events *which* sketches out in advance the manner in which the knowing procedure *that you call practice* must bind itself and adhere to the sphere opened up. This binding adherence is the rigor of research. Through the projecting of the ground plan and the prescribing of rigor, the procedure makes secure for itself its sphere of objects. *I think your colleague Ian Hacking (1992) called this the self-vindication of science. (Heidegger 1977a, 118)*

PROFESSOR PICKERING: "*Binding adherence" also sounds like what I have referred to as* disciplined human agency, the sedimented, socially sustained routines of human agency that accompany conceptual structures as well as machines and that *constrain human intentionality (Pickering 1995, 29).* I argue that existing *scientific* culture predisciplines the extended temporality of human intentionality . . . *but* the predisciplining of intent by existing culture is only partial. (Pickering 1995, 19)

PROFESSOR HEIDEGGER: *That's right. The culture can't be so draconian as to inhibit discovery, correction, and change. Thomas Kuhn (1970) provides an excellent picture of how binding adherence works in scientific practice and why it is important to scientific progress.*

PROFESSOR PICKERING: *I think the predisciplining of intent is only partial because another force is also asserting itself—material agency in the form of resistances. Resistances can confound the best-laid plans of scientists so that* the goals of scientific practice emerge in the real time of practice *rather than being fixed in the abstract planning of research.* (Pickering 1995, 19–20)

PROFESSOR HEIDEGGER: *I agree that something resists human will and goals in scientific practice, but we differ on where it comes from. As I understand resistances, you situate them between material and human agency. I situate them wholly within the ground plan of science's culture and practice, and I call them change.*

PROFESSOR PICKERING: *That sounds like resistance as disciplined agency. Don't you believe in material agency?*

PROFESSOR HEIDEGGER: *It isn't a question of belief. It's a question of ontology.* If the sphere, *the culture*, that is projected by research is to be *representative*, then it is a matter of bringing it to encounter us in the complete diversity of its levels

and interweavings. Therefore procedure, *what you call practice,* must be free to view the changeableness in whatever it encounters. Only within the horizon of the incessant otherness of change does the plenitude of particularity—of facts—show itself. But the facts must . . . represent the changeable in its changing, must bring it to stand and let the motion be a motion nevertheless. The fixedness of facts and the constantness of their change as such is "rule." The constancy of change in the necessity of its course is "law." It is only within the purview of rule and law that facts become clear *and machines work reliably.* Research into facts *or the fashioning of machines* in the realm of nature is intrinsically the establishing and verifying of rule and law. *Resistances and material agency in your account of the mangle are just changes to be accommodated within the rule and law of science, within its culture and practice.* (Heidegger 1977a, 120)

PROFESSOR PICKERING: *I disagree.* The contours of material agency are never decisively known in advance, scientists continually have to explore them in their work, problems always arise and have to be solved in the development of, say, new machines. And such solutions—if they are found at all—take the form, at minimum, of a kind of delicate material positioning or tuning, where I use "tuning" in the sense of tuning a radio set or car engine, with the caveat that the character of the signal is not known in advance in scientific research. (Pickering 1995, 14)

PROFESSOR HEIDEGGER: *Yes, but I am saying that the resistances and material agency that you talk about emerge wholly from within the rule and law of science, despite having their phenomenal origins in a realm beyond it. Your resistances and material agency are the constructions of science—the way science represents its sphere of thematic interest to itself and deceives itself about its relationship with the world that exists outside it in the phenomenal realm. The ontology of resistances and material agency is man made, not phenomenal.*

MODERATOR: So how do you see the phenomenal world as distinct from the world of the mangle of scientific practice?

PROFESSOR HEIDEGGER: *In* Being and Time *I used the term "world" to name the thingly environment in which people exist—an environing realm of related useful things* (Heidegger 1996, 61; 1962, 93). *I referred to "useful things" as a realm because* there is no such thing as *one* useful thing. There always belongs to the being of a useful thing a totality of useful things. (Heidegger 1996, 64; 1962, 97) *This idea of a realm of interconnected useful things—which I call "equipment" or "stuff" (Heidegger 1996, 64; 1962, 97)—resonates in Bruno Latour's actor network.*

PROFESSOR PICKERING: *But there are people in an actor network. Are there people in the realm of useful things?*

PROFESSOR HEIDEGGER: *No, people have a unique being of their own. But both "useful things" and "world" imply a connectedness with people. Useful things are useful to people; the world is the* wherein *that people live, in "the thick of things" as you call it. People and useful things are codependent and codetermining in their very being, but they are discrete.*

PROFESSOR PICKERING: *I also say that human and material agency* are intimately connected with one another reciprocally and emergently, defining and sustaining each other. (Pickering 1995, 17) *I also say that* a constitutive intertwining exists between material and human agency (Pickering 1995, 15) *and* the world makes us in one and the same process as we make the world. (Pickering 1995, 26)

PROFESSOR HEIDEGGER: *But you also say*, "There exist important parallels between human and material agency concerning their repetitive quality and their temporal emergence. (Pickering 1995, 15) . . . [T]here is, if not a perfect interchangeability, a very important degree of symmetry and interconnection between human agency and material agency: as respectively disciplined in practices and as captured in machines, they are both repetitive and machinelike and they collaborate in performances." (Pickering 1995, 16)

PROFESSOR PICKERING: *You dispute that?*

PROFESSOR HEIDEGGER: *My studies of Dasein (human being) have convinced me that not only are useful things not people but, more importantly, people are not useful things. It is a small step from referring to human agency as machinelike to doubting, as Law (1994) did, that there is any clear difference between people and machines constructed in their interaction. It is a small step from functional symmetry and interconnection to seeing people as part of the standing reserve ripe for exploitation in the technological world.*

PROFESSOR PICKERING: *But I make a strong case for difference based on intentionality. I* recognize that scientists usually work with some future destination in view, whereas it does not help at all to think about machines in the same way. (Pickering 1995, 17) We construct goals that refer to presently nonexistent future states and then seek to bring them about. (Pickering 1995, 18) Human intentionality, then, appears to have no counterpart in the material realm. (Pickering 1995, 17–18)

PROFESSOR HEIDEGGER: *That might be so in the constructed realm of the mangle, but thinking back to that phenomenal network of useful things, I suggest that the relatedness between useful things manifests as a thing's relevance to a task (Heidegger 1996, 78; 1962, 115). That relevance can be a thing's intentionality. Useful things are useful by virtue of being phenomenally suited to a task, not by virtue of being used by people. Experiencing their relevance to a task is how we first encounter them, first take notice of them, first realize they can be used.*

MODERATOR: So you are saying that a thing's usefulness precedes our experience of it?

PROFESSOR HEIDEGGER: *I am. And I am saying that a thing's usefulness based on its phenomenal rather than represented relevance is its intentionality and the source of the resistances Professor Pickering talks about.*

PROFESSOR PICKERING: *Are you saying that phenomenal things intend to resist?*

PROFESSOR HEIDEGGER: *I am saying that phenomenal things do resist. Such resistance doesn't call for what I would term wilful intention so much as phenomenal intention.* Scholasticism speaks of intentio only in reference to the will. (Heidegger 1988, 58) *But intention is also a way of comporting (behaving). The expression "as nature intended" is not a metaphor but an acknowledgment that natural things tend to be, to comport themselves, in certain ways that we do not control.* Comportments have the structure of directing-oneself-toward and of being-directed-toward. . . . Every comportment is a comporting toward; perception is the perceiving of. We call this comporting-toward in the narrower sense the intendere or intentio. Every comporting-toward and every being-directed-toward has its specific whereto of the comporting and toward-which of the directedness which we call the intentum. Intentionality comprises both moments, the intentio and the intentum. The two moments are different in each comportment. . . . They differ each in regard to its own peculiar intentionality. (Heidegger 1988, 58)

MODERATOR: So you are saying that intentionality doesn't have to imply will. It can mean just the relation between the most fundamental purpose (telos) of persons and things doing or being (comporting as intentio) and the functional purpose (techne) of that toward which their doing and being is directed (the intentum), what is intended. That sounds like intention is the relation between (1) people and things being themselves and (2) what they can accomplish by being themselves together. Sort of like accountants tend to crunch numbers and so they manage accounts.

PROFESSOR HEIDEGGER: *And when the phenomenal purposes (telos) of people and things being as they are align with their shared functional purposes of making, building, crafting, or knowing, they produce success, functionality, correctness, competence—achievement of functional purposes. When they conflict, they produce resistance as error, confoundment, failure.*

PROFESSOR PICKERING: *So you're saying intentionality is not adequate grounds for distinguishing between human and material agency?*

MODERATOR: Because useful things like machines also have intentionality that allows them to be useful as they are and as we hope they will be.

PROFESSOR HEIDEGGER: *Or not. Intention can also emerge as resistance. Resistance emerges when scientists' representations require things to be other than they are, other than they are determined to be by their historical place in the phenomenal network of related things and human purposes.*

MODERATOR: How does that work?

PROFESSOR HEIDEGGER: *The usefulness and relevance of a thing to its task is a product of its relatedness within its network. Your friend Latour believes much the same thing, but he says the usefulness and relevance are constructed in the comporting, in the present. I say they are historically determined, precede the comporting, and indeed make the present comporting and the imagining of new things possible. I believe that people witness rather than construct the truth of their experiences.*

PROFESSOR PICKERING: *So is resistance in science phenomenal or constructed?*

PROFESSOR HEIDEGGER: *Both. When the relatedness of things within their phenomenal network is disturbed in the imagining that is science, a thing's phenomenal usefulness disappears from view and our attention is drawn to the thing itself instead. If we are trying to get the thing to be useful outside its network, say in our experiment or machine, then we may experience phenomenal resistance because, detached from its phenomenal network, a thing is just a functionless, nonworking thing, unable to realize its intention. Until you make a new place for it as it is in the specialized sphere your discipline opens up, it will resist and confound your intentions. That is phenomenal resistance.*

MODERATOR: But Latour says things in science exist within a network of heterogeneous actors.

PROFESSOR HEIDEGGER: *Yes, but his actor network is not phenomenal; it is constructed in the moment and is semiotic. It is a representational network governed by the rules of science, not by the telos of phenomena.*

PROFESSOR PICKERING: *How can that be?*

PROFESSOR HEIDEGGER: *You will recall that I said earlier that the relevance of a useful thing to a task is determined before we encounter the useful thing. We recognize usefulness rather than create it. Even when we invent a new useful thing through the mangle of science operating in its own specialized thematic sphere, its usefulness depends on its place within its constructed network. Until we find its place in our construction, it will resist us. That is constructed resistance. If our invention or discovery has no place in either a phenomenal or constructed network—if it is so completely and utterly new that it is unrelated to anything else and irrelevant to any familiar task—it will be beyond understanding and utterly useless. I do not believe we have the capacity to conceive or create any such new thing.*

MODERATOR: But we do create new things and new ideas: computers, photocopiers, genetic engineering, space travel.

PROFESSOR HEIDEGGER: *But at the moment in history when these things and ideas seemed new, the possibility of their becoming had already been revealed. A place already existed for them within a phenomenal or constructed network. The scientists who created them did not create that place for them. Rather these new things and ideas are as they were revealed to their creators/discoverers. Whatever seems new is just newly noticed; it is not newly made. Its becoming is purely a product of its being.*

PROFESSOR PICKERING: *Isn't that an old realist position?*

PROFESSOR HEIDEGGER: *Not exactly. I believe that whatever we encounter is revealed to us,* but we do not have control over unconcealedness itself. At any given time, the real can show itself or withdraw. (Heidegger 1977a, 18) *The realist perspective gives too much power to the rational subject who claims to have the power to bring reality to unconcealedness by the force of its inquiry process. I believe we have no say over what is revealed or withheld. That is the province of being, not us. Being is the limit on our power to control how the world seems.*

MODERATOR: Being? Are we talking about God here?

PROFESSOR HEIDEGGER: *No, being is simply how things are before we encounter them. We do not control how things are. Things are as they are. They do not need will to assert their being. Their intentionality powers them. They are as they are.*

MODERATOR: But we can change the flow of a river, split the atom, splice a gene.

PROFESSOR HEIDEGGER: *Indeed we can, but our efforts do not change the ontology of those things to which we do violence. I maintain that the phenomenal essences of things assert themselves in resistances and, as Professor Pickering correctly points out, success in scientific practice requires accommodation of those resistances.*

PROFESSOR PICKERING: *That* dialectic of resistance and accommodation is, in the first instance, what I have come to call the mangle of practice. (Pickering 1995, xi)

PROFESSOR HEIDEGGER: *A valuable insight, but you didn't follow the trail you blazed to its essential truth.*

PROFESSOR PICKERING: *Which is what?*

Science's Dream World

PROFESSOR HEIDEGGER: All positive sciences of beings, as Plato says somewhere, can only dream of that which is, that is to say, of their thematic object; positive sciences of beings are not awake to what makes a being what it is as a being, namely, being. (Heidegger 1988, 52) The positive sciences—and this is what is remarkable—arrive at their results precisely while dreaming this way. (Heidegger 1988, 54)

PROFESSOR PICKERING: *So scientists are dreaming their objects because scientists do not engage with useful things as they are but as they appear in the ground plan of science?*

PROFESSOR HEIDEGGER: *In the ground plan of science, only discrete things, rather than a phenomenal network of useful things, present themselves.* Sciences as modes of commerce with *discrete* beings always apprehend thematically *only* a piece of what is; as such . . . the sciences of beings . . . dream about beings, but they are not in a position to see a being as something sighted in waking vision . . . to apprehend the being of such a being—*as a useful phenomenal thing with a telos (purpose) of its own—because phenomenal being is not in the ground plan.* (*Heidegger 1988, 53*)

MODERATOR: So it is the *telos* of useful things, then, that is the source of resistance in science? Phenomenal resistance is useful things asserting their being?

PROFESSOR HEIDEGGER: *That's my view. And because those resistances come from outside the ground plan of science, they appear to be a function of "brute chance" as Professor Pickering calls it.*

PROFESSOR PICKERING: *So you would agree that*, in advance, we have no idea what precise collection of parts will constitute a working machine, nor do we have any idea of what its precise powers will be. There is no thread in the present that we can hang onto which determines the outcome of cultural extension. (Pickering 1995, 24)

PROFESSOR HEIDEGGER: *Scientists may dream that they know what they will produce and how it will work, but being has other ideas. I think you are attuned to that at a pre-ontological level because you say*, "Captures and their properties . . . just happen. This is my basic sense of emergence, a sense of brute chance, happening in time . . . the substance of resistance and accommodation continually emerges unpredictably." (Pickering 1995, 24) *You also say, quite rightly, that this observation* "is offensive to some deeply ingrained patterns of thought." *(Pickering 1995, 24) This is because there is strong resistance to over-thinking science's basic concept of itself.* The history of all the positive sciences shows that it is only momentarily that scientists awaken from their dreaming and open their eyes to the being of the beings which they investigate. (Heidegger 1988, 54)

MODERATOR: You said in 1975 that this awakening was happening then. You said that the basic concepts of science were in a state of flux (Heidegger 1988, 54). Was that reference to "basic concepts" a nod to Kuhn's seminal influence on changing our understanding of how science worked?

PROFESSOR HEIDEGGER: *Yes, but* anyone who listens more precisely and detects the true movements of science above the external din and the busy activity of science must see that they are already dreaming again. . . . It is too uncomfortable to sit on a powder keg, knowing that the basic concepts are just well-worn opinions. . . . People have already had their fill of inquiry into the basic concepts; they want to have some respite from it. Philosophy . . . is uncomfortable for the common understanding . . . which is impressed by nothing so much as facts. (Heidegger 1988, 54)

PROFESSOR PICKERING: *So you are saying that scientists don't want to hear about how the mangle works.*

PROFESSOR HEIDEGGER: *They know how the mangle works and they know how to work the mangle. They just don't want everyone else to know, because then the powder keg is lit.*

MODERATOR: So let me summarize what I think Professor Heidegger is saying about the ontology of the mangle and the world of science. The mangle accurately captures the essence of science as culture and practice, as an opened sphere of material, cultural, and conceptual entities that are nontrivially linked through a dance of resistance and accommodation to sustain and extend itself (science) as a productive creator of knowledge and machines.

PROFESSOR PICKERING: *That makes science sound like a closed system.*

PROFESSOR HEIDEGGER: *That is how I see it, as a self-sustaining closed system.*

PROFESSOR PICKERING: *Then how is it that the knowledge and machines of science work in the phenomenal world?*

PROFESSOR HEIDEGGER: *Despite its best intentions to contain itself within its controlled environment of culture and practice, even science is situated within the phenomenal world and is connected to the network of phenomenal things. It just ignores those connections. But those connections create the possibilities that shape the plans and goals of scientists and those connections assert themselves as resistances to be accommodated. I believe the success of science in producing useful knowledge and machines is a testament to the power of phenomenal agency to prevail over science's dreaming. And that is a real post-humanist position!*

Cultural Extension and the Age of the World Picture

PROFESSOR PICKERING: *That view might have been more persuasive last century when modern science was in its infancy and the world of science was highly esoteric, mysterious, and remote from day-to-day existence, but today, science is better understood by more people, the machines of science touch people's lives daily, and scientific thinking and practice are widely respected as a most reliable source of guidance on coping with contemporary challenges. That is testimony to the effectiveness of science's cultural extension, is it not?*

PROFESSOR HEIDEGGER: *Indeed it is, and that is to be regretted.*

PROFESSOR PICKERING: *Why is it to be regretted? Science isn't so different from everyday life.*

MODERATOR: Why do you say that?

PROFESSOR PICKERING: *Like science,* much of everyday life, I would say, has the character of coping with material agency, agency that comes at us from outside the human realm and that cannot be reduced to anything within that realm. My suggestion is that we should see science and, of course, technology as a continuation and extension of this business of coping with material agency. (Pickering 1995, 6–7)

PROFESSOR HEIDEGGER: *I agree with what you say, except when you suggest that science and technology are continuations or extensions of everyday coping with material agency. Consider this: When we are dealing practically with the world, say when we are* hammering with a hammer, we neither grasp these useful things thematically as *mere* things nor do we even know of using or the structure of useful things as such. Hammering does not just have a knowledge of the useful

character of the hammer; rather, it has appropriated this useful thing in the most adequate way possible. (Heidegger 1996, 64–65; 1962, 98)

PROFESSOR PICKERING: *What do you mean by "the most adequate way"?*

PROFESSOR HEIDEGGER: *I mean adequate to understand the hammer as it is.* When we take care of things (*use them practically*), we are subordinate to the *telos* constitutive for the actual useful thing. . . . *We accommodate it.* . . . The more actively we use *the hammer*, the more original our relation to it becomes and the more undisguisedly it is encountered as what it is, as a useful thing. The act of hammering itself discovers the specific handiness of the hammer. *We don't need to do any more than use the hammer as it is intended to be used to understand it.* No matter how keenly we just look at the outward appearance of things constituted in one way or another, we cannot discover handiness. *We cannot know more about the hammer than when we use it.* When we just look at things theoretically, we lack an understanding of handiness *and know less.* (Heidegger 1996, 65; 1962, 98)

PROFESSOR PICKERING: *And your point is?*

PROFESSOR HEIDEGGER: *In our everyday lives, we deal with the world as it is. Scientists deal with the world as they dream it. In our everyday lives, we subordinate ourselves to the obvious purposes of things as they are, we accommodate ourselves to what things can do. Scientists set upon the world and do their capturing and domesticating, their taming and seducing, their taking hold of the world to bend it to their ground plan of production. By dealing with the world theoretically rather than practically—by dealing with appearances rather than functionality—scientists understand the world differently than we do in everyday life. This is why I reject the idea that science is just an extension of everyday coping with the world.*

PROFESSOR PICKERING: *But it must be clear from several decades of science studies that science is not just theoretical. It has practices and it is practiced.*

PROFESSOR HEIDEGGER: *Don't be misled by the conventional meanings of "theoretical" and "practical." When we accommodate ourselves to the relatedness, relevance, and telos of useful things, when we deal practically with things in their network, I say we look at them circumspectly. We look around them and see more than their discreteness.* Theoretical behavior is just looking noncircumspectly, *looking at things as discrete entities, freed of their essential connections, freed for other uses. (Heidegger 1996, 65; 1962, 99) This is why Professor Pickering can say,* "The world will support an indefinitely diverse set of ontologies and bodies of knowledge, each terminating in its own particular field of machines."(Pickering 1995, 32) *When one is unconstrained by what is, one can dream freely!*

PROFESSOR PICKERING: *Not that freely! What about disciplinary agency?*

PROFESSOR HEIDEGGER: Because it is noncircumspect, *theoretical* looking *needs* rules; its canon *must* take shape in method. (Heidegger 1996, 65; 1962, 99) *Disconnected things have no telos, no place in a network, no references to make them meaningful. Disconnected things exist in chaos, so a network must be created for them to create order. Professor Pickering seems to acknowledge this need for order and control when he writes in* The Mangle of Practice, "*Human and material agency* are wild and undomesticated. In the studies that follow, however, human goals and purposes do not seem to be as wild as all that. They appear as already partially tamed, already on the way to being brought to heel by the cultures in which they are situated." (Pickering 1995, 18) *Science constructs an organizing network, what Professor Pickering calls culture and practice. From culture and practice comes the rule and law of science to which scientists must bindingly adhere to create order in their chaotic dream world.*

MODERATOR: So human and material agency are brought to heel by the ground plan and by the rule and law of science, or by the paradigmatic prescriptions Kuhn (1970) identified, or by Professor Pickering's culture and practice.

PROFESSOR HEIDEGGER: *That's correct. But getting back to the point, the practices of science and the network nature of scientific entities are modeled on everyday practical engagement with a networked world of useful things, but are different in origin, effect, and purpose.*

MODERATOR: So the world of scientific practice and culture is a dream world, a constructed world different from the everyday world?

PROFESSOR HEIDEGGER: *If only that were so. But unfortunately we are seeing the everyday world being overtaken by the dream world.*

PROFESSOR PICKERING: *Tell us more.* I feel the need to understand the disciplined, industrialized and militarized, technoscientific world in which I have lived my life and how it ever got to be this way. (Pickering 1995, xii)

PROFESSOR HEIDEGGER: *That is a very comprehensive characterization of the world, as I see it, anyhow.* One of the essential phenomena of the modern age is its science. A phenomenon of no less importance is machine technology. (Heidegger 1977b, 116) *Professor Pickering referred to* "the material dimension of science—the omnipresence of machines, instruments and experimental setups in scientific research." (Pickering 1995, 2) *Those machines, instruments, and setups are now found in our everyday world too, so that, together, science and machine*

technology have created the age of the world picture. "World picture," when understood essentially, does not mean a picture of the world but the world conceived and grasped as picture. What is, in its entirety, is now taken in such a way that it first is in being and only is in being to the extent that it is set up by people, who represent and set forth. . . . The being of whatever is is sought and found in the representedness of *whatever is. This I call the enframing.* (Heidegger 1977b, 129–30)

PROFESSOR PICKERING: So science itself thus appears as a veil, clouding our perception of how things actually are. (Pickering 2006, 6)

PROFESSOR HEIDEGGER: *Unfortunately, yes.* Further, the fundamental event of the modern age is the conquest of the world as picture. The word "picture" now means the structured image that is the creature of our producing which represents and sets before. In such producing, we contend for the position in which we can be that particular being who gives the measure and draws up the guidelines for everything that is. . . . People bring into play their unlimited power for the calculating, planning and moulding of all things. Science as research is an absolutely necessary form of this establishing of self in the world; it is one of the pathways upon which the modern age rages toward fulfilment of its essence, with a velocity unknown to the participants. (Heidegger 1977b, 134–35)

PROFESSOR PICKERING: *If I may say so, Professor Heidegger, you sound like a man unhappy in his own age. Do you want to turn back the clock? Are you longing for a bygone age, a pre-scientific age?*

PROFESSOR HEIDEGGER: The flight into tradition . . . can bring about nothing in itself other than self-deception and blindness in relation to the historical moment. *Holderlin writes*: "If your soul throbs in longing over its own time, mourning, then you linger on the cold shore among your own and never know them." (Heidegger 1977b, 136)

PROFESSOR PICKERING: *So what's your point?*

PROFESSOR HEIDEGGER: *My point is that we must attend to science and technology here and now to understand ourselves, our time, and our world. The mangle has much to teach us about how our technoscientific world is created and how its culture gets extended into every corner of our existence. But now you are going backward and giving in to your modern, humanist tendencies and your scientific history.*

PROFESSOR PICKERING: *How so?*

PROFESSOR HEIDEGGER: *Where once you were concerned with the culture and practice of science that revealed the essence of the enframing and the role of people in effecting its challenge, now you are obsessed only with the opened sphere. Which sphere science opens is of no consequence so long as the culture and practice of science, of the mangle, of the enframing, persists as it does, even in the new complex sciences of systems. The foundational sphere of cybernetics is just a bigger constructed world to be managed, thematized, and conquered if not controlled. Cybernetics may represent the epitome of enframing, the grandest colonization by science of almost everything that is. And you, yourself, have been recaptured by the enframing. How else could you write,* "To renew our ontological faculties, we need to remake the world again, materially as well as representationally. This material transformation is really a big job." (Pickering, this volume)

PROFESSOR PICKERING: *I am still speaking within the dialectic of resistance and accommodation that is the mangle.*

PROFESSOR HEIDEGGER: *But I wonder what happens to that dialectic when you suggest that the new ontologies of science become so open and inclusive and cooperative with nature that what once resisted suddenly has a role to play in the new ontologies. Is there still a dialectic at work? Do we still have need of the mangle as a concept? Or does your notion of the new ontologies of science represent just one more way that research opens up a specialized sphere, more complex and holistic to be sure, but still an opened sphere of represented culture and practice rather than the phenomenal world as we encounter it outside science, in the thick of things? Don't the new ontologies merely represent an attempt to co-opt resistance so it can be overcome and put into service of our postmodern scientific dreamings?*

PROFESSOR PICKERING: *Why do you say that?*

PROFESSOR HEIDEGGER: *Because I think you still approach the world as a scientist and humanist, as a creature of your age. Even as you talk of temporal emergence and material agency in the mangle, you maintain human dominance over what is. That is the hallmark of research and science in the epoch of technicity. When you call the dialectic of the mangle "the dance of agency," who do you think is leading in that dance?*

PROFESSOR PICKERING: The extended temporal sweep of human agency is, for me, a respect in which the symmetry between human and material agency breaks down. (Pickering 1995, 19)

MODERATOR: But you do accept that material agency influences a scientist's plans and goals.

PROFESSOR PICKERING: *Of course.* Scientists do not simply fix their goals once and for all and stick to them, come what may. In the struggles with material agency that I call tuning, plans and goals too are at stake and liable to revision . . . tuning can transform the goals of scientific practice. Goals are temporally emergent from culture . . . and can themselves be transformed in, and as an integral part of, real time practice, which includes sensitive encounters with material agency. (Pickering 1995, 20) Tuning in goal-oriented practice *is what I call* a dance of agency. (21)

PROFESSOR HEIDEGGER: *An Apache dance perhaps! A dance full of violence and conquest. Didn't you say*, "scientists' machines variously capture, seduce, download, recruit, enroll or materialize material agency, taming and domesticating it, putting it at our service?" (Pickering 1995, 7) *Doesn't that have the smell of violence about it? And don't you also admire* [Martin] Krieger's suggestion . . . that physicists take hold of the world as if it were a factory, a site of productive equipment that needs to be managed? (Pickering 1995, 8) *And don't you also claim that* though the machines and instruments of science often display superhuman capacities, their performativity is nevertheless enveloped by the human realm. (Pickering 1995, 16) *You are more of a humanist than you know, Professor Pickering!*

MODERATOR: And a man's man I would suggest. What is this enthusiasm for machines, for boys' toys? And what is all this taming and domesticating? You make science sound like war against the world.

PROFESSOR HEIDEGGER: Science is at war against the world.

PROFESSOR PICKERING: *But I also argue that* the world is filled . . . with agency. The world, I want to say, is continually doing things, things that bear upon us . . . as forces upon material beings. (Pickering 1995, 6) When Morpurgo sought to extend the material and conceptual strata of his culture, the bits did not usually fit together. Resistances continually arose in his work relative to the material-conceptual alignments he needed to achieve to produce facts. (Pickering 1995, x–xi)

PROFESSOR HEIDEGGER: *Of course resistances arose to bedevil Morpurgo's alignments because* for science *concepts* come first, before fulfilling the requirement to open our eyes and take the phenomena as they offer themselves as against all firmly rooted *concepts* and even despite *them*, that is, the requirement to align *concepts* according to phenomena rather than the opposite, to

do violence to the phenomena by a preconceived *concept. Those preconceived concepts are part of the culture, the ground plan, the projected sphere of science. They are mere and deficient representations of the phenomenal network of useful things and seek to limit the phenomenal intentionality of the material world. (Heidegger 1988, 62)*

PROFESSOR PICKERING: *I recognize this. This is why I say* science itself appears as a veil clouding the perception of how things actually are. *I want to know* is it possible to draw back the veil and to live in the presence of decentered becoming? (see Pickering, this volume)

PROFESSOR HEIDEGGER: *Not so long as you believe that this veil is* "merely a stance, a particular tactic of dualist detachment and domination." (see Pickering, this volume) *Not so long as you believe that we can draw back the veil by an act of will. We cannot, as you suggest,* "stop fighting the river and let New Orleans go," *give it up to the Mississippi,* "go with the flow, start fresh with a new geography." (Pickering 2006, chapter 1)

PROFESSOR PICKERING: *Wouldn't this be a* different, better way of living in nature than grim and desperate projects of domination and control? (Pickering 2006, chapter 1)

PROFESSOR HEIDEGGER: *For someone who speaks often of the* "flow of becoming," *you have little respect for history that is the product of the flow of becoming. It is history, not us, that determines what you call "true ontology." It is history, not us, that grants being to what is. And it is not up to us to determine what can or should be. It is not our role to decide now that the Mississippi should be allowed to flow as it intends if that means New Orleans must cease to be.*

PROFESSOR PICKERING: *So you'd still have us dominate the Mississippi?*

PROFESSOR HEIDEGGER: *No, I would have us accommodate what is, which is now New Orleans and levees and the Mississippi as it flows today. I advocate merely "tuning," out of modesty before and respect for what is.*

MODERATOR: So your point is what?

PROFESSOR HEIDEGGER: *The question was, is it possible to draw back the veil of science and get to the true ontology of the world and our relation to it. The form of the question is a product of the veiling itself.*

PROFESSOR PICKERING: *How so? Didn't you suggest that* in the mode of "enframing," we humans seek to step outside nature, dominating and controlling it, challenging it forth as "standing reserve" for circuits of production

and consumption. At the same time, we challenge ourselves forth as specific kinds of beings, as standing reserve for those same circuits. (see Pickering this volume)

PROFESSOR HEIDEGGER: *Your humanism stands forth in your characterization of my thought. Enframing is not a mode of being of people. Enframing is a mode of being itself. It is how the world appears to us, becomes for us, as ready for exploitation and manipulation, as wanting ordering and dominating. We merely respond to that by exploiting and manipulating, by ordering and dominating the world, through science, through technology, through commerce, through rationality. In so doing, we become little more than standing reserve ourselves, challenged forth into service to the enframing. You cannot appreciate the power of the enframing so long as you stand within in, seeing the enframing as the work of people rather than as that which determines human possibilities of relating to the world. The enframing self-veils its own truth. People cannot draw back the veil that being has drawn itself. People cannot reveal truth. It is not a matter of their will or intention. The veil will not be drawn back by men or women.*

PROFESSOR PICKERING: *So there is nothing we can do to change things?*

The Turning

PROFESSOR HEIDEGGER: *The veil of enframing will not lift* without the coming to presence of *Dasein, so there is a role for people in the turning of the enframing toward truth.* (Heidegger 1977c, 39)

PROFESSOR PICKERING: *But not as the engine of the turning.*

PROFESSOR HEIDEGGER: *That's right. To understand the role of people in overcoming the way science and technology see the world, we must look to the comportment of people who seem to be immune to the influence of science and technology. Often artists, artisans, and traditional farmers, people who are open to being however it is given, place themselves in partnership with their materials, the weather, the landscape, the seasons, nature, and their own essence as unique creatures. For them, the enframing "turns" and reveals what you call "true being" and what I would call phenomenal being—equally redundant expressions.* Further, it is precisely in great art that the artist remains inconsequential as compared with the work (Heidegger 1971, 40). *The same holds true for the farmer and his crop, the artisan and his silver chalice, or the poet and his poem.*

MODERATOR: So is that how we can escape the influence of the enframing, by becoming open and selfless in our engagement with the world?

PROFESSOR HEIDEGGER: Probably this turning . . . will finally come to pass only when the danger *of the enframing*, which is in its concealed essence ever susceptible of turning, first comes expressly to light as the danger that it is. (*Heidegger 1977c, 41*)

PROFESSOR PICKERING: *What is that danger?*

PROFESSOR HEIDEGGER: Enframing threatens revealing, threatens it with the possibility that all revealing will be consumed in ordering and that everything will present itself only in the uncoveredness of the standing reserve. *Also*, enframing threatens to sweep *people* away into ordering as the supposed single way of revealing and so thrusts *people* into the danger of the surrender of *their* free essence. (Heidegger 1977a, 32–33)

MODERATOR: What is our free essence?

PROFESSOR HEIDEGGER: Every revealing comes to pass from out of a granting and as such a granting. For it is granting that first conveys to us that share in revealing which the coming to pass of revealing needs. As the one so needed and used, we are given to belong to the coming to pass of truth. (Heidegger 1977a, 32) *What is needs to be revealed to us so its truth can be unconcealed, unveiled. Our essence is to appreciate the revealing as revealing.*

MODERATOR: This is what you meant by saying that people witness rather than make the truth of their experience?

PROFESSOR HEIDEGGER: *That's right. To be human is to witness the truth of what is—that what is is revealed, is given, not made by us or by our minds or by our mangles. People are the partners of being in revealing the truth of what is. But if they are only interested in ordering and exploiting rather than in understanding and appreciating the truth of what is, then they are in danger of losing their free essence and being reduced to standing reserve themselves.*

PROFESSOR PICKERING: *So is it possible to resist the enframing?*

PROFESSOR HEIDEGGER: *It is not about resistance. It is about surrender. We cannot defeat the enframing. It is cultural, social, historical, and centuries old, bigger than any individual and beyond our control. We must instead wait for the saving grace.*

PROFESSOR PICKERING: *Why must we wait?*

PROFESSOR HEIDEGGER: *Because we are not running the show. We are not in charge. We are not in control, regardless of what the enframing leads us to believe. We are at the tender mercy of what is and it will reveal its truth in its own time.*

MODERATOR: So there is nothing we can do?

PROFESSOR HEIDEGGER: *People* are indeed needed and used for the restorative surmounting of the enframing. But *we are* used here in *our* essence . . . human essence must open itself to the essence of technology. *This is what Professor Pickering did in his account of the mangle. He deconstructed basic concepts. This in itself is valuable. It can be* the saving grace. (*Heidegger 1977c, 39*) *Holderlin said*, "Where danger is, grows the saving power also." "To save" is to fetch something home into its essence, in order to bring the essence for the first time into its genuine appearing. *Your idea of the mangle has brought into genuine appearing science in its essence, as a violent, exploitive assault on the world in the pursuit of productive knowledge and machines. You showed us how science through scientists orders and controls and dominates nature. But there is still work to be done.* (*Heidegger 1977a, 28*)

MODERATOR: And what is that work?

PROFESSOR HEIDEGGER: *We have not yet adequately attended to what is concealed from science. What is concealed from science is the ontological domain.* The ontological domain . . . is itself inaccessible in its meaning to positive science if indeed being is not a being and correspondingly requires a fundamentally different mode of apprehension. (Heidegger 1988, 52)

MODERATOR: What mode would that be?

PROFESSOR HEIDEGGER: *The mode of philosophical dialectic.* But for this scientists are fundamentally unqualified since they are not capable of exhibiting what a being is in its own self. They are unable to give an account of what a being is as a being. The concept of being and of the constitution of the being of beings is a mystery to them. (Heidegger 1988, 53)

PROFESSOR PICKERING: *How are they fundamentally unqualified?*

PROFESSOR HEIDEGGER: *Perhaps I should not have used the term "fundamentally," which some people interpret to mean "ontologically." I am not saying that scientists are ontologically unqualified for ontological thought. What I mean is that scientists willingly confine themselves to the thematic domain (sphere) of their discipline and in all of the domains of science*, they make use of presuppositions about what is, about its ontological constitution and leave these presuppositions unmoved. (*Heidegger 1988, 53*) *When I say that science is dreaming, I am saying that science is not awake to the presuppositions that enable it to pursue its interests.*

PROFESSOR PICKERING: *And what might those presuppositions be?*

PROFESSOR HEIDEGGER: *That people can know the world and that people can affect and be affected by the world. Professor Pickering's meticulous scholarship and con-*

fident exposition of the mangle attests to his adoption of the first presupposition, and his creation of distinct material and human realms and the concepts of resistance and accommodation and his new enthusiasm for multiple ontologies attest to his adoption of the second.

PROFESSOR PICKERING: *So what haven't I explored in my account of the mangle that I would have to explore to be more philosophical?*

PROFESSOR HEIDEGGER: *You would attend to your two presuppositions. You would have to consider how it is that we can know the world, affect it, and be affected by it, especially if the material and human realms are distinct phenomena. I guess you could say that you would have to explain why you call the links between science's representations and the world "nontrivial." To a phenomenologist, they are profoundly nontrivial; they raise the most important questions.*

MODERATOR: So what would such a mode of inquiry look like?

PROFESSOR HEIDEGGER: The methodological maxims of phenomenology *are* not to flee prematurely from the enigmatic character of phenomena nor to explain it away by the violent *coup de main* of a wild theory but rather to accentuate the puzzlement. (Heidegger 1988, 69)

MODERATOR: Can you explain those maxims in plain English?

PROFESSOR HEIDEGGER: *When enigmatic phenomena like brute chance are encountered, they deserve more attention than a few sentences of explanation. Theories like the mangle, temporal emergence, and agency would be few and far between. And instead of proffering a Theory of Everything, Professor Pickering would be scratching his head, chewing on his pipe, and reflecting on the mysterious origins of science's arrogance.*

MODERATOR: And what would be the focus of a philosophical inquiry?

PROFESSOR HEIDEGGER: *My own lifelong inquiry into people and being suggests that the focus of inquiry would be scientists as human beings and their relationship with what is.*

PROFESSOR PICKERING: *Isn't that a rather conventional approach reflecting a traditional humanist interest in the knowing subject?*

PROFESSOR HEIDEGGER: *That is a question asked from deep within the age of the world picture.* The essence of the modern age can be seen in the fact that man frees himself from the bonds of the Middle Ages in freeing himself to himself. . . . Certainly the modern age has, as a consequence of the liberation of man, introduced subjectivism and individualism . . . *but* what is decisive is not that man frees himself to himself from previous obligations, but that

the very essence of man itself changes in that man becomes subject. *We have forgotten how to see human beings as other than subjects and that is of great concern.* (*Heidegger 1977b*, 127–28)

MODERATOR: What disturbs you about that?

PROFESSOR HEIDEGGER: *The modern age* puts to nature the unreasonable demand that it supply energy that can be extracted and stored as such. . . . Agriculture is now the mechanized food industry. Air is now set upon to yield nitrogen, the earth to yield ore, ore to yield uranium, uranium to yield atomic energy . . . whatever is ordered about in this way we call the standing reserve. *Seeing the world in this way is the result of Dasein becoming subject.* When Dasein, investigating, observing, ensnares nature as an area of Dasein's own conceiving, he approaches nature as an object of research. (Heidegger 1977a, 14–19)

MODERATOR: Why is that a problem?

PROFESSOR HEIDEGGER: If Dasein is challenged, ordered to do this by *disciplinary agency*, then do not *people themselves* belong ever more originally than nature within the standing reserve? The current talk about human resources, about the supply of patients for a clinic gives evidence of this. (Heidegger 1977a, 17–18) *And look at how scientists work today.* The decisive development of the character of modern science . . . forms *people* of a different stamp. Scholars disappear . . . succeeded by *researchers* who *are* engaged in research projects . . . Moreover, *they are* constantly on the move. *They* negotiate at meetings and collect information at congresses. *They* contract for commissions with publishers. The latter now determine along with *them* what books must be written. (*Heidegger 1977b*, 125) *This* does not simply endanger *human beings* in *their* relationship to *themselves* and to everything that is. . . . It banishes *them* into that kind of revealing which is an ordering. . . . *They are* continually approaching the brink of the possibility of pursuing and pushing forward nothing but what is revealed in ordering, of deriving all *their* standards on this basis. . . . When *people are* nothing but orderers of the standing reserve, then they come to the brink of a precipitous fall; that is, they come to the point where *they themselves* will have to be taken as standing reserve. (Heidegger 1977a, 26–27)

PROFESSOR PICKERING: *So extending the mangle into everyday life and vice versa threatens to turn us into an exploitable resource?*

PROFESSOR HEIDEGGER: *It threatens all who understand the world as capable of capturing, seducing, recruiting, taming, domesticating, and putting at our service the*

material world, so long as people exalt *themselves* to the posture of lord of the earth, *the essence of people is endangered.* (Heidegger 1977a, 27)

PROFESSOR PICKERING: *And the solution, as you see it?*

PROFESSOR HEIDEGGER: *To travel more fearlessly and unequivocally down the path that you have opened with your account of the mangle, the path of decentering the subject, the path of post-humanism, the path of resistance and accommodation, the performative rather than representational path. But you must follow that path more destructively, abandoning the culture and practice and language of science.* Truth will be given over to us only when we have overcome ourselves as subject and that means when we no longer represent that which is as object. (Heidegger 1977b, 154) Science is the theory of the real. (Heidegger 1977d, 157) *Professor Pickering's mangle brings that to light. Let it be our saving grace rather than the source of new ontologies.*

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SCIENCE STUDIES

In *The Mangle of Practice* (1995), the renowned sociologist of science Andrew Pickering argued for a reconceptualization of research practice as a "mangle," an open-ended, evolutionary, and performative interplay of human and non-human agency. While Pickering's ideas originated in science and technology studies, this collection aims to extend the mangle's reach by exploring its application across a wide range of fields including history, philosophy, sociology, geography, environmental studies, literary theory, biophysics, and software engineering. As Pickering argues in the preface, the mangle points to a shift in interpretive sensibilities that makes visible a world of de-centered becoming. This volume demonstrates the viability, coherence, and promise of such a shift, not only in science and technology studies, but in the social sciences and humanities more generally.

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