

ANNA LOWENHAUPT TSING



*The
Mushroom
at the
End
of the
World*

ON THE
POSSIBILITY
OF LIFE IN
CAPITALIST
RUINS

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Capitalist Ruins*

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Enabling Entanglements

EVER SINCE THE ENLIGHTENMENT, WESTERN PHILOSOPHERS have shown us a Nature that is grand and universal but also passive and mechanical. Nature was a backdrop and resource for the moral intentionality of Man, which could tame and master Nature. It was left to fabulists, including non-Western and non-civilizational storytellers, to remind us of the lively activities of all beings, human and not human.

Several things have happened to undermine this division of labor. First, all that taming and mastering has made such a mess that it is unclear whether life on earth can continue. Second, interspecies entanglements that once seemed the stuff of fables are now materials for serious discussion among biologists and ecologists, who show how life requires the interplay of many kinds of beings. Humans cannot survive by stomping on all the others. Third, women and men from around the world have clamored to be included in the status once given to Man. Our riotous presence undermines the moral intentionality of Man's Christian masculinity, which separated Man from Nature.

The time has come for new ways of telling true stories beyond civilizational first principles. Without Man and Nature, all creatures can come back to life, and men and women can express themselves without the strictures of a parochially imagined rationality. No longer relegated to whispers in the

night, such stories might be simultaneously true and fabulous. How else can we account for the fact that anything is alive in the mess we have made?

Following a mushroom, this book offers such true stories. Unlike most scholarly books, what follows is a riot of short chapters. I wanted them to be like the flushes of mushrooms that come up after a rain: an over-the-top bounty; a temptation to explore; an always too many. The chapters build an open-ended assemblage, not a logical machine; they gesture to the so-much-more out there. They tangle with and interrupt each other—mimicking the patchiness of the world I am trying to describe. Adding another thread, the photographs tell a story alongside the text but do not illustrate it directly. I use images to present the spirit of my argument rather than the scenes I discuss.

Imagine “first nature” to mean ecological relations (including humans) and “second nature” to refer to capitalist transformations of the environment. This usage—not the same as more popular versions—derives from William Cronon’s *Nature’s Metropolis*.¹ My book then offers “third nature,” that is, what manages to live despite capitalism. To even notice third nature, we must evade assumptions that the future is that singular direction ahead. Like virtual particles in a quantum field, multiple futures pop in and out of possibility; third nature emerges within such temporal polyphony. Yet progress stories have blinded us. To know the world without them, this book sketches open-ended assemblages of entangled ways of life, as these coalesce in coordination across many kinds of temporal rhythms. My experiment in form and my argument follow each other.

The book is based on fieldwork conducted during matsutake seasons between 2004 and 2011 in the United States, Japan, Canada, China, and Finland—as well as interviews with scientists, foresters, and matsutake traders there as well as in Denmark, Sweden, and Turkey. Perhaps my own matsutake trail is not yet over: matsutake in places as far afield as Morocco, Korea, and Bhutan beckon. My hope is that readers will experience some of this “mushroom fever” with me in the chapters to come.



Below the forest floor, fungal bodies extend themselves in nets and skeins, binding roots and mineral soils, long before producing mushrooms. All books emerge from similarly hidden collaborations. A list of

individuals is inadequate, and so I begin with the collaborative engagements that made this book possible. In contrast to most recent ethnography, the research on which this book is based was pursued in experiments in collaboration. Furthermore, the questions that seemed to me worth pursuing emerged from knots of intense discussion in which I have been only one among many participants.

This book emerged from the work of the Matsutake Worlds Research Group: Timothy Choy, Lieba Faier, Elaine Gan, Michael Hathaway, Miyako Inoue, Shiho Satsuka, and myself. In much of the history of anthropology, ethnography has been a solo performance; our group convened to explore a new anthropology of always-in-process collaboration. The point of ethnography is to learn how to think about a situation together with one's informants; research categories develop *with* the research, not before it. How can one use this method when working with other researchers—each learning from different local knowledge? Rather than knowing the object in advance, as in big science, our group was determined to let our research goals emerge through collaboration. We took up this challenge by trying a variety of forms of research, analysis, and writing.

This book opens a Matsutake Worlds mini-series; Michael Hathaway and Shiho Satsuka will present the next volumes. Consider it an adventure story in which the plot unfolds from one book to the next. Our curiosity about matsutake worlds cannot be contained in one volume or expressed by one voice; stand by to find out what happens next. Furthermore, our books join other genres, including essays and articles.² Through the work of the team, plus filmmaker Sara Dosa, Elaine Gan and I designed a web space for stories of pickers, scientists, traders, and forest managers across several continents: www.matsutakeworlds.org. Elaine Gan's art-and-science practice has inspired further collaborations.³ Sara Dosa's film *The Last Season* adds to these conversations.⁴

Matsutake research takes one not only beyond disciplinary knowledge but also to places where varied languages, histories, ecologies, and cultural traditions shape worlds. Faier, Inoue, and Satsuka are scholars of Japan, and Choy and Hathaway of China. I was to be the group's Southeast Asianist, working with pickers from Laos and Cambodia in the U.S. Pacific Northwest. It turned out, however, that I needed help. Collaboration with Hjørleifur Jonsson and the assistance of Lue Vang and David Pheng were essential to my research with Southeast Asians

in the United States.⁵ Eric Jones, Kathryn Lynch, and Rebecca McLain of the Institute for Culture and Ecology got me started in the mushroom world and remained amazing colleagues. Meeting Beverly Brown was inspirational. Amy Peterson introduced me to the Japanese-American matsutake community and showed me the ropes. Sue Hilton looked at pines with me. In Yunnan, Luo Wen-hong became a team member. In Kyoto, Noboru Ishikawa was an extraordinary guide and colleague. In Finland, Eira-Maija Savonen arranged everything. Each trip made me aware of the importance of these collaborations.

There are many other kinds of collaborations that go into producing a book. This one draws particularly on two intellectual developments, both local and broad. I had the privilege of learning feminist science studies at the University of California, Santa Cruz, in part from teaching with Donna Haraway. Here I glimpsed how scholarship could cross between natural science and cultural studies not just through critique but also through world-building knowledge. Multispecies storytelling was one of our products. The feminist science studies community in Santa Cruz has continued to make my work possible. Through it, too, I met many later companions. Andrew Mathews kindly reintroduced me to forests. Heather Swanson helped me think through comparison, and Japan. Kirsten Rudestam talked to me about Oregon. I learned from conversations with Jeremy Campbell, Zachary Caple, Roseann Cohen, Rosa Ficek, Colin Hoag, Katy Overstreet, Bettina Stoetzer, and many more.

Meanwhile, the strength of critical feminist studies of capitalism in Santa Cruz and beyond inspired my interest in knowing capitalism beyond its heroic reifications. If I have continued to engage with Marxist categories, despite their sometimes-clunky relation to thick description, it is because of the insights of feminist colleagues, including Lisa Rofel and Sylvia Yanagisako. UC Santa Cruz's Institute for Advanced Feminist Research stimulated my first attempts to describe global supply chains structurally, as translation machines, as did study groups at the University of Toronto (where I was invited by Tania Li) and at the University of Minnesota (where I was invited by Karen Ho). I feel privileged to have had a short moment of encouragement from Julie Graham before her death. The "economic diversity" perspective that she pioneered with Kathryn Gibson helped not just me but many scholars. On questions of power and difference, Santa Cruz conversations with James

Clifford, Rosa Ficek, Susan Harding, Gail Hershatter, Megan Moodie, Bregje van Eekelen, and many more were essential.

A number of grants and institutional arrangements made my work possible. A seed grant from the University of California Pacific Rim Research Program helped sponsor the first stages of my research. A Toyota Foundation award sponsored Matsutake Worlds Research Group joint research in China and Japan. UC Santa Cruz allowed me to take leaves to continue my research. Nils Bubandt and Aarhus University made it possible for me to begin the conceptualization and writing of this book in a calm and stimulating environment. A fellowship from the John Simon Guggenheim Memorial Foundation in 2010–11 made writing possible. The final work on the book overlapped with the beginning of the Aarhus University Research on the Anthropocene project, funded by the Danish National Research Foundation. I am grateful for these opportunities.

Individuals have stepped forward, too, to read drafts, discuss problems, and otherwise make the book possible. Nathalia Brichet, Zachary Caple, Alan Christy, Paulla Ebron, Susan Friedman, Elaine Gan, Scott Gilbert, Donna Haraway, Susan Harding, Frida Hastrup, Michael Hathaway, Gail Hershatter, Kregg Hetherington, Rusten Hogness, Andrew Mathews, James Scott, Heather Swanson, and Susan Wright kindly listened, read, and commented. Miyako Inoue retranslated the poetry. Kathy Chetkovich was an essential writing-and-thinking guide.

This book includes photographs only because of Elaine Gan's generous help in working with them. All emerge from my research, but I have taken the liberty of using several photographs shot by my research assistant, Lue Vang, when we worked together (images preceding chapters 9, 10, 14, and bottom photo of the "Tracking" interlude). I took the others. Elaine Gan made them usable with help from Laura Wright. Elaine Gan also drew the illustrations that mark sections within the chapters. They show fungal spores, rain, mycorrhiza, and mushrooms. I leave it to readers to wander through them.



I owe another enormous set of debts to the many people who agreed to talk and work with me in all my research sites. Pickers interrupted their foraging; scientists interrupted their research; entrepreneurs took time

from their businesses. I am grateful. Yet, to protect people's privacy, most individual names in the book are pseudonyms. The exceptions are public figures, including scientists as well as those who offer their views in public spaces. For such spokespersons, it seemed disrespectful to cover up names. A similar intention shapes my use of place names: I name cities but, because this book is not primarily a village study, I avoid local place names when I move to the countryside, where mentioning names might disrupt people's privacy.

Because this book relies on such motley sources, I have included references in notes rather than compile a unified bibliography. For Chinese, Japanese, and Hmong names in the citations, I put the first letter of the family name in bold for the first usage. This allows me to vary surname order, depending on where the author's name happened to enter my research.

A few of the chapters in this book are extended in other forums. Several repeat enough to deserve mention: Chapter 3 is a summary of a longer article I published in *Common Knowledge* 18, no. 3 (2012): 505–524. Chapter 6 is excerpted from “Free in the forest,” in *Rhetorics of insecurity*, ed. Zeynep Gambetti and Marcial Godoy-Anativia (New York: New York University Press, 2013), 20–39. Chapter 9 is developed in a longer essay in *Hau* 3, no. 1 (2013): 21–43. Chapter 16 includes material from an article in *Economic Botany* 62, no. 3 (2008): 244–256; although it is only one part of the chapter, this is notable because the journal article was written with Shiho Satsuka. The third interlude exists in a longer version in *Philosophy, Activism, Nature* 10 (2013): 6–14.

**The Mushroom
at the End of
the World**



*Elusive life, Oregon.
Matsutake caps emerge
in the ruin of an
industrial forest.*

Prologue **Autumn Aroma**

Takamato ridge, crowded with expanding caps,
filling up, thriving—
the wonder of autumn aroma.

*—From the eighth-century Japanese poetry collection
Man-nyo Shu*

WHAT DO YOU DO WHEN YOUR WORLD STARTS TO FALL apart? I go for a walk, and if I'm really lucky, I find mushrooms. Mushrooms pull me back into my senses, not just—like flowers—through their riotous colors and smells but because they pop up unexpectedly, reminding me of the good fortune of just happening to be there. Then I know that there are still pleasures amidst the terrors of indeterminacy.

Terrors, of course, there are, and not just for me. The world's climate is going haywire, and industrial progress has proved much more deadly to life on earth than anyone imagined a century ago. The economy is

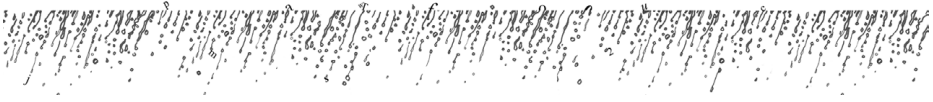
no longer a source of growth or optimism; any of our jobs could disappear with the next economic crisis. And it's not just that I might fear a spurt of new disasters: I find myself without the handrails of stories that tell where everyone is going and, also, why. Precarity once seemed the fate of the less fortunate. Now it seems that all our lives are precarious—even when, for the moment, our pockets are lined. In contrast to the mid-twentieth century, when poets and philosophers of the global north felt caged by too much stability, now many of us, north and south, confront the condition of trouble without end.

This book tells of my travels with mushrooms to explore indeterminacy and the conditions of precarity, that is, life without the promise of stability. I've read that when the Soviet Union collapsed in 1991, thousands of Siberians, suddenly deprived of state guarantees, ran to the woods to collect mushrooms.¹ These are not the mushrooms I follow, but they make my point: the uncontrolled lives of mushrooms are a gift—and a guide—when the controlled world we thought we had fails.

While I can't offer you mushrooms, I hope you will follow me to savor the "autumn aroma" praised in the poem that begins my prologue. This is the smell of matsutake, a group of aromatic wild mushrooms much valued in Japan. Matsutake is loved as a marker of the autumn season. The smell evokes sadness in the loss of summer's easy riches, but it also calls up the sharp intensity and heightened sensibilities of autumn. Such sensibilities will be needed for the end of global progress's easy summer: the autumn aroma leads me into common life without guarantees. This book is not a critique of the dreams of modernization and progress that offered a vision of stability in the twentieth century; many analysts before me have dissected those dreams. Instead, I address the imaginative challenge of living without those handrails, which once made us think we knew, collectively, where we were going. If we open ourselves to their fungal attractions, matsutake can catapult us into the curiosity that seems to me the first requirement of collaborative survival in precarious times.

Here's how a radical pamphlet put the challenge:

The spectre that many try not to see is a simple realisation—the world will not be "saved." . . . If we don't believe in a global revolutionary future, we must live (as we in fact always had to) in the present.²



When Hiroshima was destroyed by an atomic bomb in 1945, it is said, the first living thing to emerge from the blasted landscape was a matsutake mushroom.³

Grasping the atom was the culmination of human dreams of controlling nature. It was also the beginning of those dreams' undoing. The bomb at Hiroshima changed things. Suddenly, we became aware that humans could destroy the livability of the planet—whether intentionally or otherwise. This awareness only increased as we learned about pollution, mass extinction, and climate change. One half of current precarity is the fate of the earth: what kinds of human disturbances can we live with? Despite talk of sustainability, how much chance do we have for passing a habitable environment to our multispecies descendants?

Hiroshima's bomb also opened the door to the other half of today's precarity: the surprising contradictions of postwar development. After the war, the promises of modernization, backed by American bombs, seemed bright. Everyone was to benefit. The direction of the future was well known; but is it now? On the one hand, no place in the world is untouched by that global political economy built from the postwar development apparatus. On the other, even as the promises of development still beckon, we seem to have lost the means. Modernization was supposed to fill the world—both communist and capitalist—with jobs, and not just any jobs but “standard employment” with stable wages and benefits. Such jobs are now quite rare; most people depend on much more irregular livelihoods. The irony of our times, then, is that everyone depends on capitalism but almost no one has what we used to call a “regular job.”

To live with precarity requires more than railing at those who put us here (although that seems useful too, and I'm not against it). We might look around to notice this strange new world, and we might stretch our imaginations to grasp its contours. This is where mushrooms help. Matsutake's willingness to emerge in blasted landscapes allows us to explore the ruin that has become our collective home.

Matsutake are wild mushrooms that live in human-disturbed forests. Like rats, raccoons, and cockroaches, they are willing to put up with

some of the environmental messes humans have made. Yet they are not pests; they are valuable gourmet treats—at least in Japan, where high prices sometimes make matsutake the most valuable mushroom on earth. Through their ability to nurture trees, matsutake help forests grow in daunting places. To follow matsutake guides us to possibilities of coexistence within environmental disturbance. This is not an excuse for further damage. Still, matsutake show one kind of collaborative survival.

Matsutake also illuminate the cracks in the global political economy. For the past thirty years, matsutake have become a global commodity, forged in forests across the northern hemisphere and shipped fresh to Japan. Many matsutake foragers are displaced and disenfranchised cultural minorities. In the U.S. Pacific Northwest, for example, most commercial matsutake foragers are refugees from Laos and Cambodia. Because of high prices, matsutake make a substantial contribution to livelihood wherever they are picked, and even encourage cultural revitalizations.

Matsutake commerce, however, hardly leads to twentieth-century development dreams. Most of the mushroom foragers I spoke with have terrible stories to tell of displacement and loss. Commercial foraging is a better than usual way of getting by for those with no other way to make a living. But what kind of economy is this anyway? Mushroom foragers work for themselves; no companies hire them. There are no wages and no benefits; pickers merely sell the mushrooms they find. Some years there are no mushrooms, and pickers are left with their expenses. Commercial wild-mushroom picking is an exemplification of precarious livelihood, without security.

This book takes up the story of precarious livelihoods and precarious environments through tracking matsutake commerce and ecology. In each case, I find myself surrounded by patchiness, that is, a mosaic of open-ended assemblages of entangled ways of life, with each further opening into a mosaic of temporal rhythms and spatial arcs. I argue that only an appreciation of current precarity as an earthwide condition allows us to notice this—the situation of our world. As long as authoritative analysis requires assumptions of growth, experts don't see the heterogeneity of space and time, even where it is obvious to ordinary participants and observers. Yet theories of heterogeneity are still in their

infancy. To appreciate the patchy unpredictability associated with our current condition, we need to reopen our imaginations. The point of this book is to help that process along—with mushrooms.

About commerce: Contemporary commerce works within the constraints and possibilities of capitalism. Yet, following in the footsteps of Marx, twentieth-century students of capitalism internalized progress to see only one powerful current at a time, ignoring the rest. This book shows how it is possible to study capitalism without this crippling assumption—by combining close attention to the world, in all its precarity, with questions about how wealth is amassed. How might capitalism look without assuming progress? It might look patchy: *the concentration of wealth is possible because value produced in unplanned patches is appropriated for capital.*

About ecology: For humanists, assumptions of progressive human mastery have encouraged a view of nature as a romantic space of anti-modernity.⁴ Yet for twentieth-century scientists, progress also unself-consciously framed the study of landscapes. Assumptions about expansion slipped into the formulation of population biology. New developments in ecology make it possible to think quite differently by introducing cross-species interactions and disturbance histories. In this time of diminished expectations, I look for *disturbance-based ecologies in which many species sometimes live together without either harmony or conquest.*

While I refuse to reduce either economy or ecology to the other, there is one connection between economy and environment that seems important to introduce up front: the history of the human concentration of wealth through making both humans and nonhumans into resources for investment. This history has inspired investors to imbue both people and things with alienation, that is, the ability to stand alone, as if the entanglements of living did not matter.⁵ Through alienation, people and things become mobile assets; they can be removed from their life worlds in distance-defying transport to be exchanged with other assets from other life worlds, elsewhere.⁶ This is quite different from merely using others as part of a life world—for example, in eating and being eaten. In that case, multispecies living spaces remain in place. Alienation obviates living-space entanglement. The dream of alienation inspires landscape modification in which only one stand-alone asset matters;

everything else becomes weeds or waste. Here, attending to living-space entanglements seems inefficient, and perhaps archaic. When its singular asset can no longer be produced, a place can be abandoned. The timber has been cut; the oil has run out; the plantation soil no longer supports crops. The search for assets resumes elsewhere. Thus, simplification for alienation produces ruins, spaces of abandonment for asset production.

Global landscapes today are strewn with this kind of ruin. Still, these places can be lively despite announcements of their death; abandoned asset fields sometimes yield new multispecies and multicultural life. In a global state of precarity, we don't have choices other than looking for life in this ruin.

Our first step is to bring back curiosity. Unencumbered by the simplifications of progress narratives, the knots and pulses of patchiness are there to explore. Matsutake are a place to begin: However much I learn, they take me by surprise.



This is not a book about Japan, but the reader needs to know something about matsutake in Japan to proceed.⁷ Matsutake first appears in Japan's written record in the eighth-century poem that starts this prologue. Already then, the mushroom is praised for its aromatic marking of the autumn season. The mushroom became common around Nara and Kyoto, where people had deforested the mountains for wood to build temples and to fuel iron forges. Indeed, human disturbance allowed *Tricholoma matsutake* to emerge in Japan. This is because its most common host is red pine (*Pinus densiflora*), which germinates in the sunlight and mineral soils left by human deforestation. When forests in Japan are allowed to grow back, without human disturbance, broadleaf trees shade out pines, preventing their further germination.

As red pine spread with deforestation across Japan, matsutake became a valued gift, presented beautifully in a box of ferns. Aristocrats were honored by it. By the Edo period (1603–1868), well-to-do commoners, such as urban merchants, also enjoyed matsutake. The mushroom joined the celebration of the four seasons as a marker of autumn. Outings to pick matsutake in the fall were an equivalent of cherry-blossom

viewing parties in the spring. Matsutake became a popular subject for poetry.

The sound of a temple bell is heard in the cedar forest at dusk,
The autumn aroma drifts on the roads below.

—AKEMI TACHIBANA (1812–1868)⁸

As in other Japanese nature poetry, seasonal referents helped build a mood. Matsutake joined older signs of the fall season, such as the sound of deer crying or the harvest moon. The coming bareness of winter touched autumn with an incipient loneliness, at the edge of nostalgia, and the poem above offers that mood. Matsutake was an elite pleasure, a sign of the privilege to live within the artful reconstruction of nature for refined tastes.⁹ For this reason, when peasants preparing for elite outings sometimes “planted” matsutake (i.e., stuck mushrooms artfully in the ground because naturally occurring matsutake were not available), no one objected. Matsutake had become an element of an ideal seasonality, appreciated not only in poetry but also in all the arts, from tea ceremony to theater.

The moving cloud fades away, and I smell the aroma of the
mushroom.

—KOI NAGATA (1900–1997)¹⁰

The Edo period was ended by the Meiji Restoration—and Japan’s rapid modernization. Deforestation proceeded apace, privileging pine and matsutake. In the Kyoto area, *matsutake* became a generic term for “mushroom.” In the early twentieth century, matsutake were particularly common. In the mid-1950s, however, the situation began to change. Peasant woodlands were cut down for timber plantations, paved for suburban development, or abandoned by peasants moving to the city. Fossil fuel replaced firewood and charcoal; farmers no longer used the remaining woodlands, which grew up in dense thickets of broadleaf trees. Hill-sides that had once been covered by matsutake were now too shady for pine ecologies. Shade-stressed pines were killed by an invasive nematode. By the mid-1970s, matsutake had become rare across Japan.

This was the time, however, of Japan's rapid economic development, and matsutake were in demand as exquisitely expensive gifts, perks, and bribes. The price of matsutake skyrocketed. The knowledge that matsutake grew in other parts of the world suddenly became relevant. Japanese travelers and residents abroad began to send matsutake to Japan; as importers emerged to funnel the international matsutake trade, non-Japanese pickers rushed in. At first it seemed that there were a plethora of colors and kinds that might appropriately be considered matsutake—because they had the smell. Scientific names proliferated as matsutake in forests across the northern hemisphere suddenly rose from neglect. In the past twenty years, names have been consolidated. All across Eurasia, most matsutake are now *Tricholoma matsutake*.¹¹ In North America, *T. matsutake* seems to be found only in the east, and in the mountains of Mexico. In western North America, the local matsutake is considered another species, *T. magnivelare*.¹² Some scientists, however, think the generic term “matsutake” is the best way to identify these aromatic mushrooms, since the dynamics of speciation are still unclear.¹³ I follow that practice except where I am discussing questions of classification.

Japanese have figured out ways of ranking matsutake from different parts of the world, and ranks are reflected in prices. My eyes were first opened to such rankings when one Japanese importer explained: “Matsutake are like people. American mushrooms are white because the people are white. Chinese mushrooms are black, because the people are black. Japanese people and mushrooms are nicely in between.” Not everyone has the same rankings, but this stark example can stand in for the many forms of classification and valuation that structure the global trade.

Meanwhile, people in Japan worry about the loss of the peasant woodlands that have been the source of so much seasonal beauty, from spring blossoms to bright autumn leaves. Starting in the 1970s, volunteer groups mobilized to restore these woodlands. Wanting their work to matter beyond passive aesthetics, the groups looked for ways restored woodlands might benefit human livelihood. The high price of matsutake made it an ideal product of woodland restoration.

And so I return to precarity and living in our messes. But living seems to have gotten more crowded, not only with Japanese aesthetics and eco-

logical histories, but also with international relations and capitalist trading practices. This is the stuff for stories in the book that follows. For the moment, it seems important to appreciate the mushroom.

Oh, matsutake:

The excitement before finding them.

—YAMAGUCHI SODO (1642–1716)¹⁴



*Conjuring time,
Yunnan. Watching
the boss gamble.*

Part I **What's Left?**

IT WAS A STILL-BRIGHT EVENING WHEN I REALIZED I was lost and empty-handed in an unknown forest. I was on my first search for matsutake—and matsutake pickers—in Oregon’s Cascade Mountains. Earlier that afternoon, I had found the Forest Service’s “big camp” for mushroom pickers, but all the pickers were out foraging. I had decided to look for mushrooms myself while I waited for their return.

I couldn’t have imagined a more unpromising-looking forest. The ground was dry and rocky, and nothing grew except thin sticks of lodgepole pine. There were hardly any plants growing near the ground, not even grass, and when I touched the soil, sharp pumice shards cut my fingers. As the afternoon wore on, I found one or two “copper tops,” dingy mushrooms with a splash of orange and a mealy smell.¹ Nothing else. Worse yet, I was disoriented. Every way I turned, the forest looked the same. I had no idea which direction to go to find my car. Thinking I would be out there just briefly, I had brought nothing, and I knew I would soon be thirsty, hungry—and cold.

I stumbled around and eventually found a dirt road. But which way should I go? The sun was getting lower as I trudged along. I had walked less than a mile when a pickup truck drew up. A bright-faced young

man and a wizened old man were inside, and they offered me a ride. The young man introduced himself as Kao. Like his uncle, he said, he was a Mien from the hills of Laos who had come to the United States from a refugee camp in Thailand in the 1980s. They were neighbors in Sacramento, California, and here to pick mushrooms together. They brought me to their camp. The young man went to get water, driving his plastic jugs to a water storage container some ways away. The older man did not know English, but it turned out he knew a little Mandarin Chinese, as did I. As we awkwardly exchanged phrases, he pulled out a smoking bong handcrafted from PVC pipe and lit up his tobacco.

It was dusk when Kao came back with the water. But he beckoned me to go picking with him: There were mushrooms nearby. In the gathering dark, we scrambled up a rocky hillside not far from his camp. I saw nothing but dirt and some scrawny pine trees. But here was Kao with his bucket and stick, poking deep into clearly empty ground and pulling up a fat button. How could this be possible? There had been nothing there—and then there it was.

Kao handed me the mushroom. That's when I first experienced the smell. It's not an easy smell. It's not like a flower or a mouth-watering food. It's disturbing. Many people never learn to love it. It's hard to describe. Some people liken it to rotting things and some to clear beauty—the autumn aroma. At my first whiff, I was just . . . astonished.

My surprise was not just for the smell. What were Mien tribesmen, Japanese gourmet mushrooms, and I doing in a ruined Oregon industrial forest? I had lived in the United States for a long time without ever hearing about any of these things. The Mien camp pulled me back to my earlier fieldwork in Southeast Asia; the mushroom tickled my interest in Japanese aesthetics and cuisine. The broken forest, in contrast, seemed like a science fiction nightmare. To my faulty common sense, we all seemed miraculously out of time and out of place—like something that might jump out of a fairy tale. I was startled and intrigued; I couldn't stop exploring. This book is my attempt to pull you into the maze I found.



人と自然が輝く森づくり
東北
2003年10月
松山県
秋田県
山形県
福島県
茨城県
栃木県
群馬県
埼玉県
千葉県
東京都
神奈川県
新潟県
富山県
石川県
福井県
山梨県
長野県
岐阜県
静岡県
愛知県
三重県
滋賀県
京都府
大阪府
兵庫県
奈良県
和歌山県
徳島県
香川県
愛媛県
高知県
福岡県
佐賀県
大分県
熊本県
宮崎県
鹿児島県
沖縄県

自然観察の森と清流

人は自然の中で生きていく

太陽に感謝を

（桂川源流域）
マダガスカル産（希少な）試験地
松山県
秋田県
山形県
福島県
茨城県
栃木県
群馬県
埼玉県
千葉県
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神奈川県
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和歌山県
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佐賀県
大分県
熊本県
宮崎県
鹿児島県
沖縄県

大切な水、空気、土を大切に

*Conjuring time,
Kyoto Prefecture.
Mr. Imoto's map of
revitalizing. This is his
matsutake mountain:
a time machine of
multiple seasons,
histories, and hopes.*

1 **Arts of Noticing**

I am not proposing a return to the Stone Age. My intent is not reactionary, nor even conservative, but simply subversive. It seems that the utopian imagination is trapped, like capitalism and industrialism and the human population, in a one-way future consisting only of growth. All I'm trying to do is figure out how to put a pig on the tracks.

—*Ursula K. Le Guin*

IN 1908 AND 1909 TWO RAILROAD ENTREPRENEURS raced each other to build track along Oregon's Deschutes River.¹ The goal of each was to be the first to create an industrial connection between the towering ponderosas of the eastern Cascades and the stacked lumberyards of Portland. In 1910, the thrill of competition yielded to an agreement for joint service. Pine logs poured out of the region, bound for distant markets. Lumber mills brought new settlers; towns sprung

up as millworkers multiplied. By the 1930s, Oregon had become the nation's largest producer of timber.

This is a story we know. It is the story of pioneers, progress, and the transformation of "empty" spaces into industrial resource fields.

In 1989, a plastic spotted owl was hung in effigy on an Oregon logging truck.² Environmentalists had shown that unsustainable logging was destroying Pacific Northwest forests. "The spotted owl was like the canary in the coal mine," explained one advocate. "It was . . . symbolic of an ecosystem on the verge of collapse."³ When a federal judge blocked old-growth logging to save owl habitat, loggers were furious; but how many loggers were there? Logging jobs had dwindled as timber companies mechanized—and as prime timber disappeared. By 1989, many mills had already closed; logging companies were moving to other regions.⁴ The eastern Cascades, once a hub of timber wealth, were now cutover forests and former mill towns overgrown by brush.

This is a story we need to know. Industrial transformation turned out to be a bubble of promise followed by lost livelihoods and damaged landscapes. And yet: such documents are not enough. If we end the story with decay, we abandon all hope—or turn our attention to other sites of promise and ruin, promise and ruin.

What emerges in damaged landscapes, beyond the call of industrial promise and ruin? By 1989, something else had begun in Oregon's cutover forests: the wild mushroom trade. From the first it was linked to worldwide ruination: The 1986 Chernobyl disaster had contaminated Europe's mushrooms, and traders had come to the Pacific Northwest for supplies. When Japan began importing matsutake at high prices—just as jobless Indochinese refugees were settling in California—the trade went wild. Thousands rushed to Pacific Northwest forests for the new "white gold." This was in the middle of a "jobs versus the environment" battle over the forests, yet neither side noticed the mushroomers. Job advocates imagined only wage contracts for healthy white men; the foragers—disabled white veterans, Asian refugees, Native Americans, and undocumented Latinos—were invisible interlopers. Conservationists were fighting to keep human disturbance out of the forests; the entry of thousands of people, had it been noticed, would hardly have been welcome. But the mushroom hunters were mainly not noticed. At

most, the Asian presence sparked local fears of invasion: journalists worried about violence.⁵

A few years into the new century, the idea of a trade-off between jobs and the environment seemed less convincing. With or without conservation, there were fewer “jobs” in the twentieth-century sense in the United States; besides, it seemed much more likely that environmental damage would kill all of us off, jobs or no jobs. We are stuck with the problem of living despite economic and ecological ruination. Neither tales of progress nor of ruin tell us how to think about collaborative survival. It is time to pay attention to mushroom picking. Not that this will save us—but it might open our imaginations.



Geologists have begun to call our time the Anthropocene, the epoch in which human disturbance outranks other geological forces. As I write, the term is still new—and still full of promising contradictions. Thus, although some interpreters see the name as implying the triumph of humans, the opposite seems more accurate: without planning or intention, humans have made a mess of our planet.⁶ Furthermore, despite the prefix “anthropo-,” that is, human, the mess is not a result of our species biology. The most convincing Anthropocene time line begins not with our species but rather with the advent of modern capitalism, which has directed long-distance destruction of landscapes and ecologies. This time line, however, makes the “anthropo-” even more of a problem. Imagining the human since the rise of capitalism entangles us with ideas of progress and with the spread of techniques of alienation that turn both humans and other beings into resources. Such techniques have segregated humans and policed identities, obscuring collaborative survival. The concept of the Anthropocene both evokes this bundle of aspirations, which one might call the modern human conceit, and raises the hope that we might muddle beyond it. Can we live inside this regime of the human and still exceed it?

This is the predicament that makes me pause before offering a description of mushrooms and mushroom pickers. The modern human conceit won’t let a description be anything more than a decorative

footnote. This “anthropo-” blocks attention to patchy landscapes, multiple temporalities, and shifting assemblages of humans and nonhumans: the very stuff of collaborative survival. In order to make mushroom picking a worthwhile tale, then, I must first chart the work of this “anthropo-” and explore the terrain it refuses to acknowledge.

Consider, indeed, the question of what’s left. Given the effectiveness of state and capitalist devastation of natural landscapes, we might ask why anything outside their plans is alive today. To address this, we will need to watch unruly edges. What brings Mien and matsutake together in Oregon? Such seemingly trivial queries might turn everything around to put unpredictable encounters at the center of things.

We hear about precarity in the news every day. People lose their jobs or get angry because they never had them. Gorillas and river porpoises hover at the edge of extinction. Rising seas swamp whole Pacific islands. But most of the time we imagine such precarity to be an exception to how the world works. It’s what “drops out” from the system. What if, as I’m suggesting, precarity *is* the condition of our time—or, to put it another way, what if our time is ripe for sensing precarity? What if precarity, indeterminacy, and what we imagine as trivial are the center of the systematicity we seek?

Precarity is the condition of being vulnerable to others. Unpredictable encounters transform us; we are not in control, even of ourselves. Unable to rely on a stable structure of community, we are thrown into shifting assemblages, which remake us as well as our others. We can’t rely on the status quo; everything is in flux, including our ability to survive. Thinking through precarity changes social analysis. A precarious world is a world without teleology. Indeterminacy, the unplanned nature of time, is frightening, but thinking through precarity makes it evident that indeterminacy also makes life possible.

The only reason all this sounds odd is that most of us were raised on dreams of modernization and progress. These frames sort out those parts of the present that might lead to the future. The rest are trivial; they “drop out” of history. I imagine you talking back: “Progress? That’s an idea from the nineteenth century.” The term “progress,” referring to a general state, has become rare; even twentieth-century modernization has begun to feel archaic. But their categories and assumptions of improvement are with us everywhere. We imagine their objects every day:

democracy, growth, science, hope. Why would we expect economies to grow and sciences to advance? Even without explicit reference to development, our theories of history are embroiled in these categories. So, too, are our personal dreams. I'll admit it's hard for me to even say this: there might not be a collective happy ending. Then why bother getting up in the morning?

Progress is embedded, too, in widely accepted assumptions about what it means to be human. Even when disguised through other terms, such as "agency," "consciousness," and "intention," we learn over and over that humans are different from the rest of the living world because we look forward—while other species, which live day to day, are thus dependent on us. As long as we imagine that humans are *made* through progress, nonhumans are stuck within this imaginative framework too.

Progress is a forward march, drawing other kinds of time into its rhythms. Without that driving beat, we might notice other temporal patterns. Each living thing remakes the world through seasonal pulses of growth, lifetime reproductive patterns, and geographies of expansion. Within a given species, too, there are multiple time-making projects, as organisms enlist each other and coordinate in making landscapes. (The regrowth of the cutover Cascades and Hiroshima's radioecology each show us multispecies time making.) The curiosity I advocate follows such multiple temporalities, revitalizing description and imagination. This is not a simple empiricism, in which the world invents its own categories. Instead, agnostic about where we are going, we might look for what has been ignored because it never fit the time line of progress.

Consider again the snippets of Oregon history with which I began this chapter. The first, about railroads, tells of progress. It led to the future: railroads reshaped our destiny. The second is already an interruption, a history in which the destruction of forests matters. What it shares with the first, however, is the assumption that the trope of progress is sufficient to know the world, both in success and failure. The story of decline offers no leftovers, no excess, nothing that escapes progress. Progress still controls us even in tales of ruination.

Yet the modern human conceit is not the only plan for making worlds: we are surrounded by many world-making projects, human and not human.⁷ World-making projects emerge from practical activities of

making lives; in the process these projects alter our planet. To see them, in the shadow of the Anthropocene’s “anthropo-,” we must reorient our attention. Many preindustrial livelihoods, from foraging to stealing, persist today, and new ones (including commercial mushroom picking) emerge, but we neglect them because they are not a part of progress. These livelihoods make worlds too—and they show us how to look around rather than ahead.

Making worlds is not limited to humans. We know that beavers reshape streams as they make dams, canals, and lodges; in fact, all organisms make ecological living places, altering earth, air, and water. Without the ability to make workable living arrangements, species would die out. In the process, each organism changes everyone’s world. Bacteria made our oxygen atmosphere, and plants help maintain it. Plants live on land because fungi made soil by digesting rocks. As these examples suggest, world-making projects can overlap, allowing room for more than one species. Humans, too, have always been involved in multispecies world making. Fire was a tool for early humans not just to cook but also to burn the landscape, encouraging edible bulbs and grasses that attracted animals for hunting. Humans shape multispecies worlds when our living arrangements make room for other species. This is not just a matter of crops, livestock, and pets. Pines, with their associated fungal partners, often flourish in landscapes burned by humans; pines and fungi work together to take advantage of bright open spaces and exposed mineral soils. Humans, pines, and fungi make living arrangements simultaneously for themselves and for others: multispecies worlds.

Twentieth-century scholarship, advancing the modern human conceit, conspired against our ability to notice the divergent, layered, and conjoined projects that make up worlds. Entranced by the expansion of certain ways of life over others, scholars ignored questions of what else was going on. As progress tales lose traction, however, it becomes possible to look differently.

The concept of *assemblage* is helpful. Ecologists turned to assemblages to get around the sometimes fixed and bounded connotations of ecological “community.” The question of how the varied species in a species assemblage influence each other—if at all—is never settled: some thwart (or eat) each other; others work together to make life possible; still others just happen to find themselves in the same place. As-

semblages are open-ended gatherings. They allow us to ask about communal effects without assuming them. They show us potential histories in the making. For my purposes, however, I need something other than organisms as the elements that gather. I need to see lifeways—and non-living ways of being as well—coming together. Nonhuman ways of being, like human ones, shift historically. For living things, species identities are a place to begin, but they are not enough: ways of being are emergent effects of encounters. Thinking about humans makes this clear. Foraging for mushrooms is a way of life—but not a common characteristic of all humans. The issue is the same for other species. Pines find mushrooms to help them use human-made open spaces. Assemblages don't just gather lifeways; they make them. Thinking through assemblage urges us to ask: How do gatherings sometimes become “happenings,” that is, greater than the sum of their parts? If history without progress is indeterminate and multidirectional, might assemblages show us its possibilities?

Patterns of unintentional coordination develop in assemblages. To notice such patterns means watching the interplay of temporal rhythms and scales in the divergent lifeways that gather. Surprisingly, this turns out to be a method that might revitalize political economy as well as environmental studies. Assemblages drag political economy inside them, and not just for humans. Plantation crops have lives different from those of their free-living siblings; cart horses and hunter steeds share species but not lifeways. Assemblages cannot hide from capital and the state; they are sites for watching how political economy works. If capitalism has no teleology, we need to see what comes together—not just by prefabrication, but also by juxtaposition.

Other authors use “assemblage” with other meanings.⁸ The qualifier “polyphonic” may help explain my variant. Polyphony is music in which autonomous melodies intertwine. In Western music, the madrigal and the fugue are examples of polyphony. These forms seem archaic and strange to many modern listeners because they were superseded by music in which a unified rhythm and melody holds the composition together. In the classical music that displaced baroque, unity was the goal; this was “progress” in just the meaning I have been discussing: a unified coordination of time. In twentieth-century rock-and-roll, this unity takes the form of a strong beat, suggestive of the listener's heart;

we are used to hearing music with a single perspective. When I first learned polyphony, it was a revelation in listening; I was forced to pick out separate, simultaneous melodies *and* to listen for the moments of harmony and dissonance they created together. This kind of noticing is just what is needed to appreciate the multiple temporal rhythms and trajectories of the assemblage.

For those not musically inclined, it may be useful to imagine the polyphonic assemblage in relation to agriculture. Since the time of the plantation, commercial agriculture has aimed to segregate a single crop and work toward its simultaneous ripening for a coordinated harvest. But other kinds of farming have multiple rhythms. In the shifting cultivation I studied in Indonesian Borneo, many crops grew together in the same field, and they had quite different schedules. Rice, bananas, taro, sweet potatoes, sugarcane, palms, and fruit trees mingled; farmers needed to attend to the varied schedules of maturation of each of these crops. These rhythms were their relation to human harvests; if we add other relations, for example, to pollinators or other plants, rhythms multiply. The polyphonic assemblage is the gathering of these rhythms, as they result from world-making projects, human and not human.

The polyphonic assemblage also moves us into the unexplored territory of the modern political economy. Factory labor is an exemplar of coordinated progress time. Yet the supply chain is infused with polyphonic rhythms. Consider the tiny Chinese garment factory studied by Nellie Chu; like its many competitors, it served multiple supply lines, constantly switching among orders for local boutique brands, knock-off international brands, and generic to-be-branded-later production.⁹ Each required different standards, materials, and kinds of labor. The factory's job was to match industrial coordination to the complex rhythms of supply chains. Rhythms further multiply when we move out of factories to watch foraging for an unpredictable wild product. The farther we stray into the peripheries of capitalist production, the more coordination between polyphonic assemblages and industrial processes becomes central to making a profit.

As the last examples suggest, abandoning progress rhythms to watch polyphonic assemblages is not a matter of virtuous desire. Progress felt great; there was always something better ahead. Progress gave us the "progressive" political causes with which I grew up. I hardly know how

to think about justice without progress. The problem is that progress stopped making sense. More and more of us looked up one day and realized that the emperor had no clothes. It is in this dilemma that new tools for noticing seem so important.¹⁰ Indeed, life on earth seems at stake. Chapter 2 turns to dilemmas of collaborative survival.



*Conjuring time,
Yunnan. The matsutake
embroidered on this Yi
market goer's vest
performs the promise of
wealth and well-being.
The vest codifies (Yi)
ethnicity and (fungal)
species, making these
units available for a
moment of action within
shifting histories of
encounter.*

2 Contamination as Collaboration

I wanted someone to tell me things were going to be fine, but no one did.

—*Mai Neng Moua, "Along the Way to the Mekong"*

HOW DOES A GATHERING BECOME A “HAPPENING,” that is, greater than a sum of its parts? One answer is contamination. We are contaminated by our encounters; they change who we are as we make way for others. As contamination changes world-making projects, mutual worlds—and new directions—may emerge.¹ Everyone carries a history of contamination; purity is not an option. One value of keeping precarity in mind is that it makes us remember that changing with circumstances is the stuff of survival.

But what is survival? In popular American fantasies, survival is all about saving oneself by fighting off others. The “survival” featured in U.S. television shows or alien-planet stories is a synonym for conquest and expansion. I will not use the term that way. Please open yourself to

another usage. This book argues that staying alive—for every species—requires livable collaborations. Collaboration means working across difference, which leads to contamination. Without collaborations, we all die.

Popular fantasies are hardly the whole problem: one-against-all survival has also engaged scholars. Scholars have imagined survival as the advancement of individual interests—whether “individuals” are species, populations, organisms, or genes—human or otherwise. Consider the twin master sciences of the twentieth century, neoclassical economics and population genetics. Each of these disciplines came to power in the early twentieth century with formulations bold enough to redefine modern knowledge. Population genetics stimulated the “modern synthesis” in biology, uniting evolutionary theory and genetics. Neoclassical economics reshaped economic policy, creating the modern economy of its imagination. While practitioners of each have had little to do with each other, the twins set up similar frames. At the heart of each is the self-contained individual actor, out to maximize personal interests, whether for reproduction or wealth. Richard Dawkins’s “selfish gene” gets across the idea, useful at many life scales: It is the ability of genes (or organisms, or populations) to look out for their own interests that fuels evolution.² Similarly, the life of *Homo economicus*, economic man, is a series of choices to follow his best interests.

The assumption of self-containment made an explosion of new knowledge possible. Thinking through self-containment and thus the self-interest of individuals (at whatever scale) made it possible to ignore contamination, that is, transformation through encounter. Self-contained individuals are not transformed by encounter. Maximizing their interests, they use encounters—but remain unchanged in them. *Noticing* is unnecessary to track these unchanging individuals. A “standard” individual can stand in for all as a unit of analysis. It becomes possible to organize knowledge through logic alone. Without the possibility of transformative encounters, mathematics can replace natural history and ethnography. It was the productiveness of this simplification that made the twins so powerful, and the obvious falsity of the original premise was increasingly forgotten.³ Economy and ecology thus each became sites for algorithms of progress-as-expansion.

The problem of precarious survival helps us see what is wrong. Precarity is a state of acknowledgment of our vulnerability to others. In order to survive, we need help, and help is always the service of another, with or without intent. When I sprain my ankle, a stout stick may help me walk, and I enlist its assistance. I am now an encounter in motion, a woman-and-stick. It is hard for me to think of any challenge I might face without soliciting the assistance of others, human and not human. It is unselfconscious privilege that allows us to fantasize—counterfactually—that we each survive alone.

If survival always involves others, it is also necessarily subject to the indeterminacy of self-and-other transformations. We change through our collaborations both within and across species. The important stuff for life on earth happens in those transformations, not in the decision trees of self-contained individuals. Rather than seeing only the expansion-and-conquest strategies of relentless individuals, we must look for histories that develop through contamination. Thus, how might a gathering become a “happening”?

Collaboration is work across difference, yet this is not the innocent diversity of self-contained evolutionary tracks. The evolution of our “selves” is already polluted by histories of encounter; we are mixed up with others before we even begin any new collaboration. Worse yet, we are mixed up in the projects that do us the most harm. The diversity that allows us to enter collaborations emerges from histories of extermination, imperialism, and all the rest. Contamination makes diversity.

This changes the work we imagine for names, including ethnicities and species. If categories are unstable, we must watch them emerge within encounters. To use category names should be a commitment to tracing the assemblages in which these categories gain a momentary hold.⁴ Only from here can I return to meeting Mien and matsutake in a Cascades forest. What does it mean to be “Mien” or to be “forest”? These identities entered our meeting from histories of transformative ruin, even as new collaborations changed them.

Oregon’s national forests are managed by the U.S. Forest Service, which aims to conserve forests as a national resource. Yet the conservation status of the landscape has been hopelessly confused by a hundred-year history of logging and fire suppression. Contamination creates forests,

transforming them in the process. Because of this, noticing as well as counting is required to know the landscape.

Oregon's forests played a key role in the U.S. Forest Service's early-twentieth-century formation, during which foresters worked to find kinds of conservation that timber barons would support.⁵ Fire suppression was the biggest result: Loggers and foresters could agree on it. Meanwhile, loggers were eager to take out the ponderosa pines that so impressed white pioneers in the eastern Cascades. The great ponderosa stands were logged out by the 1980s. It turned out that they could not reproduce without the periodic fires the Forest Service had stopped. But fir and spindly lodgepole pines were flourishing with fire exclusion—at least if flourishing means spreading in ever denser and more flammable thickets of live, dead, and dying trees.⁶ For several decades, Forest Service management has meant, on the one hand, trying to make the ponderosas come back, and, on the other, trying to thin, cut, or otherwise control flammable fir and lodgepole thickets. Ponderosa, fir, and lodgepole, each finding life through human disturbance, are now creatures of contaminated diversity.

Surprisingly, in this ruined industrial landscape, new value emerged: matsutake. Matsutake fruit especially well under mature lodgepole, and mature lodgepole exists in prodigious numbers in the eastern Cascades because of fire exclusion. With the logging of ponderosa pines and fire exclusion, lodgepoles have spread, and despite their flammability, fire exclusion allows them a long maturity. Oregon matsutake fruit only after forty to fifty years of lodgepole growth, made possible by excluding fire.⁷ The abundance of matsutake is a recent historical creation: contaminated diversity.

And what are Southeast Asian hill people doing in Oregon? Once I realized that almost everyone in the forest was there for explicitly "ethnic" reasons, finding out what these ethnicities implied became urgent. I needed to know what created communal agendas that included mushroom hunting; thus I followed the ethnicities they named for me. The pickers, like the forests, must be appreciated in becoming, not just counted. Yet almost all U.S. scholarship on Southeast Asian refugees ignores ethnic formation in Southeast Asia. To counteract this omission, allow me an extended story. Despite their specificity, Mien stand in here

for all the pickers—and the rest of us too. Transformation through collaboration, ugly and otherwise, is the human condition.

The distant ancestors of Kao's Mien community are imagined as emerging already in contradiction and on the run. Moving through the hills of southern China to hide from imperial power, they also treasured imperial documents exempting them from taxation and *corvée*. A little more than a hundred years ago, some moved farther out of the way—into the northern hills of what are now Laos, Thailand, and Vietnam. They brought a distinctive script, based on Chinese characters and used for writing to spirits.⁸ As both refusal and acceptance of Chinese authority, the script is a neat expression of contaminated diversity: Mien are Chinese, and not Chinese. Later they would learn to be Lao/Thai, but not Lao/Thai, and then American, and not American.

Mien are not known for their respect for national boundaries; communities have repeatedly crossed back and forth, especially when armies threaten. (Kao's uncle learned Chinese and Lao from cross-border movement.) Yet, despite this mobility, Mien are hardly an autonomous tribe, free from the control of the state. Hjørleifur Jonsson has shown how Mien lifeways have repeatedly changed in relation to state agendas. In the first half of the twentieth century, for example, Mien in Thailand organized their communities around the opium trade. Only large, polygynous households controlled by powerful senior men could keep hold of the opium contracts. Some households had one hundred members. The Thai state did not mandate this family organization; it arose from the Mien encounter with opium. In a similarly unplanned process in the late twentieth century, Mien in Thailand came to identify as an "ethnic group" with distinctive customs; Thai policy toward minorities made this identity possible. Meanwhile, along the Laos/Thailand border, Mien slipped back and forth, evading state policy on both sides even while being shaped by it.⁹

Those cross-boundary Asian hills have known many peoples, and Mien sensibilities have developed in engagement with these shifting groups as all have negotiated imperial governance and rebellion, licit and illicit trade, and millennial mobilization. To understand how Mien came to be matsutake pickers requires considering their relationship with another group now in the Oregon forests, Hmong. Hmong are

like Mien in many ways. They also ran south from China; they also crossed borders and occupied the high altitudes suited to commercial opium farming; they also value their distinctive dialects and traditions. A mid-twentieth-century millennial movement started by an illiterate farmer produced a completely original Hmong script. This was the time of the U.S.-Indochina War, and Hmong were in the thick of it. As linguist William Smalley points out, discarded military ordnance in the area would have exposed this inspired farmer to English, Russian, and Chinese writing, and he might also have seen Lao and Thai.¹⁰ Emerging from the trash of war, this distinctive and multiply derivative Hmong script, like that of the Mien, is a wonderful icon for contaminated diversity.

Hmong are proud of their patrilineal clan organization, and, according to ethnographer William Geddes, clans have been key to forming long-distance ties among men.¹¹ Clan relations allowed military leaders to recruit outside their face-to-face networks. This proved relevant when the United States took over imperial oversight after the French defeat by Vietnamese nationalists in 1954, thus inheriting the loyalty of French-trained Hmong soldiers. One of those soldiers became General Vang Pao, who mobilized Hmong in Laos to fight in behalf of the United States, becoming what 1970s CIA director William Colby called “the biggest hero of the Vietnam War.”¹² Vang Pao recruited not just individuals but villages and clans into the war. Although his claims to represent Hmong disguised the fact that Hmong also fought for the communist Pathet Lao, Vang Pao made his cause simultaneously a Hmong cause and a U.S. anticommunist cause. Through his control over opium transport, bombing targets, and CIA rice drops, as well as his charisma, Vang Pao generated enormous ethnic loyalty, consolidating one kind of “Hmong.”¹³ It is hard to think of a better example of contaminated diversity.

Some Mien fought in Vang Pao’s army. Some followed Hmong to the Ban Vinai refugee camp Vang Pao helped to have established in Thailand after he fled Laos following the U.S. withdrawal in 1975. But the war did not give Mien the sense of ethnic-political unity it gave Hmong. Some Mien fought for other political leaders, including Chao La, a Mien general. Some left Laos for Thailand long before the communist victory in Laos. Jonsson’s oral histories of Mien in the United States suggest that what are often imagined as innocent “regional”

groupings of Laotian Mien—northern Mien, southern Mien—refer to divergent histories of forced resettlement by Vang Pao and Chao La, respectively.¹⁴ War, he argues, creates ethnic identities.¹⁵ War forces people to move but also cements ties to reimagined ancestral cultures. Hmong helped to stimulate the mix, and Mien came to participate.

In the 1980s, Mien who had crossed from Laos to Thailand joined U.S. programs to bring anticommunists from Southeast Asia to the United States and allow them, through refugee status, to become citizens. The refugees arrived in the United States just as welfare was being cut; they were offered few resources for livelihood or assimilation. Most of those from Laos and Cambodia had neither money nor Western education; they moved into off-the-grid jobs such as matsutake picking. In the Oregon woods, they use skills honed in Indochinese wars. Those experienced in jungle fighting rarely get lost, since they know how to find their way in unfamiliar forests. Yet the forest has not stimulated a generic Indochinese—or American—identity. Mimicking the structure of Thai refugee camps, Mien, Hmong, Lao, and Khmer keep their places separate. Yet white Oregonians sometimes call them all “Cambodians,” or, with even more confusion, “Hong Kongs.” Negotiating multiple forms of prejudice and dispossession, contaminated diversity proliferates.

I hope that at this point you are saying, “This is hardly news! I can think of plenty of similar examples from the landscape and people around me.” I agree; contaminated diversity is everywhere. If such stories are so widespread and so well known, the question becomes: Why don’t we use these stories in how we know the world? One reason is that contaminated diversity is complicated, often ugly, and humbling. Contaminated diversity implicates survivors in histories of greed, violence, and environmental destruction. The tangled landscape grown up from corporate logging reminds us of the irreplaceable graceful giants that came before. The survivors of war remind us of the bodies they climbed over—or shot—to get to us. We don’t know whether to love or hate these survivors. Simple moral judgments don’t come to hand.

Worse yet, contaminated diversity is recalcitrant to the kind of “summing up” that has become the hallmark of modern knowledge. Contaminated diversity is not only particular and historical, ever changing, but also relational. It has no self-contained units; its units

are encounter-based collaborations. Without self-contained units, it is impossible to compute costs and benefits, or functionality, to any “one” involved. No self-contained individuals or groups assure their self-interests oblivious to the encounter. Without algorithms based on self-containment, scholars and policymakers might have to learn something about the cultural and natural histories at stake. That takes time, and too much time, perhaps, for those who dream of grasping the whole in an equation. But who put them in charge? If a rush of troubled stories is the best way to tell about contaminated diversity, then it’s time to make that rush part of our knowledge practices. Perhaps, like the war survivors themselves, we need to tell and tell until all our stories of death and near-death and gratuitous life are standing with us to face the challenges of the present. It is in listening to that cacophony of troubled stories that we might encounter our best hopes for precarious survival.

This book tells a few such stories, which take me not only to the Cascades but also to Tokyo auctions, Finnish Lapland, and a scientist’s lunchroom, where I am so excited I spill my tea. Following all these stories at once is as challenging—or, once one gets the hang of it, as simple—as singing a madrigal in which each singer’s melody courses in and out of the others. Such interwoven rhythms perform a still lively temporal alternative to the unified progress-time we still long to obey.



*Conjuring time, Tokyo.
Arranging matsutake for
auction at the Tsukiji
wholesale market.
Turning mushrooms into
inventory takes work:
commodities accelerate to
market tempos only when
earlier ties are severed.*

3 **Some Problems with Scale**

No, no, you are not thinking; you are just being logical.

—Physicist Niels Bohr defending “spooky action at a distance”

TO LISTEN TO AND TELL A RUSH OF STORIES IS A *method*. And why not make the strong claim and call it a science, an addition to knowledge? Its research object is contaminated diversity; its unit of analysis is the indeterminate encounter. To learn anything we must revitalize arts of noticing and include ethnography and natural history. But we have a problem with scale. A rush of stories cannot be neatly summed up. Its scales do not nest neatly; they draw attention to interrupting geographies and tempos. These interruptions elicit more stories. This is the rush of stories’ power as a science. Yet it is just these interruptions that step out of the bounds of most modern science, which demands the possibility for infinite expansion without changing the research framework. Arts of noticing are considered archaic because

they are unable to “scale up” in this way. The ability to make one’s research framework apply to greater scales, without changing the research questions, has become a hallmark of modern knowledge. To have any hope of thinking with mushrooms, we must get outside this expectation. In this spirit, I lead a foray into mushroom forests as “anti-plantations.”

The expectation of scaling up is not limited to science. Progress itself has often been defined by its ability to make projects expand without changing their framing assumptions. This quality is “scalability.” The term is a bit confusing, because it could be interpreted to mean “able to be discussed in terms of scale.” Both scalable and nonscalable projects, however, can be discussed in relation to scale. When Fernand Braudel explained history’s “long durée” or Niels Bohr showed us the quantum atom, these were not projects of scalability, although they each revolutionized thinking about scale. Scalability, in contrast, is the ability of a project to change scales smoothly without any change in project frames. A scalable business, for example, does not change its organization as it expands. This is possible only if business relations are not transformative, changing the business as new relations are added. Similarly, a scalable research project admits only data that already fit the research frame. Scalability requires that project elements be oblivious to the indeterminacies of encounter; that’s how they allow smooth expansion. Thus, too, scalability banishes meaningful diversity, that is, diversity that might change things.

Scalability is not an ordinary feature of nature. Making projects scalable takes a lot of work. Even after that work, there will still be interactions between scalable and nonscalable project elements. Yet, despite the contributions of thinkers such as Braudel and Bohr, the connection between scaling up and the advancement of humanity has been so strong that scalable elements receive the lion’s share of attention. The nonscalable becomes an impediment. It is time to turn attention to the nonscalable, not only as objects for description but also as incitements to theory.

A theory of nonscalability might begin in the work it takes to create scalability—and the messes it makes. One vantage point might be that early and influential icon for this work: the European colonial plantation. In their sixteenth- and seventeenth-century sugarcane plantations in Brazil, for example, Portuguese planters stumbled on a formula for

smooth expansion. They crafted self-contained, interchangeable project elements, as follows: exterminate local people and plants; prepare now-empty, unclaimed land; and bring in exotic and isolated labor and crops for production. This landscape model of scalability became an inspiration for later industrialization and modernization. The sharp contrast between this model and the matsutake forests that form the subject of this book is a useful platform from which to build a critical distance from scalability.¹

Consider the elements of the Portuguese sugarcane plantation in colonial Brazil. First, the cane, as Portuguese knew it: Sugarcane was planted by sticking a cane in the ground and waiting for it to sprout. All the plants were clones, and Europeans had no knowledge of how to breed this New Guinea cultigen. The interchangeability of planting stock, undisturbed by reproduction, was a characteristic of European cane. Carried to the New World, it had few interspecies relations. As plants go, it was comparatively self-contained, oblivious to encounter.

Second, cane labor: Portuguese cane-growing came together with their newly gained power to extract enslaved people from Africa. As cane workers in the New World, enslaved Africans had great advantages from growers' perspectives: they had no local social relations and thus no established routes for escape. Like the cane itself, which had no history of either companion species or disease relations in the New World, they were isolated. They were on their way to becoming self-contained, and thus standardizable as abstract labor. Plantations were organized to further alienation for better control. Once central milling operations were started, all operations had to run on the time frame of the mill. Workers had to cut cane as fast as they could, and with full attention, just to avoid injury. Under these conditions, workers did, indeed, become self-contained and interchangeable units. Already considered commodities, they were given jobs made interchangeable by the regularity and coordinated timing engineered into the cane.

Interchangeability in relation to the project frame, for both human work and plant commodities, emerged in these historical experiments. It was a success: Great profits were made in Europe, and most Europeans were too far away to see the effects. The project was, for the first time, scalable—or, more accurately, seemingly scalable.² Sugarcane plantations expanded and spread across the warm regions of the world. Their

contingent components—cloned planting stock, coerced labor, conquered and thus open land—showed how alienation, interchangeability, and expansion could lead to unprecedented profits. This formula shaped the dreams we have come to call progress and modernity. As Sidney Mintz has argued, sugarcane plantations were the model for factories during industrialization; factories built plantation-style alienation into their plans.³ The success of expansion through scalability shaped capitalist modernization. By envisioning more and more of the world through the lens of the plantation, investors devised all kinds of new commodities. Eventually, they posited that everything on earth—and beyond—might be scalable, and thus exchangeable at market values. This was utilitarianism, which eventually congealed as modern economics and contributed to forging more scalability—or at least its appearance.

Contrast the matsutake forest: unlike sugarcane clones, matsutake make it evident that they cannot live without transformative relations with other species. Matsutake mushrooms are the fruiting bodies of an underground fungus associated with certain forest trees. The fungus gets its carbohydrates from mutualistic relations with the roots of its host trees, for whom it also forages. Matsutake make it possible for host trees to live in poor soils, without fertile humus. In turn, they are nourished by the trees. This transformative mutualism has made it impossible for humans to cultivate matsutake. Japanese research institutions have thrown millions of yen into making matsutake cultivation possible, but so far without success. Matsutake resist the conditions of the plantation. They require the dynamic multispecies diversity of the forest—with its contaminating relationality.⁴

Furthermore, matsutake foragers are far from the disciplined, interchangeable laborers of the cane fields. Without disciplined alienation, no scalable corporations form in the forest. In the U.S. Pacific Northwest, foragers flock to the forest following “mushroom fever.” They are independent, finding their way without formal employment.

Yet it would be a mistake to see matsutake commerce as a primitive survival; this is the misapprehension of progress blinders. Matsutake commerce does not occur in some imagined time before scalability. It is dependent on scalability—in ruins. Many pickers in Oregon are displaced from industrial economies, and the forest itself is the remains of

scalability work. Both matsutake commerce and ecology depend on interactions between scalability and its undoing.

The U.S. Pacific Northwest was the crucible of U.S. timber policy and practice in the twentieth century. This region attracted the timber industry after it had already destroyed midwestern forests—and just as scientific forestry became a power in U.S. national governance. Private and public (and, later, environmentalist) interests battled it out in the Pacific Northwest; the scientific-industrial forestry on which they tenuously agreed was a creature of many compromises. Still, here is a place to see forests treated as much like scalable plantations as they might ever be. During the heyday of joint public-private industrial forestry in the 1960s and 1970s, this meant monocrop even-aged timber stands.⁵ Such management took a huge amount of work. Unwanted tree species, and indeed all other species, were sprayed with poison. Fires were absolutely excluded. Alienated work crews planted “superior” trees. Thinning was brutal, regular, and essential. Proper spacing allowed maximum rates of growth as well as mechanical harvesting. Timber trees were a new kind of sugarcane: managed for uniform growth, without multispecies interference, and thinned and harvested by machines and anonymous workers.

Despite its technological prowess, the project of turning forests into plantations worked out unevenly at best. Earlier, timber companies had made a killing by just harvesting the most expensive trees; when national forests were opened for logging after World War II, they continued “high grading,” a practice dignified under standards that said mature trees were better replaced by fast-growing youngsters. Clear-cutting, or “even-aged management,” was introduced to move beyond the inefficiencies of such pick-and-choose harvesting. But the regrowing trees of scientific-industrial management were not so inviting, profit-wise. Where the great timber species had earlier been maintained by Native American burning, it was difficult to reproduce the “right” species. Firs and lodgepole pines grew up where great ponderosas had once held dominance. Then the price of Pacific Northwest timber plummeted. Without easy pickings, timber companies began to search elsewhere for cheaper trees. Without the political clout and funds of big timber, the region’s Forest Service districts lost funding, and maintaining plantation-like forests became cost-prohibitive. Environmentalists started going to

the courts, asking for stricter conservation protections. They were blamed for the crashing timber economy, but the timber companies—and most of the big trees—had already left.⁶

By the time I wandered into the eastern Cascades, in 2004, fir and lodgepole had made great advances across what once had been almost pure stands of ponderosa pine. Although signs along the highways still said “Industrial Timber,” it was hard to imagine industry. The landscape was covered with thickets of lodgepole and fir: too small for most timber users; not scenic enough for recreation. But something else had emerged in the regional economy—matsutake. Forest Service researchers in the 1990s found that the annual commercial value of the mushrooms was as least as much as the value of the timber.⁷ Matsutake had stimulated a nonscalable forest economy in the ruins of scalable industrial forestry.

The challenge for thinking with precarity is to understand the ways projects for making scalability have transformed landscape and society, while also seeing where scalability fails—and where nonscalable ecological and economic relations erupt. It is key to take note of the careers of both scalability and nonscalability. But it would be a huge mistake to assume that scalability is bad and nonscalability is good. Nonscalable projects can be as terrible in their effects as scalable ones. Unregulated loggers destroy forests more rapidly than scientific foresters. The main distinguishing feature between scalable and nonscalable projects is not ethical conduct but rather that the latter are more diverse because they are not geared up for expansion. Nonscalable projects can be terrible or benign; they run the range.

New eruptions of nonscalability do not mean that scalability has disappeared. In an era of neoliberal restructuring, scalability is increasingly reduced to a technical problem rather than a popular mobilization in which citizens, governments, and corporations should work together. As chapter 4 explores, the articulation between scalable accounting and nonscalable workplace relations is increasingly accepted as a model for capitalist accumulation. Production does not have to be scalable as long as elites are able to regularize their account books. Can we keep sight of the continuing hegemony of scalability projects while immersing ourselves in the forms and tactics of precarity?

Part 2 of this book traces the interplay between scalable and non-scalable in forms of capitalism in which scalable accounting allows non-scalable labor and natural resource management. In this “salvage” capitalism, supply chains organize the translation process in which wildly diverse forms of work and nature are made commensurate—for capital. Part 3 returns to matsutake forests as anti-plantations in which transformative encounters create the possibilities of life. The contaminated diversity of ecological relations takes center stage.

But first, a foray into indeterminacy: the central feature of the assemblages I follow. So far, I’ve defined assemblages in relation to their negative features: their elements are contaminated and thus unstable; they refuse to scale up smoothly. Yet assemblages are defined by the strength of what they gather as much as their always-possible dissipation. They make history. This combination of ineffability and presence is evident in smell: another gift of the mushroom.



MUSHROOM BUYER



*Capitalist edge effects,
Oregon. A buyer sets up
by the side of the
highway. Commerce
connects undisciplined
labor and resources with
central locations for
inventory, where
capitalist value is
amassed in translation.*

Part II **After Progress: Salvage Accumulation**

I FIRST HEARD OF MATSUTAKE FROM MYCOLOGIST David Arora, who studied matsutake camps in Oregon between 1993 and 1998. I was looking for a culturally colorful global commodity, and Arora's stories of matsutake intrigued me. He told me of the buyers set up tents by the side of the highway to buy mushrooms at night. "They have nothing to do all day, so they'll have plenty of time to talk to you," he ventured.

And there the buyers were—but so much more! In the big camp, I seemed to have stepped into rural Southeast Asia. Mien wearing sarongs boiled water in kerosene cans over stone tripods and hung strips of game and fish over the stove to dry. Hmong all the way from North Carolina brought home-canned bamboo shoots for sale. Lao noodle tents sold not only *pho* but also the most authentic *laap* I had eaten in the United States, all raw blood, chilies, and intestines. Lao karaoke blared from battery-powered speakers. I even met a Cham picker, although he did not speak Cham, which I thought perhaps I could manage from its closeness to Malay. Mocking my linguistic limitations, a Khmer teenager wearing grunge boasted that he spoke four languages: Khmer, Lao, English, and Ebonics. Local Native Americans sometimes

came to sell their mushrooms. There were also both whites and Latinos, although most avoided the official camp, staying in the woods alone or in small groups. And visitors: A Sacramento Filipino followed Mien friends up here one year, although he said he never got the point. A Portland Korean thought maybe he might join.

Yet there was something not at all cosmopolitan about the scene as well: A rift separated these pickers and buyers from shops and consumers in Japan. Everyone knew that the mushrooms (except for a small percentage bought for Japanese American markets) were going to Japan. Every buyer and bulker longed to sell directly to Japan—but none had any idea how. Misconceptions about the matsutake trade both in Japan and in other supply sites proliferated. White pickers swore that the value of the mushrooms in Japan was as an aphrodisiac. (While matsutake in Japan do have phallic connotations, no one eats them as a drug.) Some complained about the Chinese Red Army, which, they said, drafted people to pick, which depressed global prices. (Pickers in China are independent, just as in Oregon.) When someone discovered extremely high prices in Tokyo on the Internet, no one realized that these prices referred to *Japanese* matsutake. One exceptional bulker, of Chinese origin and fluent in Japanese, whispered to me about these misunderstandings—but he was an outsider. Except for this man, Oregon pickers, buyers, and bulkers were completely in the dark about the Japanese side of the trade. They made up fantasy landscapes of Japan, and they did not know how to assess them. They had their own matsutake world: a patch of practices and meanings that brought them together as matsutake suppliers—but did not inform the mushrooms' further passage.

This rift between U.S. and Japanese segments of the commodity chain guided my search. Different processes for making and accessing value characterized each segment. Given this diversity, what makes this part of that global economy we call capitalism?



*Capitalist edge effects,
Oregon. Pickers line up to
sell matsutake to a
roadside buyer. Precarious
livelihoods show
themselves at the edges of
capitalist governance.
Precarity is that here and
now in which pasts may
not lead to futures.*

4 **Working the Edge**

IT MAY SEEM ODD TO WANT TO TACKLE CAPITALISM with a theory that stresses ephemeral assemblages and multidirectional histories. After all, the global economy has been the centerpiece of progress, and even radical critics have described its forward-looking motion as filling up the world. Like a giant bulldozer, capitalism appears to flatten the earth to its specifications. But all this only raises the stakes for asking what else is going on—not in some protected enclave, but rather everywhere, both inside and out.

Impressed by the rise of factories in the nineteenth century, Marx showed us forms of capitalism that required the rationalization of wage labor and raw materials. Most analysts have followed this precedent, imagining a factory-driven system with a coherent governance structure, built in cooperation with nation-states. Yet today—as then—much of the economy takes place in radically different scenes. Supply chains snake back and forth not only across continents but also across standards; it would be hard to identify a single rationality across the chain. Yet assets are still amassed for further investment. How does this work?

A supply chain is a particular kind of commodity chain: one in which lead firms direct commodity traffic.¹ Throughout this part, I explore the supply chain linking matsutake pickers in the forests of Oregon with those who eat the mushrooms in Japan. The chain is surprising and full of cultural variety. The factory work through which we know capitalism is mainly missing. But the chain illuminates something important about capitalism today: Amassing wealth is possible without rationalizing labor and raw materials. Instead, it requires acts of translation across varied social and political spaces, which, borrowing from ecologists' usage, I call "patches." Translation, in Shiho Satsuka's sense, is the drawing of one world-making project into another.² While the term draws attention to language, it can also refer to other forms of partial attunement. Translations across sites of difference *are* capitalism: they make it possible for investors to accumulate wealth.

How do mushrooms foraged as trophies of freedom become capitalist assets—and later, exemplary Japanese gifts? Answering this question requires attention to the unexpected assemblages of the chain's component links, as well as the translation processes that draw the links together into a transnational circuit.



Capitalism is a system for concentrating wealth, which makes possible new investments, which further concentrate wealth. This process is accumulation. Classic models take us to the factory: factory owners concentrate wealth by paying workers less than the value of the goods that the workers produce each day. Owners "accumulate" investment assets from this extra value.

Even in factories, however, there are other elements of accumulation. In the nineteenth century, when capitalism first became an object of inquiry, raw materials were imagined as an infinite bequest from Nature to Man. Raw materials can no longer be taken for granted. In our food procurement system, for example, capitalists exploit ecologies not only by reshaping them but also by taking advantage of their capacities. Even in industrial farms, farmers depend on life processes outside their control, such as photosynthesis and animal digestion. In capitalist farms, living things made within ecological processes are coopted for

the concentration of wealth. This is what I call “salvage,” that is, taking advantage of value produced without capitalist control. Many capitalist raw materials (consider coal and oil) came into existence long before capitalism. Capitalists also cannot produce human life, the prerequisite of *labor*. “Salvage accumulation” is the process through which lead firms amass capital without controlling the conditions under which commodities are produced. Salvage is not an ornament on ordinary capitalist processes; it is a feature of how capitalism works.³

Sites for salvage are simultaneously inside and outside capitalism; I call them “pericapitalist.”⁴ All kinds of goods and services produced by pericapitalist activities, human and nonhuman, are salvaged for capitalist accumulation. If a peasant family produces a crop that enters capitalist food chains, capital accumulation is possible through salvaging the value created in peasant farming. Now that global supply chains have come to characterize world capitalism, we see this process everywhere. “Supply chains” are commodity chains that translate value to the benefit of dominant firms; translation between noncapitalist and capitalist value systems is what they do.

Salvage accumulation through global supply chains is not new, and some well-known earlier examples can clarify how it works. Consider the nineteenth-century ivory supply chain connecting central Africa and Europe as told in Joseph Conrad’s novel *Heart of Darkness*.⁵ The story turns around the narrator’s discovery that the European trader he much admired has turned to savagery to procure his ivory. The savagery is a surprise because everyone expects the European presence in Africa to be a force for civilization and progress. Instead, civilization and progress turn out to be cover-ups and translation mechanisms for getting access to value procured through violence: classic salvage.

For a brighter view of supply-chain translation, consider Herman Melville’s account of the nineteenth-century procurement of whale oil for Yankee investors.⁶ *Moby-Dick* tells of a ship of whalers whose rowdy cosmopolitanism contrasts sharply with our stereotypes of factory discipline; yet the oil they obtain from killing whales around the world enters a U.S.-based capitalist supply chain. Strangely, all the harpooners on the *Pequod* are unassimilated indigenous people from Asia, Africa, America, and the Pacific. The ship is unable to kill a single whale without the expertise of people who are completely untrained in U.S.

industrial discipline. But the products of this work must eventually be translated into capitalist value forms; the ship sails only because of capitalist financing. The conversion of indigenous knowledge into capitalist returns is salvage accumulation. So too is the conversion of whale life into investments.

Before you conclude that salvage accumulation is archaic, let me turn to a contemporary example. Technological advances in managing inventory have energized today's global supply chains; inventory management allows lead firms to source their products from all kinds of economic arrangements, capitalist and otherwise. One firm that helped put such innovations in place is the retail giant Wal-Mart. Wal-Mart pioneered the required use of universal product codes (UPCs), the black-and-white bars that allow computers to know these products as inventory.⁷ The legibility of inventory, in turn, means that Wal-Mart is able to ignore the labor and environmental conditions through which its products are made: pericapitalist methods, including theft and violence, may be part of the production process. With a nod to Woody Guthrie, we might think about the contrast between production and accounting through the two sides of the UPC tag.⁸ One side of the tag, the side with the black-and-white bars, allows the product to be minutely tracked and assessed. The other side of the tag is blank, indexing Wal-Mart's total lack of concern with how the product is made, since value can be translated through accounting. Wal-Mart has become famous for forcing its suppliers to make products ever more cheaply, thus encouraging savage labor and destructive environmental practices.⁹ Savage and salvage are often twins: Salvage translates violence and pollution into profit.

As inventory moves increasingly under control, the requirement to control labor and raw materials recedes; supply chains make value from translating values produced in quite varied circumstances into capitalist inventory. One way of thinking about this is through scalability, the technical feat of creating expansion without the distortion of changing relations. The legibility of inventory allows scalable retail expansion for Wal-Mart without requiring that production be scalable. Production is left to the riotous diversity of nonscalability, with its relationally particular dreams and schemes. We know this best in "the race to the bottom": the role of global supply chains in promoting coerced labor, dangerous sweatshops, poisonous substitute ingredients, and irresponsible

environmental gouging and dumping. Where lead firms pressure suppliers to provide cheaper and cheaper products, such production conditions are predictable outcomes. As in *Heart of Darkness*, unregulated production is translated in the commodity chain, and even reimagined as progress. This is frightening. At the same time, as J. K. Gibson-Graham argue in their optimistic reach toward a “postcapitalist politics,” economic diversity can be hopeful.¹⁰ Pericapitalist economic forms can be sites for rethinking the unquestioned authority of capitalism in our lives. At the very least, diversity offers a chance for multiple ways forward—not just one.

In her insightful comparison between the supply chains for French green beans (*haricots verts*) that link West Africa with France and East Africa with Great Britain, respectively, geographer Susanne Freidberg offers a sense of how supply chains, drawing variously on colonial and national histories, may encourage quite different economic forms.¹¹ French neocolonial schemes mobilize peasant cooperatives; British supermarket standards encourage expatriate scam operations.¹² Within and across differences such as these, there is room for building a politics to confront and navigate salvage accumulation. But following Gibson-Graham to call this politics “postcapitalist” seems to me premature. Through salvage accumulation, lives and products move back and forth between noncapitalist and capitalist forms; these forms shape each other and interpenetrate. The term “pericapitalist” acknowledges that those of us caught in such translations are never fully shielded from capitalism; pericapitalist spaces are unlikely platforms for a safe defense and recuperation.

At the same time, the more prominent critical alternative—shutting one’s eyes to economic diversity—seems even more ridiculous in these times. Most critics of capitalism insist on the unity and homogeneity of the capitalist system; many, like Michael Hardt and Antonio Negri, argue that there is no longer a space outside of capitalism’s empire.¹³ Everything is ruled by a singular capitalist logic. As for Gibson-Graham, this claim is an attempt to build a critical political position: the possibility of transcending capitalism. Critics who stress the uniformity of capitalism’s hold on the world want to overcome it through a singular solidarity. But what blindsers this hope requires! Why not instead admit to economic diversity?

My goal in bringing up Gibson-Graham and Hardt and Negri is not to dismiss them; indeed, I think they are perhaps the early twenty-first century's most trenchant anticapitalist critics. Furthermore, by setting out strongly contrasting goal posts between which we might think and play, they jointly do us an important service. Is capitalism a single, overarching system that conquers all, or one segregated economic form among many?¹⁴ Between these two positions, we might see how capitalist and noncapitalist forms interact in pericapitalist spaces. Gibson-Graham advise us, quite correctly I think, that what they call “noncapitalist” forms can be found everywhere in the midst of capitalist worlds—rather than just in archaic backwaters. But they see such forms as alternatives to capitalism. Instead, I would look for the noncapitalist elements on which capitalism depends. Thus, for example, when Jane Collins reports that workers in Mexican garment assembly factories are expected to know how to sew before they begin their jobs, *because they are women*, we are offered a glimpse of noncapitalist and capitalist economic forms working together.¹⁵ Women learn to sew growing up at home; salvage accumulation is the process that brings this skill into the factory to the benefit of owners. To understand capitalism (and not just its alternatives), then, we can't stay inside the logics of capitalists; we need an ethnographic eye to see the economic diversity through which accumulation is possible.

It takes concrete histories to make any concept come to life. And isn't mushroom collecting a place to look, after progress? The rifts and bridges of the Oregon-to-Japan matsutake commodity chain show capitalism achieved through economic diversity. Matsutake foraged and sold in pericapitalist performances become capitalist inventory as they are sent to Japan a day later. Such translation is the central problem of many global supply chains. Let me begin by describing the first part of the chain.¹⁶



Americans don't like middlemen, who, they say, just rip off value. But middlemen are consummate translators; their presence directs us to salvage accumulation. Consider the North American side of the commodity chain that brings matsutake from Oregon to Japan. (The Japanese side—with its many middlemen—will be considered later.) Independen-

dent foragers pick the mushrooms in national forests. They sell to independent buyers, who sell, in turn, to bulkers' field agents, who sell to other bulkers or to exporters, who sell and ship, at last, to importers in Japan. Why so many middlemen? The best answer may be a history.

Japanese traders began importing matsutake in the 1980s, when the scarcity of matsutake in Japan first became clear. Japan was bursting with investment capital, and matsutake were prime luxuries, equally suitable as perks, gifts, or bribes. American matsutake were still an expensive novelty in Tokyo, and restaurants competed to get some. Emerging matsutake traders in Japan were like other Japanese traders of that time, ready to use their capital to organize supply chains.

The mushrooms were expensive, so the incentives for suppliers were good. North American traders remember the 1990s as a time of extraordinary prices—and high-risk gambling. If a supplier was able to hit the Japanese markets correctly, the payoff was huge. But with an inconsistent and easy-to-spoil forest product and rapidly changing demand, the possibilities for total wipeout were also great. Everyone spoke of those days in casino metaphors. One Japanese trader compared the importers then to the Mafia in international ports after World War I: It was not just that the importers were gambling but that they were also catalyzing gambling—and keeping the gambling going.

Japanese importers needed local know-how, and they began through alliances with exporters. In the Pacific Northwest, the first exporters were Asian Canadians in Vancouver—and because of their precedent, most U.S. matsutake continue to be exported by their firms. These exporters were not interested only in matsutake. They shipped seafood, or cherries, or log homes to Japan; matsutake were added to those activities. Some—especially the Japanese immigrants—told me they added matsutake to sweeten long-term relations with importers. They were willing to ship matsutake at a loss, they said, to keep their relations intact.

Alliances between exporters and importers formed a basis for the transpacific trade. But the exporters—experts in fish, or fruit, or timber—knew nothing about how to get the mushrooms. In Japan, matsutake come to the market via an agricultural cooperative, or from individual farmers. In North America, matsutake are scattered across enormous national (U.S.) or commonwealth (Canadian) forests. This is where the small companies that I call “bulklers” come in; bulklers gather mushrooms

to sell to exporters. Bulklers' field agents buy mushrooms from "buyers" who buy from pickers. Field agents, like buyers, must know the terrain and the people likely to search it.

In the earliest days of the U.S. Pacific Northwest matsutake trade, most field agents, buyers, and pickers were white men who found solace in the mountains, such as Vietnam veterans, displaced loggers, and rural "traditionalists" who rejected liberal urban society. After 1989, an increasing number of refugees from Laos and Cambodia came to pick, and field agents had to stretch their abilities to work with Southeast Asians. Southeast Asians eventually became buyers, and a few became field agents. Working around each other, the whites and Southeast Asians found a common vocabulary in "freedom," which could mean many things dear to each group, even if they were not the same. Native Americans found resonance, but Latino pickers did not share the rhetoric of freedom. Despite this variation, the overlapping concerns of self-exiled whites and Southeast Asian refugees became the heartbeat of the trade; freedom brought out the matsutake.

Through shared concerns with freedom, the U.S. Pacific Northwest became one of the world's great matsutake exporting areas. Yet this way of life was segregated from the rest of the commodity chain. Bulklers and buyers longed to export matsutake directly to Japan but did not succeed. Neither buyers nor bulklers could get beyond the already difficult exchange with Canadian exporters of Asian origin, for whom English was not often a first language. They complained about unfair practices, but in fact they were useless at the cultural translation necessary for the making of inventory. For it is not just language that separates pickers, buyers, and bulklers in Oregon from Japanese traders; it is the conditions of production. Oregon mushrooms are contaminated with the cultural practices of "freedom."

The story of an exception makes the point. "Wei" first went to Japan from his native China to study music; when he found he could not make a living, he entered the Japanese vegetable import trade. He became fluent in Japanese, although still prickly about some features of life in Japan. When his company wanted someone to go to North America, he volunteered. This is how he became an idiosyncratic combination of field agent, bulker, and exporter. He goes to the matsutake area to watch the buying, just like other field agents, but he has a direct line

to Japan. Unlike the other field agents, he is constantly on the phone with Japanese traders, gauging opportunities and prices. He also talks to Japanese Canadian exporters, although he does not sell his mushrooms through them; because he can talk to them in Japanese, they constantly ask him to explain conditions in the field, including the behavior of the field agents whose mushrooms they buy. Meanwhile, the other field agents refuse to include him in their company and conspire against his buyers. He is not welcomed into their discussions, and, indeed, is shunned by the freedom-loving mountain men.

Unlike the other field agents, Wei pays his buyers a salary, rather than a commission. He demands the loyalty and discipline of employees, refusing them the freewheeling independence of the other buyers. He buys matsutake for particular shipments, with particular characteristics, rather than buying for the pleasure and prowess of free competition, as the others do. He is already making inventory in the buying tents. His difference highlights the distinctiveness of the freedom assemblage as a patch.

As international matsutake commerce entered the twenty-first century, regularization was afoot in Japan. Prices there stabilized as supply chains in many countries developed, as rankings of foreign matsutake congealed, and as perk-money in Japan diminished and the demand for matsutake became more specialized. The prices of Oregon matsutake in Japan became relatively stable—considering, of course, that matsutake is still a wild product with an irregular supply. However, this stability was not reflected in Oregon, where prices continued to roller-coaster, even if never returning to 1990s' highs. When I talked to Japanese importers about this discrepancy, they explained it as a matter of American "psychology." An importer who specialized in Oregon matsutake was thrilled to show me photographs from his visits and reminisce about his Wild West experiences in Oregon. White and Southeast Asian pickers and buyers, he explained, would not produce mushrooms without the excitement of what he called an "auction," and the more the price fluctuated, the better the buying. (In contrast, he said, Mexican pickers in Oregon were willing to accept a constant price, but the others dominated the trade.) His job was to facilitate American peculiarities; his company had a parallel specialist in Chinese matsutake, whose job was to accommodate Chinese quirks. By facilitating varied cultural economies, his

company could build its business through mushrooms from around the world.

It was this man's expectation of the necessity of cultural translation that first alerted me to the problem of salvage accumulation. In the 1970s, Americans expected the globalization of capital to mean the spread of U.S. business standards all over the world. In contrast, Japanese traders had become specialists in building international supply chains and using them as mechanisms of translation to bring goods into Japan without Japanese production facilities or employment standards. As long as these goods could be made into legible inventory in their transit to Japan, Japanese traders could use them to accumulate capital. By the end of the century, Japanese economic power had slipped, and twentieth-century Japanese business innovations were eclipsed by neoliberal reforms. But no one cares to reform the matsutake commodity chain; it is too small and too "Japanese." Here is a place, then, to look for the Japanese trading strategies that rocked the world. At their center is translation between diverse economies. Traders as translators become masters of salvage accumulation.

Before taking on translation, however, I need to visit the freedom assemblage.





*Active landscapes,
Yunnan. Active
landscapes are puzzles,
turning nature-as-we-
knew-it on its head.
Here, pines, oaks, goats,
humans: why does
matsutake flourish
in the midst of
all this traffic?*

Part III **Disturbed Beginnings: Unintentional Design**

WHEN KATO-SAN INTRODUCED ME TO THE WORK HE was doing for the prefectural forest-research service to restore the forest, I was shocked. As an American tutored in wilderness sensibilities, I thought forests were best at restoring themselves. Kato-san disagreed: If you want matsutake in Japan, he explained, you must have pine, and if you want pine, you must have human disturbance. He was supervising work to remove broadleaf trees from the hillside he showed me. Even the topsoil had been carted away, and the steep slope now looked gouged and bare to my American eyes. "What about erosion?" I asked. "Erosion is good," he answered. Now I was really startled. Isn't erosion, the loss of soil, always bad? Still, I was willing to listen: pine flourishes on mineral soils, and erosion uncovers them.

Working with forest managers in Japan changed how I thought about the role of disturbance in forests. Deliberate disturbance to revitalize forests surprised me. Kato-san was not planting a garden. The forest he hoped for would have to grow itself. But he wanted to help it along by creating a certain kind of mess: a mess that would advantage pine.

Kato-san's work engages with a popular and scientific cause: restoring *satoyama* woodlands. *Satoyama* are traditional peasant landscapes,

combining rice agriculture and water management with woodlands. The woodlands—the heart of the satoyama concept—were once disturbed, and thus maintained, through their use for firewood and charcoal-making as well as nontimber forest products. Today, the most valuable product of the satoyama woodland is matsutake. To restore woodlands for matsutake encourages a suite of other living things: pines and oaks, understory herbs, insects, birds. Restoration requires disturbance—but disturbance to enhance diversity and the healthy functioning of ecosystems. Some kinds of ecosystems, advocates argue, flourish with human activities.

Ecological restoration programs around the world use human action to rearrange natural landscapes. What distinguishes satoyama revitalization, for me, is the idea that human activities should be part of the forest in the same way as nonhuman activities. Humans, pines, matsutake, and other species should all make the landscape together, in this project. One Japanese scientist explained matsutake as the result of “unintentional cultivation,” because human disturbance makes the presence of matsutake more likely—despite the fact that humans are entirely incapable of cultivating the mushroom. Indeed, one could say that pines, matsutake, and humans all cultivate each other unintentionally. They make each other’s world-making projects possible. This idiom has allowed me to consider how landscapes more generally are products of *unintentional design*, that is, the overlapping world-making activities of many agents, human and not human. The design is clear in the landscape’s ecosystem. But none of the agents have planned this effect. Humans join others in making landscapes of unintentional design.

As sites for more-than-human dramas, landscapes are radical tools for decentering human hubris. Landscapes are not backdrops for historical action: they are themselves active. Watching landscapes in formation shows humans joining other living beings in shaping worlds. Matsutake and pine don’t just grow in forests; they make forests. Matsutake forests are gatherings that build and transform landscapes. This part of the book begins with disturbance—and I make disturbance a beginning, that is, an opening for action. Disturbance realigns possibilities for transformative encounter. Landscape patches emerge from disturbance. Thus precarity is enacted in more-than-human sociality.



*Active landscapes, Kyoto
Prefecture. Satoyama
forest in December.
Sometimes the life of
the forest is most evident
as it bursts through
obstacles. Farmers chop;
winter chills: life still
breaks through.*

11 **The Life of the Forest**

TO WALK ATTENTIVELY THROUGH A FOREST, EVEN A damaged one, is to be caught by the abundance of life: ancient and new; underfoot and reaching into the light. But how does one tell the life of the forest? We might begin by looking for drama and adventure beyond the activities of humans. Yet we are not used to reading stories without human heroes. This is the puzzle that informs this section of the book. Can I show landscape as the protagonist of an adventure in which humans are only one kind of participant?

Over the past few decades, many kinds of scholars have shown that allowing only human protagonists into our stories is not just ordinary human bias; it is a cultural agenda tied to dreams of progress through modernization.¹ There are other ways of making worlds. Anthropologists have become interested, for example, in how subsistence hunters recognize other living beings as “persons,” that is, protagonists of stories.² Indeed, how could it be otherwise? Yet expectations of progress block this insight: talking animals are for children and primitives. Their voices silent, we imagine well-being without them. We trample over them for our advancement; we forget that collaborative survival requires

cross-species coordinations. To enlarge what is possible, we need other kinds of stories—including adventures of landscapes.³

One place to begin is a nematode—and a thesis on livability.



“Call me *Bursaphelenchus xylophilus*. I’m a tiny, wormlike creature, a nematode, and I spend most of my time crunching the insides of pine trees. But my kin are as well-traveled as any whaler sailing the seven seas. Stick with me, and I’ll tell you about some curious voyages.”

But wait: who would want to hear about the world from a worm? That was, in effect, the question addressed by Jakob von Uexküll in 1934, when he described the world experienced by a tick.⁴ Working with the tick’s sensory abilities, such as its ability to detect the heat of a mammal, and thus a potential blood meal, Uexküll showed that a tick knows and makes worlds. His approach brought landscapes to life as scenes of sensuous activity; creatures were not to be treated as inert objects but as knowing subjects.

And yet: Uexküll’s idea of affordances limited his tick to the bubble-like world of its few senses. Caught in a small frame of space and time, it was not a participant in the wider rhythms and histories of the landscape.⁵ This is not enough—as the voyages of *Bursaphelenchus xylophilus*, the pine wilt nematode, attest. Consider one of the most colorful:

Pine wilt nematodes are unable to move from tree to tree without the help of pine sawyer beetles, who carry them without benefit to themselves. At a particular stage in a nematode’s life, it may take advantage of a beetle’s journey to hop on as a stowaway. But this is not a casual transaction. Nematodes must approach beetles in a particular stage of the beetles’ life cycle, just as they are about to emerge from their piney cavities to move to a new tree. The nematodes ride in the beetles’ tracheae. When the beetles move to a new tree to lay their eggs, the nematodes slip into the new tree’s wound. This is an extraordinary feat of coordination, in which nematodes tap into beetles’ life rhythms.⁶ To immerse oneself in such webs of coordination, Uexküll’s bubble worlds are not enough.

Despite this sojourn with a nematode, I have not abandoned matsutake. A major reason for the current rarity of matsutake in Japan is the demise of pines that results from the habits of pine wilt nematodes. Just as whalers catch whales, pine wilt nematodes catch pines and kill

them and their fungal companions. Still, nematodes were not always involved in this way of making a living. Just as for whalers and whales, nematodes become killers of pines only through the contingencies of circumstance and history. Their voyage into Japanese history is as extraordinary as the webs of coordination they weave.

Pine wilt nematodes are only minor pests for American pines, which evolved with them. These nematodes became tree killers only when they traveled to Asia, where pines were unprepared and vulnerable. Amazingly, ecologists have traced this process rather precisely. The first nematodes disembarked at Japan's Nagasaki harbor from the United States in the first decade of the twentieth century, riding in American pine.⁷ Timber was a resource for industrializing Japan, where elites were hungry for resources from around the world. Many uninvited guests arrived with those resources, including the pine wilt nematode. Soon after its arrival, it traveled with local pine sawyer beetles; its moves can be traced concentrically out from Nagasaki. Together, the local beetle and the foreign nematode changed Japan's forest landscapes.

Still, an infected pine might not die if it is living in good conditions, and this indeterminate threat thus holds matsutake, implicated as collateral damage, in suspense. Pines stressed by forest crowding, lack of light, and too much soil enrichment are easy prey to nematodes. Evergreen broadleaf trees crowd and shade Japanese pine. Blue-stain fungus sometimes grows in pine's wounds, feeding the nematodes.⁸ The warmer temperatures of anthropogenic climate change help the nematodes to spread.⁹ Many histories come together here; they draw us beyond bubble worlds into shifting cascades of collaboration and complexity. The livelihoods of the nematode—and the pine it attacks and the fungus that tries to save it—are honed within unstable assemblages as opportunities arise and old talents gain new purchase. Japan's matsutake enters the fray of all this history: its fate depends on the enhancement or debilitation of the Uexküllian agilities of pine wilt nematodes.

Tracking matsutake through the journeys of nematodes allows me to return to my questions about telling the adventures of landscapes, this time with a thesis. First, rather than limit our analyses to one creature at a time (including humans), or even one relationship, if we want to know what makes places livable we should be studying polyphonic assemblages, gatherings of ways of being. Assemblages are performances of

livability. Matsutake stories draw us into pine stories and nematode stories; in their moments of coordination with each other they create livable—or killing—situations.

Second, species-specific agilities are honed in the coordinations of assemblages. Uexküll gets us on the right track by noticing how even humble creatures participate in making worlds. To extend his insights, we must follow multispecies attunements in which each organism comes into its own. Matsutake is nothing without the rhythms of the matsutake forest.

Third, coordinations come in and out of existence through the contingencies of historical change. Whether matsutake and pine in Japan can continue to collaborate depends a great deal on other collaborations set in motion by the arrival of pine wilt nematodes.

To put all this together it may be useful to recall the polyphonic music mentioned briefly in chapter 1. In contrast to the unified harmonies and rhythms of rock, pop, or classical music, to appreciate polyphony one must listen both to the separate melody lines and their coming together in unexpected moments of harmony or dissonance. In just this way, to appreciate the assemblage, one must attend to its separate ways of being at the same time as watching how they come together in sporadic but consequential coordinations. Furthermore, in contrast to the predictability of a written piece of music that can be repeated over and over, the polyphony of the assemblage shifts as conditions change. This is the listening practice that this section of the book attempts to instill.

By taking landscape-based assemblages as my object, it is possible to attend to the interplay of many organisms' actions. I am not limited to tracking human relations with their favored allies, as in most animal studies. Organisms don't have to show their human equivalence (as conscious agents, intentional communicators, or ethical subjects) to count. If we are interested in livability, impermanence, and emergence, we should be watching the action of landscape assemblages. Assemblages coalesce, change, and dissolve: *this is the story.*



The story of landscapes is both easy and hard to tell. Sometimes it relaxes readers into somnolence, making us think we are not learning anything new. This is a result of the unfortunate wall we have built be-

tween concepts and stories. We can see this, for example, in the gap between environmental history and science studies. Science studies scholars, unpracticed in reading concepts through stories, don't bother with environmental history. Consider, for example, Stephen Pyne's fine work on fire in the making of landscapes; because his concepts are embedded in his histories, science studies scholars remain uninfluenced by his radical suggestions on geochemical agency.¹⁰ Pauline Peters's trenchant analysis of how the logic of the British enclosure system came to Botswana range management—or Kate Showers's surprising findings about erosion control in Lesotho—could revolutionize our notions of normal science, but they have not.¹¹ Such refusals impoverish science studies, encouraging the play of concepts in a reified space. Distilling general principles, theorists expect that others will fill in the particulars—but “filling in” is never so simple. This is an intellectual apparatus that shores up the wall between concepts and stories, thus, indeed, draining the significance of the sensitivities science studies scholars try to refine. In what follows, then, I challenge readers to notice concepts and methods within the landscape histories I present.



Telling stories of landscape requires getting to know the inhabitants of the landscape, human and not human. This is not easy, and it makes sense to me to use all the learning practices I can think of, including our combined forms of mindfulness, myths and tales, livelihood practices, archives, scientific reports, and experiments. But this hodgepodge creates suspicions—particularly, indeed, with the allies I hailed in reaching out to anthropologists of alternative world makings. For many cultural anthropologists, science is best regarded as a straw man against which to explore alternatives, such as indigenous practices.¹² To mix scientific and vernacular forms of evidence invites accusations of bowing down to science. Yet this assumes a monolithic science that digests all practices into a single agenda. Instead, I offer stories built through layered and disparate practices of knowing and being. If the components clash with each other, this only enlarges what such stories can do.

At the heart of the practices I am advocating are arts of ethnography and natural history. The new alliance I propose is based on commitments

to observation and fieldwork—and what I call noticing.¹³ Human-disturbed landscapes are ideal spaces for humanist and naturalist noticing. We need to know the histories humans have made in these places *and* the histories of nonhuman participants. Satoyama restoration advocates were exceptional teachers here; they revitalized my understanding of “disturbance” as both coordination and history. They showed me how disturbance might initiate a story of the life of the forest.¹⁴

Disturbance is a change in environmental conditions that causes a pronounced change in an ecosystem. Floods and fires are forms of disturbance; humans and other living things can also cause disturbance. Disturbance can renew ecologies as well as destroy them. How terrible a disturbance is depends on many things, including scale. Some disturbances are small: a tree falls in the forest, creating a light gap. Some are huge: a tsunami knocks open a nuclear power plant. Scales of time also matter: short-term damage may be followed by exuberant regrowth. Disturbance opens the terrain for transformative encounters, making new landscape assemblages possible.¹⁵

Humanists, not used to thinking with disturbance, connect the term with damage. But disturbance, as used by ecologists, is not always bad—and not always human. Human disturbance is not unique in its ability to stir up ecological relations. Furthermore, as a beginning, disturbance is always in the middle of things: the term does not refer us to a harmonious state before disturbance. Disturbances follow other disturbances. Thus all landscapes are disturbed; disturbance is ordinary. But this does not limit the term. Raising the question of disturbance does not cut off discussion but opens it, allowing us to explore landscape dynamics. Whether a disturbance is bearable or unbearable is a question worked out through what follows it: the reformation of assemblages.

Disturbance emerged as a key concept in ecology at the very same time that scholars in the humanities and social sciences were beginning to worry about instability and change.¹⁶ On both sides of the humanist/naturalist line, concerns about instability followed after the post-World War II American enthusiasm for self-regulating systems: a form of stability in the midst of progress. In the 1950s and 1960s, the idea of ecosystem equilibrium seemed promising; through natural succession, ecological formations were thought to reach a comparatively stable balance point. In the 1970s, however, attention turned to disruption and change,

which generate the heterogeneity of the landscape. In the 1970s, too, humanists and social scientists began worrying about the transformative encounters of history, inequality, and conflict. Looking back, such coordinated changes in scholarly fashion might have been early warning of our common slide into precarity.

As an analytic tool, disturbance requires awareness of the observer's perspective—just as with the best tools in social theory. Deciding what counts as disturbance is always a matter of point of view. From a human's vantage, the disturbance that destroys an anthill is vastly different from that obliterating a human city. From an ant's perspective, the stakes are different. Points of view also vary *within* species. Rosalind Shaw has elegantly shown how men and women, urban and rural, and rich and poor each conceptualize “floods” differently in Bangladesh, because they are differentially affected by rising waters; for each group, the rise exceeds what is bearable—and thus becomes a flood—at a different point.¹⁷ No single standard for assessing disturbance is possible; disturbance matters in relation to how we live. This means we need to pay attention to the assessments through which we know disturbance. Disturbance is never a matter of “yes” or “no”; disturbance refers to an open-ended range of unsettling phenomena. Where is the line that marks off too much? With disturbance, this is always a problem of perspective, based, in turn, on ways of life.

Since it is already infused with attention to perspective, I am unapologetic about my use of the term “disturbance” to refer to the distinctive ways the concept is used in varied places. I learned this layered usage from Japanese forest managers and scientists, who constantly stretch European and American conventions, even as they use them. Disturbance is a good tool with which to begin the inconsistent layering of global-and-local, expert-and-vernacular knowledge layers I have promised.

Disturbance brings us into heterogeneity, a key lens for landscapes. Disturbance creates patches, each shaped by diverse conjunctures. Conjunctures may be initiated by nonliving disturbance (e.g., floods and fires) or by living creatures' disturbances. As organisms make intergenerational living spaces, they redesign the environment. Ecologists call the effects that organisms create on their environments “ecosystems engineering.”¹⁸ A tree holds boulders in its roots that otherwise might be swept away by a stream; an earthworm enriches the soil. Each of these

is an example of ecosystems engineering. If we look at the interactions across many acts of ecosystems engineering, patterns emerge, organizing assemblages: unintentional design. This is the sum of the biotic and abiotic ecosystems engineering—intended and unintended; beneficial, harmful, and of no account—within a patch.



Species are not always the right units for telling the life of the forest. The term “multispecies” is only a stand-in for moving beyond human exceptionalism. Sometimes individual organisms make drastic interventions. And sometimes much larger units are more able to show us historical action. This is the case, I find, for oaks and pines as well as matsutake. Oaks, which interbreed readily and with fertile results across species lines, confuse our dedication to species. But of course what units one uses depends on the story one wants to tell. To tell the story of matsutake forests forming and dissolving across continental shifts and glaciation events, I need “pines” as a protagonist—in all their marvelous diversity. *Pinus* is the most common matsutake host. When it comes to oaks, I stretch even farther, embracing *Lithocarpus* (tanoaks) and *Castanopsis* (chinquapin) as well as *Quercus* (oaks). These closely related genera are the most common broadleaf hosts for matsutake. My oaks, pines, and matsutake are thus not identical within their group; they spread and transform their storylines, like humans, in diaspora.¹⁹ This helps me see action in the story of assemblage. I follow their spread, noticing the worlds they make. Rather than forming an assemblage because they are a certain “type,” my oaks, pines, and matsutake become themselves in assemblage.²⁰

Traveling with this in mind, I investigated matsutake forests in four places: central Japan, Oregon (U.S.A.), Yunnan (southwest China), and Lapland (northern Finland). My small immersion in satoyama restoration helped me see that foresters in each place had different ways of “doing” forests. In contrast to satoyama, humans were *not* part of forest assemblages in matsutake management in the United States and China; managers there leaped to anxieties about too much human disturbance, not too little. In contrast, too, to satoyama work, forestry elsewhere was measured on a yardstick of rational advancement: could the forest make

futures of scientific and industrial productivity? In distinction, a Japanese satoyama aims for a livable here and now.²¹

But, more than comparison, I seek histories through which humans, matsutake, and pine create forests. I work the conjunctures to raise unanswered research questions rather than to create boxes. I look for the same forest in different guises. Each appears through the shadows of the others. Exploring this simultaneously single and multiple formation, the next four chapters take me into pines. Each illustrates how ways of life develop through coordination in disturbance. As ways of life come together, patch-based assemblages are formed. Assemblages, I show, are scenes for considering livability—the possibility of common life on a human-disturbed earth.

Precarious living is always an adventure.

*Elusive life, Oregon.
Remembering Leke
Nakashimura. Leke
worked to keep matsutake
memory alive by
encouraging old and
young to follow him into
the forest, looking for
mushrooms.*

Spore Trail **The Further Adventures** **of a Mushroom**

ONE OF THE STRANGEST PROJECTS OF PRIVATIZATION and commodification in the early twentieth-first century has been the movement to commoditize scholarship. Two versions have been surprisingly powerful. In Europe, administrators demand assessment exercises that reduce the work of scholars to a number, a sum total for a life of intellectual exchange. In the United States, scholars are asked to become entrepreneurs, producing ourselves as brands and seeking stardom from the very first days of our studies, when we know nothing. Both projects seem to me bizarre—and suffocating. By privatizing what is necessarily collaborative work, these projects aim to strangle the life out of scholarship.

Anyone who cares about ideas is forced, then, to create scenes that exceed or escape “professionalization,” that is, the surveillance techniques of privatization. This means designing research that requires playgroups and collaborative clusters: not congeries of individuals calculating costs and benefits, but rather scholarship that emerges through its collaborations. Thinking through mushrooms, once again, can help.

What if we imagined intellectual life as a peasant woodland, a source of many useful products emerging in unintentional design? The image calls up its opposites: In assessment exercises, intellectual life is a plantation; in scholarly entrepreneurship, intellectual life is pure theft, the private appropriation of communal products. Neither is appealing. Consider, instead, the pleasures of the woodland. There are many useful products there, from berries and mushrooms to firewood, wild vegetables, medicinal herbs, and even timber. A forager can choose what to gather and can make use of the woodland's patches of unexpected bounty. But the woodland requires continuing work, not to make it a garden but rather to keep it open and available for an array of species. Human coppicing, grazing, and fire maintain this architecture; other species gather to make it their own. For intellectual work, this seems just right. Work in common creates the possibilities of particular feats of individual scholarship. To encourage the unknown potential of scholarly advances—like the unexpected bounty of a nest of mushrooms—requires sustaining the common work of the intellectual woodland.

In this spirit, the Matsutake Worlds Research Group—the group that made my matsutake research possible—has tried to build playful collaborations into our individual and collective work. This has not been simple; pressures to privatize worm their way into every scholar's life. The tempo of collaboration is necessarily sporadic. But we have coppiced and burned, and our common intellectual woodland flourishes.

This means, too, that the intellectual equivalents of forest products have become available to each of us as gatherers. This book is just one harvest of those products. It is not the last: a woodland draws us again and again to its shifting treasures. If there is one mushroom, might there yet be more? This book opens a series of forays to our matsutake woodland. There will be more, to China, to trace commerce, and to Japan, to follow cosmopolitan science. Consider the further adventures in these companion volumes:

In China, exuberance about global trade has transformed even the most remote villages, creating a "rural China" with transnational trade at its heart. Matsutake is the ideal vehicle to follow this development. Michael Hathaway's "Emerging Matsutake Worlds" traces the making of distinctive paths for global commerce in Yunnan. The book explores

conflicting transnational pressures of conservation and commerce—as seen, for example, in the hard-to-explain presence of pesticides on Chinese mushrooms—showing how particular places, including matsutake forests, develop within global connections. One surprising finding is the importance of ethnic entrepreneurship: in both Tibetan and Yi areas, pickers and village-based dealers work within ethnic circuits. Hathaway examines both the cosmopolitan character and the traditionalist preoccupations of the new ethnic aspirations promoted by matsutake.

Opening science, and knowledge more generally, to cosmopolitan history is an urgent task for scholars. Matsutake science in Japan turns out to be an ideal site for understanding the intersections between science and vernacular knowledge, on the one hand, and international and local expertise, on the other. Shiho Satsuka's "The Charisma of a Wild Mushroom" delves into such intersections to show how Japanese science is always already cosmopolitan and vernacular. She develops a concept of translation in which all knowledge is based in translation. Rather than the immaculate "Japanese" knowledge of both Orientalist and nationalist imaginations, matsutake science is translation all the way down. Her work moves beyond familiar Western epistemologies and ontologies to explore unexpected forms of personhood and thingness within the poorly differentiated human-nonhuman world matsutake shows us.

What kind of book is this that refuses to end? Like the matsutake forest, each contingent gathering sponsors others in unexpected bounty. None of this would be possible without transgressing against the commodification of scholarship. Woodlands, too, offend the plantation and the strip miner. But it is hard to make woodlands fully disappear. Intellectual woodlands too: ideas born in common play still beckon.

In "The Carrier Bag Theory of Fiction," Ursula K. Le Guin argues that stories of hunting and killing have allowed readers to imagine that individual heroism is the point of a story. Instead, she proposes that storytelling might pick up diverse things of meaning and value and gather them together, like a forager rather than a hunter waiting for the big kill. In this kind of storytelling, stories should never end, but rather lead to further stories. In the intellectual woodlands I have been trying to encourage, adventures lead to more adventures, and treasures

lead to further treasures. When gathering mushrooms, one is not enough; finding the first encourages me to find more. But Le Guin says it with so much humor and spirit that I give her the last word:

Go on, say I, wandering off towards the wild oats, with Oo Oo in the sling and little Oom carrying the basket. You just go on telling how the mammoth fell on Boob and how Cain fell on Abel and how the bomb fell on Nagasaki and how the burning jelly fell on the villagers and how the missiles will fall on the Evil Empire, and all the other steps in the Ascent of Man.

If it is a human thing to do to put something you want, because it's useful, edible, or beautiful, into a bag, or a basket, or a bit of rolled bark or leaf, or a net woven of your own hair, or what have you, and then take it home with you, home being another, larger kind of pouch or bag, a container for people, and then later you take it out and eat it or share it or store it up for winter in a solidier container or put it in the medicine bundle or the shrine or the museum, the holy place, the area that contains what is sacred, and then next day you probably do much the same again—if to do that is human, if that's what it takes, then I am a human being after all. Fully, freely, gladly, for the first time.¹

Notes

ENABLING ENTANGLEMENTS

1. William Cronon, *Nature's metropolis* (New York: W. W. Norton, 1992).
2. See Matsutake Worlds Research Group, "A new form of collaboration in cultural anthropology: Matsutake worlds," *American Ethnologist* 36, no. 2 (2009): 380–403; Matsutake Worlds Research Group, "Strong collaboration as a method for multi-sited ethnography: On mycorrhizal relations," in *Multi-sited ethnography: Theory, praxis, and locality in contemporary research*, ed. Mark-Anthony Falzon, 197–214 (Farnham, UK: Ashgate, 2009); Anna Tsing and Shiho Satsuka, "Diverging understandings of forest management in matsutake science," *Economic Botany* 62, no. 3 (2008): 244–256. A special issue of articles by the group is currently under preparation.
3. Elaine Gan and Anna Tsing, "Some experiments in the representation of time: Fungal clock," paper presented at the annual meeting of the American Anthropological Association, San Francisco, 2012; Gan and Tsing, "Fungal time in the satoyama forest," animation by Natalie McKeever, video installation, University of Sydney, 2013.
4. Sara Dosa, *The last season* (Filament Productions, 2014). The film follows the relationship of two matsutake pickers in Oregon: a white veteran of the U.S.-Indochina war and a Cambodian refugee.
5. Hjørleifur Jonsson's book *Slow anthropology: Negotiating difference with the Iu Mien* (Ithaca, NY: Cornell University Southeast Asia Program Publications, 2014)

emerged from the stimulus of our collaboration—and Jonsson’s continuing research with Iu Mien.

PROLOGUE. AUTUMN AROMA

Epigraph: Miyako Inoue kindly worked through this translation with me; we aimed for a version both evocative and literal. For an alternative, see Matsutake Research Association, ed., *Matsutake* [in Japanese] (Kyoto: Matsutake Research Association, 1964), front matter: “The aroma of pine mushrooms. The path to the hilltop of Takamatsu, Tall Pine Tree Village, has just been barred by the rings and lines of rapidly rising caps (of pine mushrooms). They emit an attractive autumnal aroma that refreshes me a great deal . . .”

1. Sveta Yamin-Pasternak, “How the devils went deaf: Ethnomycology, cuisine, and perception of landscape in the Russian far north” (PhD diss., University of Alaska, Fairbanks, 2007).

2. *Desert* (Stac an Armin Press, 2011), 6, 78.

3. Chinese matsutake traders first told me the story, which I took to be urban legend; however, a scientist trained in Japan confirmed the existence of this story in Japanese newspapers in the 1990s. I have not yet found it. Still, the timing of the bomb in August would have corresponded to the beginning of the matsutake fruiting season. How radioactive those mushrooms were is a continuing mystery. One Japanese scientist told me he planned to research the radioactivity of Hiroshima matsutake, but the authorities told him to stay away from this topic. The U.S. bomb exploded more than five hundred meters above the city; official wisdom has it that the radioactivity was carried into global wind systems, with little local contamination.

4. In this book, I use the term “humanist” to include those trained in both the humanities and the social sciences. In using this term in contrast to natural scientists, I am evoking what C. P. Snow called “the two cultures.” Charles Percy Snow, *The Two Cultures* (1959; London: Cambridge University Press, 2001). Among humanists, I include, too, those who call themselves “posthumanists.”

5. Marx used “alienation” particularly to speak of the separation of the worker from the processes and products of production, as well as other workers. Karl Marx, *Economic and philosophical manuscripts of 1844* (Mineola, NY: Dover Books, 2007). I stretch the term from this use to consider the separation of nonhumans as well as humans from their livelihood processes.

6. Alienation was also intrinsic to the state-led industrial socialism of the twentieth century. Because it is increasingly obsolete, I do not discuss it here.

7. This section draws on Okamura Toshihisa, *Matsutake no bunkashi* [*The cultural history of matsutake*] (Tokyo: Yama to Keikokusha, 2005). Fusako Shimura kindly translated the book for me. For other discussions of mushrooms in Japanese culture, see R. Gordon Wasson, “Mushrooms and Japanese culture,” *Transactions of the Asiatic Society of Japan* 11 (1973): 5–25; Neda Hitoshi, *Kinoko hakubutsukan* [*Mushroom museum*] (Tokyo: Yasaka Shobô, 2003).

8. Quoted in Okamura, *Matsutake*, 55 (trans. Fusako Shimura and Miyako Inoue).

9. Haruo Shirane calls this “second nature”; see *Japan and the culture of the four seasons: Nature, literature, and the arts* (New York: Columbia University Press, 2012).

10. Quoted in Okamura, *Matsutake*, 98 (trans. Fusako Shimura and Miyako Inoue).

11. The question of whether southern Europe and North Africa’s *T. caligatum* (which also sells as matsutake) is the same species has not yet been resolved. For the argument in favor of separate species status, see I. Kytovuori, “The *Tricholoma caligatum* group in Europe and North Africa,” *Karstenia* 28, no. 2 (1988): 65–77. Northwestern America’s *T. caligatum* is another species entirely, but it too sells as matsutake. See Ra Lim, Alison Fischer, Mary Berbee, and Shannon M. Berch, “Is the booted tricholoma in British Columbia really Japanese matsutake?” *BC Journal of Ecosystems and Management* 3, no. 1 (2003): 61–67.

12. The type specimen for *T. magnivelare* is from the eastern United States, and it may prove yet to be *T. matsutake* (David Arora, personal communication, 2007). Northwestern American matsutake will need another scientific name.

13. For recent research on classification, see Hitoshi Murata, Yuko Ota, Muneyoshi Yamaguchi, Akiyoshi Yamada, Shinichiro Katahata, Yuichiro Otsuka, Katsuhiko Babasaki, and Hitoshi Neda, “Mobile DNA distributions refine the phylogeny of ‘matsutake’ mushrooms, *Tricholoma* sect. *Caligata*,” *Mycorrhiza* 23, no. 6 (2013): 447–461. For more on scientists’ views about matsutake diversity, see chapter 17.

14. Quoted in Okamura, *Matsutake*, 54 (trans. Fusako Shimura and Miyako Inoue).

PART I. WHAT’S LEFT?

- i. For mushroom lovers: This was *Tricholoma focale*.

CHAPTER I. ARTS OF NOTICING

Epigraph: Ursula K. Le Guin, “A non-Euclidean view of California as a cold place to be,” in *Dancing at the edge of the world*, 80–100 (New York: Grove Press, 1989), on 85.

1. Philip Cogswell, “Deschutes Country Pine Logging,” in *High and mighty*, ed. Thomas Vaughan, 235–260 (Portland: Oregon Historical Society, 1981); Ward Tonsfeldt and Paul Claeysens, “Railroads up the Deschutes canyon” (Portland: Oregon Historical Society, 2014), http://www.ohs.org/education/oregonhistory/narratives/subtopic.cfm?subtopic_ID=395.

2. “Spotted owl hung in effigy,” *Eugene Register-Guard*, May 3, 1989: 13.

3. Ivan Maluski, Oregon Sierra Club, quoted in Taylor Clark, “The owl and the chainsaw,” *Willamette Week*, March 9, 2005, <http://www.wweek.com/portland/article-4188-1989.html>.

4. In 1979, the price of Oregon timber dropped; mill closings and corporate mergers followed. Gail Wells, “Restructuring the timber economy” (Portland: Oregon

Historical Society, 2006), http://www.ohs.org/education/oregonhistory/narratives/subtopic.cfm?subtopic_ID=579.

5. See, for example, Michael McRae, “Mushrooms, guns, and money,” *Outside* 18, no. 10 (1993): 64–69, 151–154; Peter Gillins, “Violence clouds Oregon gold rush for wild mushrooms,” *Chicago Tribune*, July 8, 1993, 2; Eric Gorski, “Guns part of fungi season,” *Oregonian*, September 24, 1996, 1, 9.

6. Donna Haraway, “Anthropocene, Capitalocene, Chthulucene: Staying with the Trouble,” presentation for “Arts of Living on a Damaged Planet,” Santa Cruz, CA, May 9, 2014, <http://anthropocene.au.dk/arts-of-living-on-a-damaged-planet>, argues that “Anthropocene” gestures to sky gods; instead, she suggests we honor the “tentacular ones”—and multispecies entanglements—by calling our era the Chthulucene. Indeed, Anthropocene calls up varied meanings, as the 2014 debate over plans for a “good” Anthropocene illustrated. See, for example, Keith Kloor, who embraces the Anthropocene through a “green modernism” in “Facing up to the Anthropocene,” <http://blogs.discovermagazine.com/collideescape/2014/06/20/facing-anthropocene/#.U6h8XBbgvpA>.

7. World making can be understood in dialogue with what some scholars are calling “ontology,” that is, philosophies of being. Like those scholars, I am interested in interrupting common sense, including the sometimes unselfconscious assumptions of imperial conquest (e.g., Eduardo Viveiros de Castro, “Cosmological deixis and Amerindian perspectivism,” *Journal of the Royal Anthropological Institute* 4, no. 3 (1998): 469–488). World-making projects, as with alternative ontologies, show that other worlds are possible. World making, however, focuses us on practical activities rather than cosmologies. It is thus easier to discuss how nonhuman beings might contribute their own perspectives. Most scholars use ontology to understand human perspectives on nonhumans; to my knowledge, only Eduardo Kohn’s *How forests think* (Berkeley: University of California Press, 2013), working through Piercian semiotics, allows the radical claim that other beings have their own ontologies. In contrast, every organism makes worlds; humans have no special status. Finally, world-making projects overlap. While most scholars use ontology to segregate perspectives, one at a time, thinking through world making allows layering and historically consequential friction. A world-making approach draws ontological concerns into the multi-scalar analysis that James Clifford’s *Returns* calls “realism” (Cambridge, MA: Harvard University Press, 2013).

8. Some social scientists use the term to refer to something more like a Foucaultian discursive formation (e.g., Aihwa Ong and Stephen Collier, eds., *Global assemblages* [Hoboken, NJ: Wiley-Blackwell, 2005]). Such “assemblages” expand across space and conquer place; they are not constituted through indeterminacy. Because constitutive encounters are a key for me, my assemblages are what gathers in a place, at whatever scale. Other “assemblages” are networks, as in Actor-Network Theory (Bruno Latour, *Reassembling the social* [Oxford: Oxford University Press, 2007]). A network is a chain of associations that structures further associations; my assemblages gather ways of being without assuming that interactional structure.

Assemblage translates philosopher Gilles Deleuze's *agencement*, and this has sponsored varied attempts to open up the "social"; my use joins this configuration.

9. Nellie Chu, "Global supply chains of risks and desires: The crafting of migrant entrepreneurship in Guangzhou, China" (PhD diss., University of California, Santa Cruz, 2014).

10. As a method, one might think of this as combining insights from Donna Haraway and Marilyn Strathern. Strathern shows us how the startle of surprise interrupts common sense, allowing us to notice different world-making projects within the assemblage. Haraway follows threads to draw our attention to the interplay across divergent projects. By taking these methods together, I trace out assemblages informed by the disconcerting interruptions of one kind of project by others. It may be useful to point out that these scholars are the source points for anthropological thinking, respectively, with ontology (Strathern) and world making (Haraway). See Marilyn Strathern, "The ethnographic effect," in *Property, substance, and effect* (London: Athlone Press, 1999), 1–28; Donna Haraway, *Companion species manifesto* (Chicago: Prickly Paradigm Press, 2003).

CHAPTER 2. CONTAMINATION AS COLLABORATION

Epigraph: Mai Neng Moua, "Along the way to the Mekong," in *Bamboo among the oaks: Contemporary writing by Hmong Americans*, ed. Mai Neng Moua, 57–61 (St. Paul, MN: Borealis Books, 2002), on 60.

1. Multicellular life was made possible by multiple, mutual contaminations of bacteria. Lynn Margulis and Dorion Sagan, *What is life?* (Berkeley: University of California Press, 2000).

2. Richard Dawkins, *The selfish gene* (Oxford: Oxford University Press, 1976).

3. Many critics have refused the "selfishness" of these assumptions and inserted altruism into these equations. The problem, however, is not selfishness but self-containment.

4. A species name is a useful heuristic with which to introduce an organism, but the name does not capture either the particularity of that organism or its position within sometimes-rapid collective transformations. An ethnic name has the same problem. But doing without these names is worse: we are left imagining that all trees, or Asians, look alike. I need names to give substance to noticing, but I need them as names-in-motion.

5. Harold Steen, *The U.S. Forest Service: A history* (1976; Seattle: University of Washington Press, centennial ed., 2004); William Robbins, *American forestry* (Lincoln: University of Nebraska Press, 1985).

6. For the related ecologies of Oregon's Blue Mountains, see Nancy Langston, *Forest dreams, forest nightmares* (Seattle: University of Washington Press, 1996). For a fuller discussion of eastern Cascades ecology, see chapter 14.

7. Interview, forester Phil Cruz, October 2004.

8. Jeffery MacDonald, *Transnational aspects of Iu-Mien refugee identity* (New York: Routledge, 1997).

9. Hjørleifur Jonsson, *Mien relations: Mountain people and state control in Thailand* (Ithaca, NY: Cornell University Press, 2005).

10. William Smalley, Chia Koua Vang, and Gnia Yee Vang, *Mother of writing: The origin and development of a Hmong messianic script* (Chicago: University of Chicago Press, 1990).

11. William Geddes, *Migrants of the mountains: The cultural ecology of the Blue Miao (Hmong Nyua) of Thailand* (Oxford: Oxford University Press, 1976).

12. Quoted by Douglas Martin, “Gen. Vang Pao, Laotian who aided U.S., dies at 81,” *New York Times*, January 8, 2011, <http://www.nytimes.com/2011/01/08/world/asia/08vangpao.html>.

13. Sources for this history include Alfred McCoy, *The politics of heroin: CIA complicity in the global drug trade* (Chicago: Chicago Review Press, 2003); Jane Hamilton-Merritt, *Tragic mountains: The Hmong, the Americans, and the secret war in Laos, 1942–1992* (Indianapolis: Indiana University Press, 1999); Gary Yia Lee, ed., *The impact of globalization and transnationalism on the Hmong* (St. Paul, MN: Center for Hmong Studies, 2006).

14. Personal communication, 2007.

15. Hjørleifur Jonsson, “War’s ontogeny: Militias and ethnic boundaries in Laos and exile,” *Southeast Asian Studies* 47, no. 2 (2009): 125–149.

CHAPTER 3. SOME PROBLEMS WITH SCALE

Epigraph: Niels Bohr quoted in Otto Robert Frisch, *What little I remember* (Cambridge: Cambridge University Press, 1980), 95.

1. A rich interdisciplinary literature—comprising anthropology, geography, art history, and historical agronomy, among other fields—has gathered around the sugarcane plantation. See especially Sidney Mintz, *Sweetness and power: The place of sugar in modern history* (Harmondsworth, UK: Penguin, 1986); and Mintz, *Worker in the cane* (New Haven, CT: Yale University Press, 1960); J. H. Galloway, *The sugar cane industry* (Cambridge: Cambridge University Press, 1991); Jill Casid, *Sowing empire* (Minneapolis: University of Minnesota Press, 2005); and Jonathan Sauer, *A historical geography of crop plants* (Boca Raton, FL: CRC Press, 1993).

2. Sugarcane plantations were never as fully scalable as planters wished. Enslaved labor escaped into maroon communities. Imported fungal rots spread with the cane. Scalability is never stable; at best, it takes a huge amount of work.

3. Mintz, *Sweetness and power*, 47.

4. For introductions to matsutake biology and ecology, see Ogawa Makoto, *Matsutake no Seibutsugaku [Matsutake biology]* (1978; Tokyo: Tsukiji Shokan, 1991); David Hosford, David Pilz, Randy Molina, and Michael Amaranthus, *Ecology and management of the commercially harvested American matsutake mushroom* (USDA Forest Service General Technical Report PNW-412, 1997).

5. Key references include Paul Hirt, *A conspiracy of optimism: Management of the national forests since World War Two* (Lincoln: University of Nebraska Press, 1994); William Robbins, *Landscapes of conflict: The Oregon story, 1940–2000* (Seattle: Univer-

sity of Washington Press, 2004); Richard Rajala, *Clearcutting the Pacific rainforest: Production, science, and regulation* (Vancouver: UBC Press, 1998).

6. For what went wrong, see Langston, *Forest dreams* (cited in chap. 2, n. 6). For the eastern Cascades, see Mike Znerold, “A new integrated forest resource plan for ponderosa pine forests on the Deschutes National Forest,” paper presented at the Ontario Ministry of Natural Resources workshop, “Tools for Site Specific Silviculture in Northwestern Ontario,” Thunder Bay, Ontario, April 18–20, 1989.

7. Susan Alexander, David Pilz, Nancy Weber, Ed Brown, and Victoria Rockwell, “Mushrooms, trees, and money: Value estimates of commercial mushrooms and timber in the Pacific Northwest,” *Environmental Management* 30, no. 1 (2002): 129–141.

INTERLUDE. SMELLING

Epigraph: John Cage, “Mushroom haiku,” <http://www.youtube.com/watch?v=XNzVQ8wRCB0>.

1. See <http://www.lcdf.org/indeterminacy/>. For a live performance, see <http://www.youtube.com/watch?v=AJMekwS6b9U>.

2. This translation is found on p. 97 of R. H. Blyth, “Mushrooms in Japanese verse,” *Transactions of the Asiatic Society of Japan*, 3rd ser., II (1973): 93–106.

3. For Cage’s discussion of the translation, see <http://www.youtube.com/watch?v=XNzVQ8wRCB0>.

4. Alan Rayner, *Degrees of freedom: Living in dynamic boundaries* (London: Imperial College Press, 1997).

5. Kyorai Mukai, reproduced and translated in Blyth, “Mushrooms,” 98.

6. Walter Benjamin, “On the concept of history,” *Gesammelten Schriften*, trans. Dennis Redmond, (Frankfurt: Suhrkamp Verlag, 1974), sec. 6, 1:2.

7. *Ibid.*, sec. 14. He is comparing fashion and revolution here; each harvests from the past to meet the present.

8. Verran, personal communication, 2010. Verran develops the concept of the here and now in many of her writings concerning the Yolngu. Thus, for example: “Yolngu knowledge is the intrusion of the Dreaming into the secular. The Dreaming is brought into the here and now by the doing of particular things at particular times by particular people. . . . Knowledge can only ever be a performance of the Dreaming, a bringing to life in the here and now of the elements of the other domain” (Verran quoted in Caroline Josephs, “Silence as a way of knowing in Yolngu indigenous Australian storytelling,” in *Negotiating the Sacred II*, ed. Elizabeth Coleman and Maria Fernandez-Dias, 173–190 [Canberra: ANU Press, 2008], on 181).

9. David Arora, *Mushrooms demystified* (Berkeley: Ten Speed Press, 1986), 191.

10. William F. Wood and Charles K. Lefevre, “Changing volatile compounds from mycelium and sporocarp of American matsutake mushroom, *Tricholoma mag-nivelare*,” *Biochemical Systematics and Ecology* 35 (2007): 634–636. I have not found the Japanese research but was told about it by Dr. Ogawa. I don’t know if the same chemicals were isolated as the essence of the smell.

CHAPTER 4. WORKING THE EDGE

1. A commodity chain is any arrangement connecting producers and consumers of commodities. Supply chains are those commodity chains organized by lead firms' outsourcing. Lead firms may be producers, traders, or retailers. See Anna Tsing, "Supply chains and the human condition," *Rethinking Marxism* 21, no. 2 (2009): 148–176.
2. Shiho Satsuka, *Nature in translation* (Durham, NC: Duke University Press, 2015). Satsuka draws on extended meanings of "translation" in postcolonial theory and science studies; for further discussion, see chapter 16.
3. The term takes off from Marx's "primitive accumulation," the violence through which rural people destined for industrial work are disenfranchised. As in Marx's analysis, I step outside industrial formations to see how capitalism comes into being. In contrast to primitive accumulation, salvage is never complete; accumulation always depends on it. Salvage accumulation is also required for the production of labor power. Factory workers are produced and reproduced through life processes never fully controlled by capitalists. In factories, capitalists use the abilities of workers to make goods, but they cannot produce all those abilities. To transform workers' abilities into capitalist value is salvage accumulation.
4. I reserve the term "noncapitalist" for forms of value making outside capitalist logics. "Pericapitalist" is my term for *sites* that are both in and out. This is not a classificatory hierarchy but rather a way to explore ambiguity.
5. Joseph Conrad, *Heart of darkness* (1899; Mineola, NY: Dover Books, 1990).
6. Herman Melville, *Moby-Dick* (1851; New York: Signet Classics, 1998).
7. Misha Petrovic and Gary Hamilton, "Making global markets: Wal-Mart and its suppliers," in *Wal-Mart: The face of twenty-first-century capitalism*, ed. Nelson Lichtenstein, 107–142 (New York: W. W. Norton 2006).
8. "Was a high wall there that tried to stop me, A sign was painted said: Private Property, But on the back side it didn't say nothing—This land was made for you and me." Woody Guthrie, "This land," 1940, http://www.woodyguthrie.org/Lyrics/This_Land.htm.
9. Sources include Barbara Ehrenreich, *Nickled and dimed: On (not) getting by in America* (New York: Metropolitan Books, 2001); Lichtenstein, ed., *Wal-Mart*; Anthony Bianco, *The bully of Bentonville: The high cost of Wal-Mart's everyday low prices* (New York: Doubleday, 2006).
10. J. K. Gibson-Graham, *A post-capitalist politics* (Minneapolis: University of Minnesota Press, 2006).
11. Susanne Freidberg, *French beans and food scares: Culture and commerce in an anxious age* (Oxford: Oxford University Press, 2004).
12. Susanne Freidberg, "Supermarkets and imperial knowledge," *Cultural Geographies* 14, no. 3 (2007): 321–342.
13. Michael Hardt and Antonio Negri, *Empire* (Cambridge, MA: Harvard University Press, 2000).

14. The interplay between Hardt and Negri's *Commonwealth* (Cambridge, MA: Harvard University Press, 2009) and Gibson-Graham's *Post-capitalist politics* is particularly good to think with. See also J. K. Gibson-Graham, *The end of capitalism (as we knew it): A feminist critique of political economy* (London: Blackwell, 1996).

15. Jane Collins, *Threads: Gender, labor, and power in the global apparel industry* (Chicago: University of Chicago Press, 2003).

16. Lieba Faier offers a related view of the matsutake commodity chain in Japan: "Fungi, trees, people, nematodes, beetles, and weather: Ecologies of vulnerability and ecologies of negotiation in matsutake commodity exchange," *Environment and Planning A* 43 (2011): 1079–1097.

CHAPTER 5. OPEN TICKET, OREGON

1. When pickers buy Forest Service picking permits, they are given maps that show picking and no-picking zones. However, the zones are marked only in abstract space. The maps show only major thoroughfares and no topography, railroads, small roads, or vegetation. It is almost impossible for even the most determined reader to make sense of the map on the ground. Besides, many pickers cannot read maps. One Lao picker showed me a no-picking zone on his map by indicating a lake. Some pickers use the maps as toilet paper, which is scarce in the campgrounds.

2. A regulation requires buyers to record the place where matsutake are picked; however, I never saw such records being made. In other matsutake buying areas, this regulation is enforced through pickers' self-statements.

3. This is fire protection mandated by the industry-promoted Healthy Forests Restoration Act of 2003. Jacqueline Vaughn and Hanna Cortner, *George W. Bush's healthy forests* (Boulder: University Press of Colorado, 2005).

4. During the four seasons I watched the buying, I saw two buyers leave, mid-season, because of quarrels with their respective field agents; another absconded. No one was forced out of business because of competition.

5. Jerry Guin's *Matsutake mushroom: "White" goldrush of the 1990s* (Happy Camp, CA: Naturegraph Publishers, 1997) offers a picker's diary from 1993.

6. For one example, see the account of Marlboro's history in Richard Barnet, *Global dreams: Imperial corporations and the new world order* (New York: Touchstone, 1995).

7. Other amazing accounts of precarious labor in the forests of the U.S. Pacific Northwest include Rebecca McLain, "Controlling the forest understory: Wild mushroom politics in central Oregon" (PhD diss., University of Washington, 2000); Beverly Brown and Agueda Marin-Hernández, eds., *Voices from the woods: Lives and experiences of non-timber forest workers* (Wolf Creek, OR: Jefferson Center for Education and Research, 2000); Beverly Brown, Diana Leal-Mariño, Kirsten McIlveen, Ananda Lee Tan, *Contract forest laborers in Canada, the U.S., and Mexico* (Portland, OR: Jefferson Center for Education and Research, 2004); Richard Hansis, "A political ecology of picking: Non-timber forest products in the Pacific Northwest,"

Human Ecology 26, no. 1 (1998): 67–86; Rebecca Richards and Susan Alexander, *A social history of wild huckleberry harvesting in the Pacific Northwest* (USDA Forest Service PNW-GTR-657, 2006).

CHAPTER 6. WAR STORIES

1. For a Vang Pao supporter's blow-by-blow account, see Hamilton-Merritt, *Tragic mountains* (cited in chap. 2, n. 13).

2. CBS News, "Deer hunter charged with murder," November 29, 2004, <http://www.cbsnews.com/stories/2004/11/30/national/main658296.shtml>.

3. "The Refugee Population," *A country study: Laos*, Library of Congress, Country Studies, <http://lcweb2.loc.gov/frd/cs/latoc.html#la0065>.

4. Susan Star and James Griesemer, "Institutional ecology, 'translations' and boundary objects," *Social Studies of Science* 19, no. 3 (1989): 387–420.

CHAPTER 7. WHAT HAPPENED TO THE STATE?

1. *Shigin* refers to classical poetry recitation in Japan. This poem was distributed, in Japanese and with an English translation, by Kokkan Nomura, at the September 18, 2005 celebration of matsutake heritage at the Oregon Nikkei Legacy Center. Miyako Inoue helped to craft this new English translation.

2. This agreement forced Japan to stop issuing new passports for potential immigrants; it did not cover wives and family members of men already living in the United States. This exception encouraged the practice of finding "picture brides," a practice that was stopped by the "Ladies' Agreement" of 1920.

3. Pegues writes (personal communication, 2014): "Executive Order 9066 is signed on Feb. 19, 1942, with most of the relocation and internment/incarceration occurring between March–June. In August the Western Defense Commander announces that Japanese American removal and internment is complete. On the other side of things, Mexico declares war on the Axis powers on June 1st and the U.S. establishes the Bracero Program in July 1942 by executive order."

4. The term comes from Lauren Kessler, *Stubborn twig: Three generations in the life of a Japanese American family* (Corvallis: Oregon State University Press, 2008), chap. 13.

5. Many of the Southeast Asian pickers in Open Ticket receive disability checks and/or Aid to Dependent Children from the government; however, these do not cover expenses.

6. The first Christian Great Awakening of the eighteenth century was a precursor of the American Revolution. The second, of the early nineteenth century, is credited with creating the political culture of the American frontier as well as the Civil War. The third, in the late nineteenth century, sparked the social gospel of American nationalism and its worldwide missionary movement. Some call the Born-Again movement of the late twentieth century the Fourth Great Awakening. These Christian revivals are not the only kind of civic mobilizations in the United States, but it may be useful to see them as forming the *pattern* on which mobilization to shape public culture can successfully occur.

7. Susan Harding, “Regulating religion in mid-20th century America: The ‘Man: A Course of Study’ curriculum,” paper presented at “Religion and Politics in Anxious States,” University of Kentucky, 2014.

8. Thomas Pearson, *Missions and conversions: Creating the Montagnard-Dega refugee community* (New York: Palgrave Macmillan, 2009).

CHAPTER 8. BETWEEN THE DOLLAR AND THE YEN

1. U.S. whaling interests pushed this initiative, which demanded assistance for U.S. whaling ships (Alan Christy, personal communication, 2014). *Moby-Dick* haunts me.

2. The 1858 Harris Treaty opened more ports, made foreign nationals free from Japanese law, and put foreigners in charge of import-export duties. European powers then imposed similar treaties.

3. Kunio Yoshihara, *Japanese economic development* (Oxford: Oxford University Press, 1994); Tessa Morris-Suzuki, *A history of Japanese economic thought* (London: Routledge, 1989).

4. Satsuka, *Nature in translation* (cited in chap. 4, n. 2).

5. Hidemasa Morikawa, *Zaibatsu: The rise and fall of family enterprise groups in Japan* (Tokyo: University of Tokyo Press, 1992).

6. E. Herbert Norman, *Japan’s emergence as a modern state* (1940; Vancouver: UBC Press, 2000), 49.

7. Some three hundred zaibatsu were listed for breakup, but only about ten were dissolved before the occupation government changed course. Still, regulations were put in place that made prewar vertical integration difficult to sustain (Alan Christy, personal communication, 2014).

8. Kenichi Miyashita and David Russell, *Keiretsu: Inside the hidden Japanese conglomerates* (New York: McGraw-Hill, 1994); Michael Gerlach, *Alliance capitalism: The social organization of Japanese business* (Berkeley: University of California Press, 1992). In *The fable of the keiretsu* (Chicago: University of Chicago Press, 2006), Yoshiro Miwa and J. Mark Ramseyer reassert neoclassical orthodoxy and call the *keiretsu* a figment of Japanese Marxist and Western Orientalist imaginations.

9. Alexander Young, *The sogo shosha: Japan’s multinational trading companies* (Boulder, CO: Westview, 1979); Michael Yoshiro and Thomas Lifson, *The invisible link: Japan’s sogo shosha and the organization of trade* (Cambridge, MA: MIT Press, 1986); Yoshihara, *Japanese economic development*, 49–50, 154–155.

10. When global commodity chains first came to the attention of American sociologists in the 1980s (Gary Gerrefi and Miguel Korzeniewicz, eds., *Commodity chains and global capitalism* [Westport, CT: Greenwood Publishing Group, 1994]), they were impressed by the new “buyer-driven” chains (clothes, shoes) and contrasted them with earlier “producer-driven” chains (computers, cars). Japanese economic history recommends equal attention to “trader-driven” chains.

11. Anna Tsing, *Friction* (Princeton, NJ: Princeton University Press, 2005); Peter Dauvergne, *Shadows in the forest: Japan and the politics of timber in Southeast Asia*

(Cambridge, MA: MIT Press, 1997); Michael Ross, *Timber booms and institutional breakdown in Southeast Asia* (Cambridge: Cambridge University Press, 2001).

12. On salmon in Chile, see Heather Swanson, “Caught in comparisons: Japanese salmon in an uneven world” (PhD diss., University of California, Santa Cruz, 2013).

13. Robert Castley, *Korea’s economic miracle: The crucial role of Japan* (New York: Palgrave Macmillan, 1997).

14. *Ibid.*, 326.

15. *Ibid.*, 69.

16. Kaname Akamatsu, “A historical pattern of economic growth in developing countries,” *Journal of Developing Economies* 1, no. 1 (1962): 3–25.

17. “Quality control” was a part of this transnational dialogue: an American idea that took off in Japan during the American-led rationalization of Japanese industry after World War II, it was reimported to the United States in the 1970s and 1980s. William M. Tsutsui, “W. Edwards Deming and the origins of quality control in Japan,” *Journal of Japanese Studies* 22, no. 2 (1996): 295–325.

18. For an example of U.S. anti-Japanese economic journalism from this period, see Robert Kearns, *Zaibatsu America: How Japanese firms are colonizing vital U.S. industries* (New York: Free Press, 1992).

19. My analysis is inspired by Karen Ho, *Liquidated* (Durham, NC: Duke University Press, 2009).

20. For an example of U.S.-style reforms promoted by a Japanese economist, see Hiroshi Yoshikawa, *Japan’s lost decade*, trans. Charles Stewart, Long-Term Credit Bank of Japan Intl. Trust Library Selection 11 (Tokyo: International House of Japan, 2002). The book argues that small- and medium-size enterprises are a drain on the economy.

21. Robert Brenner, *The boom and the bubble: The U.S. in the world economy* (London: Verso, 2003).

22. Shintaro Ishihara, *The Japan that can say no*, trans. Frank Baldwin (1989, with Akio Morita; New York: Touchstone Books, 1992).

23. Petrovic and Hamilton, “Making global markets” (cited in chap. 4, n. 7), 121.

24. According to Robert Brenner (*The boom*), the Reverse Plaza Accord of 1995, in which world powers stopped the ascent of the yen, triggered a shift in the world economy by both killing U.S. manufacturing and triggering the Asian financial crisis.

25. Quoted in Miguel Korzeniewicz, “Commodity chains and marketing strategies: Nike and the global athletic footwear industry,” in *Commodity chains*, ed. Gerrefi and Korzeniewicz, 247–266, on 252.

CHAPTER 9. FROM GIFTS TO COMMODITIES—AND BACK

1. Bronislaw Malinowski, *Argonauts of the Western Pacific* (London: Routledge, 1922).

2. My ability to think about objects, alienated and otherwise, draws on Marilyn Strathern, *The gender of the gift* (Berkeley: University of California Press, 1990); Amiria

Henare, Martin Holbraad, and Sari Wastell, eds., *Thinking through things* (London: Routledge, 2006); and David Graeber, *Toward an anthropological theory of value* (London: Palgrave Macmillan, 2001).

3. Capitalist commodities, unlike kula objects, cannot carry the weight of entanglement histories and obligations. It is not simply *exchange* that defines capitalist commodities; alienation is required.

4. Marilyn Strathern paraphrases Christopher Gregory: “If in a commodity economy things and persons assume the social forms of things, then in a gift economy they assume the social forms of persons” (Strathern, *Gender*, 134, citing Christopher Gregory, *Gifts and commodities* [Waltham, MA: Academic Press, 1982], 41).

5. Many matsutake foraged in the U.S. Pacific Northwest are labeled as Canadian because exporters send them from British Columbia. Exporters attach tags based on the location of the exporting airport. Japanese law forbids foreign food products from being labeled by region, a privilege saved for Japanese products. Only national origins are allowed.

6. Matsutake are not the only fine foods used in this way. Specialty melons and salmon are among the goods that enter this gift economy and, like matsutake, mark seasonality. Such gifts are commonly regarded as confirming “Japanese” ways of life; their status as gifts drives rankings and prices.

7. If all mushrooms are picked before their spores mature, there is no reason—in terms of the reproductive success of the fungus—to privilege babies.

8. Babies are conventionally sorted “number 3” grade (out of five), although the mushroom hunters sometimes intervene to get a few into the more expensive “number 1” crate.

9. Buyers in the central Cascades sort matsutake by maturity into five priced grades. Bulklers re-sort by size; exported mushrooms are packed by both size and maturity.

CHAPTER 10. SALVAGE RHYTHMS

1. Daisuke Naito, personal communication, 2010.

2. The accumulation of capital relies on translations in which pericapitalist sites are brought into capitalist supply lines. Here again are some of my key claims: (1) salvage accumulation is the process through which value created in noncapitalist value forms is translated into capitalist assets, allowing accumulation; (2) pericapitalist spaces are sites in which both capitalist and noncapitalist value forms may flourish simultaneously—thus allowing translations; (3) supply chains are organized through such translations, which link the inventory-making of lead firms with pericapitalist sites, where all kinds of practices, capitalist and otherwise, flourish; (4) economic diversity makes capitalism possible—and offers sites of instability and refusal of capitalist governance.

3. Some examples: In her influential study of electronics workers in Malaysia, Aihwa Ong (*Spirits of resistance and capitalist discipline* [Albany: State University of New York Press, 1987]) found that contingent trajectories of colonial and

postcolonial governance produced the kind of rural Malay women that factories wanted to hire. Sylvia Yanagisako (*Producing culture and capital* [Princeton, NJ: Princeton University Press, 2002]) showed how factory owners and managers based their decisions on cultural ideals. Rather than a neutral system of efficiency, she argues, capitalist business develops within cultural histories. Owners as well as workers develop class interests through cultural agendas.

4. Jane Guyer's study of West African economic transactions shows how monetary exchanges need not be a sign of already-established equivalence; money can be used to realign cultural economies and translate their logics from one patch to another (*Marginal gains* [Chicago: University of Chicago Press, 2004]). Transactions may incorporate nonmarket logics even as money is exchanged. Guyer's research shows how economic systems incorporate difference. Transnational commodity chains are a privileged place to see this: Lisa Rofel and Sylvia Yanagisako explore how Italian silk companies negotiate the making of value with Chinese producers across gaps of comprehension and practice ("Managing the new silk road: Italian-Chinese collaborations," Lewis Henry Morgan Lecture, University of Rochester, October 20, 2010). See also Aihwa Ong, *Neoliberalism as Exception* (Durham, NC: Duke University Press, 2006); Neferti Tadiar, *Things fall away* (Durham, NC: Duke University Press, 2009); Laura Bear, *Navigating austerity* (Stanford, CA: Stanford University Press, 2015).

5. Jeffrey Mantz, "Improvisational economies: Coltan production in the eastern Congo," *Social Anthropology* 16, no. 1 (2008): 34–50; James Smith, "Tantalus in the digital age: Coltan ore, temporal dispossession, and 'movement' in the eastern Democratic Republic of the Congo," *American Ethnologist* 38, no. 1 (2011): 17–35.

6. Peter Hugo, "A global graveyard for dead computers in Ghana," *New York Times Magazine*, August 4, 2010. http://www.nytimes.com/slideshow/2010/08/04/magazine/20100815-dump.html?_r=1&.

INTERLUDE. TRACKING

1. Charles Darwin ends *On the origin of species* ([London: John Murray, 1st ed., 1859], 490) with the image of an entangled bank: "from so simple a beginning endless forms most beautiful and most wonderful have been, and are being, evolved."

2. For a sampler of introductions, see Nicholas Money, *Mr. Bloomfield's orchard* (Oxford: Oxford University Press, 2004) [general exposition]; G. C. Ainsworth, *Introduction to the history of mycology* (Cambridge: Cambridge University Press, 2009) [history]; J. André Fortin, Christian Plenchette, and Yves Poché, *Mycorrhizas: The new green revolution* (Quebec: Editions Multimondes, 2009) [agronomy]; Jens Pedersen, *The kingdom of fungi* (Princeton, NJ: Princeton University Press, 2013) [photography].

3. Lisa Curran, "The ecology and evolution of mast-fruiting in Bornean Dipterocarpaceae: A general ectomycorrhizal theory" (PhD diss., Princeton University, 1994).

4. Paul Stamets's *Mycelium running* (Berkeley: Ten Speed Press, 2005) offers this and other fungal stories.

5. S. Kohlmeier, T.H.M. Smits, R. M. Ford, C. Keel, H. Harms, and L. Y. Wick, “Taking the fungal highway: Mobilization of pollutant-degrading bacteria by fungi,” *Environmental Science and Technology* 39 (2005): 4640–4646.

6. Scott Gilbert and David Epel’s *Ecological developmental biology* (Sunderland, MA: Sinauer, 2008), chap. 10, details some of the most important mechanisms.

7. Margaret McFall-Ngai, “The development of cooperative associations between animals and bacteria: Establishing détente among domains,” *American Zoologist* 38, no. 4 (1998): 593–608.

8. Gilbert and Epel, *Ecological developmental biology*, 18. *Wolbachia* infection also causes problems for many insects through how it shapes reproduction. John Thompson, *Relentless evolution* (Chicago: University of Chicago Press, 2013), 104–106, 192.

9. J. A. Thomas, D. J. Simcox, and R. T. Clarke, “Successful conservation of a threatened *Maculinea* butterfly,” *Science* 203 (2009): 458–461. For related entanglements, see Thompson, *Relentless evolution*, 182–183; Gilbert and Epel, *Ecological developmental biology*, chap. 3.

10. Gilbert and Epel, *Ecological developmental biology*, 20–27.

11. Scott F. Gilbert, Emily McDonald, Nicole Boyle, Nicholas Buttino, Lin Gyi, Mark Mai, Neelakantan Prakash, and James Robinson, “Symbiosis as a source of selectable epigenetic variation: Taking the heat for the big guy,” *Philosophical Transactions of the Royal Society B* 365 (2010): 671–678, on 673.

12. Ilana Zilber-Rosenberg and Eugene Rosenberg, “Role of microorganisms in the evolution of animals and plants: The hologenome theory of evolution,” *FEMS Microbiology Reviews* 32 (2008): 723–735.

13. Gil Sharon, Daniel Segal, John Ringo, Abraham Hefetz, Ilana Zilber-Rosenberg, and Eugene Rosenberg, “Commensal bacteria play a role in mating preferences of *Drosophila melanogaster*,” *Proceedings of the National Academy of Science* (November 1, 2010): <http://www.pnas.org/cgi/doi/10.1073/pnas.1009906107>.

14. Gilbert et al., “Symbiosis,” 672, 673.

15. Thomas et al., “Successful conservation.”

16. Population geneticists do study mutualisms, including those involving ectomycorrhizal fungi and trees. But the structure of the discipline urges most studies to see each organism as analytically self-contained rather than emerging in historical interaction. As one recent review explains, “Mutualisms are reciprocal exploitations that nevertheless increase the fitness of each partner” (Teresa Pawlowska, “Population genetics of fungal mutualists of plants,” in *Microbial population genetics*, ed. Jianping Xu, 125–138 [Norfolk, UK: Horizon Scientific Press, 2010], 125). The goal of the study of mutualism is then to measure costs and benefits to each self-contained species, with special attention to “cheating.” Researchers can ask how more or less mutualistic variants of a species emerge to exploit benefits, but they cannot see transformative synergies.

17. Margulis and Sagan, *What is life?* (cited in chap. 2, n. 1).

18. Masayuki Horie, Tomoyuki Honda, Yoshiyuki Suzuki, Yuki Kobayashi, Takuji Daito, Tatsuo Oshida, Kazuyoshi Ikuta, Patric Jern, Takashi Gojobori, John

M. Coffin, and Keizo Tomonaga, “Endogenous non-retroviral RNA virus elements in mammalian genomes,” *Nature* 463 (2010): 84–87.

19. One promising edge of population genetics uses DNA sequencing techniques to differentiate variant alleles within a single population. To study allelic differences requires a different set of DNA markers than to study species. The specificity of scale matters. Nonscalability theory welcomes stories that can be told about allelic differences and notes that they do not translate easily in research methods and results to other scales.

20. Daniel Winkler, interview, 2007.

21. R. Peabody, D. C. Peabody, M. Tyrell, E. Edenburn-MacQueen, R. Howdy, and K. Semelrath, “Haploid vegetative mycelia of *Amillaria gallica* show among-cell-line variation for growth and phenotypic plasticity,” *Mycologia* 97, no. 4 (2005): 777–787.

22. Scott Turner, “Termite mounds as organs of extended physiology,” State University of New York College of Environmental Science and Forestry, <http://www.esf.edu/efb/turner/termite/termhome.htm>.

CHAPTER II. THE LIFE OF THE FOREST

1. Reflections on this problem have emerged from science studies (e.g., Bruno Latour, “Where are the missing masses?” in *Technology and society*, ed. Deborah Johnson and Jameson Wetmore, 151–180 [Cambridge, MA: MIT Press, 2008]); indigenous studies (e.g., Marisol de la Cadena, “Indigenous cosmopolitics in the Andes: Conceptual reflections beyond ‘politics’” *Cultural Anthropology* 25, no. 2 [2010]: 334–370); postcolonial theory (e.g., Dipesh Chakrabarty, *Provincializing Europe* [Princeton, NJ: Princeton University Press, 2000]); new materialism (e.g., Jane Bennett, *Vibrant matter* [Durham, NC: Duke University Press, 2010]); and folklore and fiction (e.g., Ursula Le Guin, *Buffalo gals and other animal presences* [Santa Barbara, CA: Capra Press, 1987]).

2. Richard Nelson, *Make prayers to the raven: A Koyukon view of the northern forest* (Chicago: University of Chicago Press, 1983); Rane Willerslev, *Soul hunters: Hunting, animism, and personhood among the Siberian Yukaghirs* (Berkeley: University of California Press, 2007); Viveiros de Castro, “Cosmological deixis” (cited in chap. 1, n. 7).

3. Some humanists worry about the politics of the word “landscape,” because one of its genealogies leads to landscape painting, with its distance between viewer and scene. As Kenneth Olwig reminds us, however, another genealogy leads to that political unit in which moots could be convened (“Recovering the substantive nature of landscape,” *Annals of the Association of American Geographers* 86, no. 4 (1996): 630–653). My landscapes are places for patchy assemblages, that is, for moots that include both human and nonhuman participants.

4. Jakob von Uexküll, *A foray into the world of animals and humans*, trans. Joseph D. O’Neil (1934; Minneapolis: University of Minnesota Press, 2010).

5. Uexküll’s bubble worlds inspired Martin Heidegger’s idea that nonhuman animals are “poor in world.” Martin Heidegger, *The fundamental concepts of meta-*

physics: World, finitude, solitude, trans. W. McNeill and N. Walker (1938; Indianapolis: Indiana University Press, 2001).

6. Lilin Zhao, Shuai Zhang, Wei Wei, Haijun Hao, Bin Zhang, Rebecca A. Butcher, Jianghua Sun, “Chemical signals synchronize the life cycles of a plant-parasitic nematode and its vector beetle,” *Current biology* (October 10, 2013): <http://dx.doi.org/10.1016/j.cub.2013.08.041>.

7. Kazuo Suzuki, interview, 2005; Kazuo Suzuki, “Pine Wilt and the Pine Wood Nematode,” in *Encyclopedia of forest sciences*, ed. Julian Evans and John Youngquist, 773–777 (Waltham, MA: Elsevier Academic Press, 2004).

8. Yu Wang, Toshihiro Yamada, Daisuke Sakaue, and Kazuo Suzuki, “Influence of fungi on multiplication and distribution of the pinewood nematode,” in *Pine wilt disease: A worldwide threat to forest ecosystems*, ed. Manuel Mota and Paolo Viera, 115–128 (Berlin: Springer, 2008).

9. T. A. Rutherford and J. M. Webster, “Distribution of pine wilt disease with respect to temperature in North America, Japan, and Europe,” *Canadian Journal of Forest Research* 17, no. 9 (1987): 1050–1059.

10. Stephen Pyne, *Vestal fire* (Seattle: University of Washington Press, 2000).

11. Pauline Peters, *Dividing the commons* (Charlottesville: University of Virginia Press, 1994); Kate Showers, *Imperial gullies* (Athens: Ohio University Press, 2005).

12. While Bruno Latour has worked hard to separate the truth claims of science, on the one hand, and the practices of science, on the other, his deployment of the legacy of French structuralism to contrast structural logics has encouraged sharp dichotomies between science and indigenous thought. See Bruno Latour, *We have never been modern* (Cambridge, MA: Harvard University Press, 1993).

13. Here I evoke the “new alliance” of Ilya Prigogine and Isabelle Stengers’s *La nouvelle alliance*, unfortunately translated into English as *Order out of chaos* (New York: Bantam Books, 1984). Prigogine and Stengers argue that appreciation of indeterminacy and irreversible time might lead to a new alliance between the natural and human sciences. The gauntlet they lay down inspires my efforts.

14. A most useful English-language reference on satoyama is K. Takeuchi, R. D. Brown, I. Washitani, A. Tsunekawa, and M. Yokohari, *Satoyama: The traditional rural landscape of Japan* (Tokyo: Springer, 2008). For a sampling of the extensive literature, see also Arioka Toshiyuki, *Satoyama* [in Japanese] (Tokyo: Hosei University Press, 2004); T. Nakashizuka and Y. Matsumoto, eds., *Diversity and interaction in a temperate forest community: Ogawa Forest Reserve of Japan* (Tokyo: Springer, 2002); Katsue Fukamachi and Yukihuro Morimoto, “Satoyama management in the twenty-first century: The challenge of sustainable use and continued biocultural diversity in rural cultural landscapes,” *Landscape and Ecological Engineering* 7, no. 2 (2011): 161–162; Asako Miyamoto, Makoto Sano, Hiroshi Tanaka, and Kaoru Niiyama, “Changes in forest resource utilization and forest landscapes in the southern Abukuma Mountains, Japan during the twentieth century,” *Journal of Forestry Research* 16 (2011): 87–97; Björn E. Berglund, “Satoyama, traditional farming landscape in Japan, compared to Scandinavia,” *Japan Review* 20 (2008): 53–68; Katsue Fukamachi, Hirokazu Oku,

and Tohru Nakashizuka, “The change of a satoyama landscape and its causality in Kamiseya, Kyoto Prefecture, Japan between 1970 and 1995,” *Landscape Ecology* 16 (2001): 703–717.

15. For an introduction to disturbance, see Seth Reice, *The silver lining: The benefits of natural disasters* (Princeton, NJ: Princeton University Press, 2001). For an attempt to bring histories of disturbance into social theory (here psychoanalysis), see Laura Cameron, “Histories of disturbance,” *Radical History Review* 74 (1999): 4–24.

16. Histories of ecological thought include Frank Golley, *A history of the ecosystem concept in ecology* (New Haven, CT: Yale University Press, 1993); Stephen Bocking, *Ecologists and environmental politics* (New Haven, CT: Yale University Press, 1997); Donald Worster, *Nature’s economy: A history of ecological ideas* (Cambridge: Cambridge University Press, 1994).

17. Rosalind Shaw, “‘Nature,’ ‘culture,’ and disasters: Floods in Bangladesh,” in *Bush base: Forest farm*, ed. Elisabeth Croll and David Parkin, 200–217 (London: Routledge, 1992).

18. Clive Jones, John Lawton, and Moshe Shachak, “Organisms as ecosystems engineers,” *Oikos* 69, no. 3 (1994): 373–386; Clive Jones, John Lawton, and Moshe Shachak, “Positive and negative effects of organisms as physical ecosystems engineers,” *Ecology* 78, no. 7 (1997): 1946–1957.

19. Consider a world with multiple interbreeding hominids; we might imagine resemblance beyond species more readily in that world. Our loneliness without closer cousins shapes our willingness to allow each species to stand apart in a biblical tableau.

20. This process is what Donna Haraway usefully calls “becoming with” (*When species meet* [Minneapolis: University of Minnesota Press, 2007]).

21. More contrasts: The matsutake I saw in the United States and Finland grew in industrial timber; in China, as in Japan, they grew in peasant woodlands. In Yunnan and Oregon, matsutake grow in forests regarded as messy mistakes; in Lapland and Japan, matsutake forests are aesthetically idealized. Two-by-two tables would be possible—but I have not wanted to set each location as a type. I am looking for how assemblages gather.

CHAPTER 12. HISTORY

1. As long as one does not get stuck in their stereotypes, it is possible to mix “mythology” and “history.” History is not just national teleology; mythology is not just eternal return. To become entangled in history, one does not have to share a cosmology. Renato Rosaldo (*Ilongot headhunting* [Stanford, CA: Stanford University Press, 1980]) and Richard Price (*Alabi’s World* [Baltimore, MD: Johns Hopkins University Press, 1990]) offer examples of the interweaving of varied cosmologies and world-making practices in making history. Morten Pedersen (*Not quite shamans* [Ithaca, NY: Cornell University Press, 2011]) shows histories in the making of cosmology. Many others, however, emphasize contrasts between mythology and history. By limiting the meaning of “history” through this contrast, however, they lose

the ability to see the hybrid, layered, and contaminated cosmologies of any history in the making—and vice versa.

2. Thom van Dooren (*Flight ways* [New York: Columbia University Press, 2014]) argues that birds tell stories through the ways they make places into homes. In this meaning of “story,” many organisms tell stories. These are among the traces I watch as “history.”

3. Chris Maser, *The redesigned forest* (San Pedro, CA: R. & E. Miles, 1988).

4. David Richardson, ed., *Ecology and biogeography of Pinus* (Cambridge: Cambridge University Press, 1998).

5. David Richardson and Steven Higgins, “Pines as invaders in the southern hemisphere,” in *Ecology*, ed. Richardson, 450–474.

6. Peter Becker, “Competition in the regeneration niche between conifers and angiosperms: Bond’s slow seedling hypothesis,” *Functional Ecology* 14, no. 4 (2000): 401–412.

7. James Agee, “Fire and pine ecosystems,” in *Ecology*, ed. Richardson, 193–218.

8. David Read, “The mycorrhizal status of *Pinus*,” in *Ecology*, ed. Richardson, 324–340, on 324.

9. Ronald Lanner, *Made for each other: A symbiosis of birds and pines* (Oxford: Oxford University Press, 1996).

10. Ronald Lanner, “Seed dispersal in pines,” in *Ecology*, ed. Richardson, 281–295.

11. Charles Lefevre, interview, 2006; Charles Lefevre, “Host associations of *Tricholoma magnivelare*, the American matsutake” (PhD diss., Oregon State University, 2002).

12. Ogawa, *Matsutake* (cited in chap. 3, n. 4).

13. Lefevre, “Host associations.”

14. Pines were in Finland by nine thousand years ago (Katherine Willis, Keith Bennett, and John Birks, “The late Quaternary dynamics of pines in Europe,” in *Ecology*, ed. Richardson, 107–121, on 113). The first artifact of human presence is a Karelian fishing net from 8300 BCE (Vaclav Smil, *Making the modern world: Materials and dematerialization* [Hoboken, NJ: John Wiley and Sons, 2013], 13).

15. Simo Hannelius and Kullervo Kuusela, *Finland: The country of evergreen forest* (Tampere, FI: Forssan Kirkapiiano Oy, 1995). I also draw on field trips with foresters.

16. Medieval farmers in Finland ringed pine and spruce to bring landscapes into broadleaf agroforestry rotations (Timo Myllyntaus, Mina Hares, and Jan Kunnas, “Sustainability in danger? Slash-and-burn cultivation in nineteenth-century Finland and twentieth-century Southeast Asia,” *Environmental History* 7, no. 2 [2002]: 267–302). For a vivid description of Finnish swidden, see Stephen Pyne, *Vestal fire* (cited in chap. II, n. 10), 228–234.

17. Timo Myllyntaus, “Writing about the past with green ink: The emergence of Finnish environmental history,” H-Environment, <http://www.h-net.org/~environ/historiography/finland.htm>.

18. By the mid-nineteenth century, timber outpaced tar as an export. Sven-Erik Åström, *From tar to timber: Studies in northeast European forest exploitation and foreign*

trade, 1660–1860, Commentationes Humanarum Litterarum, no. 85 (Helsinki: Finnish Society of Sciences and Letters, 1988).

19. Edmund von Berg, *Kertomus Suomenmaan metsisistä* (1859; Helsinki: Metsälehti Kustannus, 1995). This translation is from Pyne, *Vestal fire*, 259.

20. Ibid. This translation is from Martti Ahtisaari, “Sustainable forest management in Finland: Its development and possibilities,” *Unasylva* 200 (2000): 56–59, on 57.

21. Raw and processed timber accounted for three-quarters of the value of Finnish exports by 1913. David Kirby, *A concise history of Finland* (Cambridge: Cambridge University Press, 2006). Twentieth-century settlements dispersed in the forests, following the work, a pattern that continued until the 1970s, when mill jobs declined because of competition from tropical wood. Jarmo Kortelainen, “Mill closure—options for a restart: A case study of local response in a Finnish mill community,” in *Local economic development*, ed. Cecily Neil and Markku Tykkäinen, 205–225 (Tokyo: United Nations University Press, 1998).

22. One-third of the reparations were paid directly in forestry and paper products; the other two-thirds involved agricultural products and machinery. Providing the last of these built Finland’s postwar industry. Max Jacobson, *Finland in the new Europe* (Westport, CT: Greenwood Publishing, 1998), 90.

23. Hannelius and Kuusela, *Finland*, 139.

24. Timo Kuuluvainen, “Forest management and biodiversity conservation based on natural ecosystem dynamics in northern Europe: The complexity challenge,” *Ambio* 38 (2009): 309–315.

25. For example, Hannelius and Kuusela, *Finland*, 175.

26. Curran, *Ecology and evolution* (cited in “Tracking” interlude, n. 3).

27. Weather and undergrowth conditions also make a difference in whether seeds will sprout and if seedlings will become established. For wavelike regeneration of northern Sweden’s Scots pine, without fire, see Olle Zackrisson, Marie-Charlotte Nilsson, Ingeborg Steijlen, and Greger Hornberg, “Regeneration pulses and climate-vegetation interactions in nonpyrogenic boreal Scots pine stands,” *Journal of Ecology* 83, no. 3 (1995): 469–483; Jon Agren and Olle Zackrisson, “Age and size structure of *Pinus sylvestris* populations on mires in central and northern Sweden,” *Journal of Ecology* 78, no. 4 (1990): 1049–1062. The authors do not consider masting. Other researchers report: “Most years are relatively frequent but at the boreal forest limit seed maturation is impeded by the short growing season; most years may occur as seldom as once or twice in 100 years.” Csaba Matyas, Lennart Ackzell, and C.J.A. Samuel, *EUFORGEN technical guidelines for genetic conservation and use of Scots pine* (*Pinus sylvestris*) (Rome: International Genetic Resources Institute, 2004), 1.

28. Hiromi Fujita, “Succession of higher fungi in a forest of *Pinus densiflora*” [in Japanese], *Transactions of the Mycological Society of Japan* 30 (1989): 125–147.

29. The study of matsutake ecology in Nordic Europe is in its infancy. For an introduction, see Niclas Bergius and Eric Darnell, “The Swedish matsutake (*Tricholoma nouseosum* syn. *T. matsutake*): Distribution, abundance, and ecology,” *Scandinavian Journal of Forest Research* 15 (2000): 318–325.

CHAPTER 13. RESURGENCE

1. Scholarship on the disappearance of the peasantry begins with histories of the formation of the modern (e.g., Eugen Weber, *Peasants into Frenchmen* [Stanford, CA: Stanford University Press, 1976]). In the discussion of contemporary life, the trope is used to suggest our entry into a postmodern era (e.g., Michael Kearney, *Reconceptualizing the peasantry* [Boulder, CO: Westview Press, 1996]; Michael Hardt and Antonio Negri, *Multitude* [New York: Penguin, 2004]).

2. As discussed in chapter II, I include *Quercus*, *Lithocarpus*, and *Castanopsis* in my use of the term “oak.”

3. Oliver Rackham, *Woodlands* (London: Collins, 2006). Some biologists speculate that oaks may have developed their ability to coppice from long association with elephants, once common in the global north (George Monbiot, *Feral* [London: Penguin, 2013]). Even the suggestion speaks of the new importance of the cross-species evolutionary thinking discussed in the “Tracking” interlude.

4. For Japan: Hideo Tabata, “The future role of *satoyama* woodlands in Japanese society,” in *Forest and civilisations*, ed. Y. Yasuda, 155–162 (New Delhi: Roli Books, 2001). For the coexistence of tree species in the *satoyama*, see Nakashizuka, and Matsumoto, *Diversity* (cited in chap. II, n. 14).

5. Atsuki Azuma, “Birds of prey living in *yatsuda* and *satoyama*,” in *Satoyama*, ed. Takeuchi et al., (cited in chap. II, n. 14), 102–109.

6. *Ibid.*, 103–104.

7. Larval forms of this butterfly eat *Celtis sinensis*, one of the species of the coppice woodlands. Adults eat the sap of *Quercus acutissima*, another peasant coppiced oak (Izumi Washitani, “Species diversity in *satoyama* landscapes,” in *Satoyama*, ed. Takeuchi et al., 89–93 [cited in chap. II n. 14], on 90). Coppice supports a high diversity of plants as well as insects; in comparison, abandoning an area may allow a few aggressive species to dominate. See Wajirou Suzuki, “Forest vegetation in and around Ogawa Forest Reserve in relation to human impact,” in *Diversity*, ed. Nakashizuka and Matsumoto, 27–42.

8. Conrad Totman following earlier Japanese historians, offers this focus in *The green archipelago: Forestry in preindustrial Japan* (Berkeley: University of California Press, 1989).

9. This paragraph draws from Totman, *Green archipelago*; Margaret McKean, “Defining and dividing property rights in the commons: Today’s lessons from the Japanese past,” International Political Economy Working Paper no. 150, Duke University, 1991; Utako Yamashita, Kulbhushan Balooni, and Makoto Inoue, “Effect of instituting ‘authorized neighborhood associations’ on communal (*iriai*) forest ownership in Japan,” *Society and Natural Resources* 22 (2009): 464–473; Gaku Mitsumata and Takeshi Murata, “Overview and current status of the *irai* (commons) system in the three regions of Japan, from the Edo era to the beginning of the 21st century,” Discussion Paper No. 07–04 (Kyoto: Multilevel Environmental Governance for Sustainable Development Project, 2007).

10. Oliver Rackham points out that aristocrats in Europe used oak for elite building; thus oak was a lords' tree. In Japan, lords had sugi and hinoki for building. Rackham, "Trees, woodland, and archaeology," paper presented at Yale Agrarian Studies Colloquium, October 19, 2013, <http://www.yale.edu/agrarianstudies/colloqu-papers/07rackham.pdf>.

11. Tabata, "The future role of satoyama."

12. Matsuo Tsukada, "Japan," in *Vegetation history*, ed., B. Huntley and T. Webb III, 459–518 (Dordrecht, NL: Kluwer Academic Publishers, 1988).

13. Interview, 2008. Deforestation was associated with logging, shifting cultivation, the spread of intensive agriculture, and residential settlement. See Yamada Asako, Harada Hiroshi, and Okuda Shigetoshi, "Vegetation mapping in the early Meiji era and changes in vegetation in southern Miura peninsula" [in Japanese], *Eco-Habitat* 4, no. 1 (1997): 33–40; Ogura Junichi, "Forests of the Kanto region in the 1880s" [in Japanese], *Journal of the Japanese Institute of Landscape Architects* 57, no. 5 (1994): 79–84; Kaoru Ichikawa, Tomoo Okayasu, and Kazuhiko Takeuchi, "Characteristics in the distribution of woodland vegetation in the southern Kanto region since the early 20th century," *Journal of Environmental Information Science* 36, no. 5 (2008): 103–108.

14. Interview, 2008. About one well-documented Kanto forest, Wajirou Suzuki notes the acceleration of logging: "With development of domestic industries after World War I, the demand for charcoal increased dramatically, and during World War II, charcoal-burning and manufacturing equipment for military horses became the main industries in the area" (Suzuki, "Forest vegetation," 30).

15. As in central Japan, Yunnan forests without human disturbance revert to broadleaf associations, without pine. Stanley Richardson, *Forestry in communist China* (Baltimore, MD: Johns Hopkins University Press, 1966), 31. Histories of village use also show parallels. While he does not write about Yunnan, Nicholas Menzies describes village forest use in imperial China in a way quite reminiscent of the satoyama literature: "The community forests of Shanxi were known collectively as *She Shan* (village mountains). . . . These hillsides were unsuitable for agriculture, but they were important to their users to provide for ritual needs (such as grave sites for clan members), and as a source of forest products. Ren Chengtong noted that villages used the timber from their forests to provide funding and materials for public works within the community, and that villagers also had rights to gather nuts, fruit, wildlife (for meat), mushrooms, and medicinal herbs for their private use" (Menzies, *Forest and land management in imperial China* [London: St. Martin's Press, 1994], 80–81).

16. Forest reform, leading to several kinds of tenure categories including contracts with households, began in 1981. For an analysis of changing forest tenure, see Liu Dachang, "Tenure and management of non-state forests in China since 1950," *Environmental History* 6, no. 2 (2001): 239–263.

17. Yin Shaoting's pioneering work on shifting cultivation in Yunnan introduced the sustainability of the peasant landscape to scholars for whom peasants

were generally imagined as backward. Yin, *People and forests*, trans. Magnus Fiskesjo (Kunming: Yunnan Education Publishing House, 2001).

18. Liu (“Tenure,” 244) writes of the “disastrous deforestation” of this period.

CHAPTER 14. SERENDIPITY

1. A useful description of the mills and their work is found in P. Cogswell, Jr., “Deschutes country pine logging,” in *High and mighty: Selected sketches about the Deschutes country*, ed. T. Vaughn, 235–259 (Portland, OR: Oregon Historical Society, 1981). One of the stranger mill towns was Hixon, “which wandered about Deschutes, Lake, and Klamath counties, moving every few years to be close to Shelvin-Hixon’s logging operations” (251). With the advent of logging roads, mill towns settled down.

2. When the company withdrew its drug policy, many people signed up.

3. The Healthy Forests Restoration Act of 2003—which mandated logging, thinning, and post-burn salvage as the route to forest health—pushed the Forest Service into a series of continuing battles with conservationists (Vaughn and Cortner, *George W. Bush’s healthy forests* [cited in chap. 5, n. 3]).

4. William Robbins, *Landscapes of promise: The Oregon story, 1800–1940* (Seattle: University of Washington Press, 1997), 224.

5. Quoted in *ibid.*, 223.

6. Quoted in *ibid.*, 225.

7. Quoted in *ibid.*, 231.

8. This part of the story is well documented by local historians. Two points come through in all accounts. First, private owners from the first encroached on what was supposed to be public land, creating a mix of public and private forest holdings (e.g., Cogswell, “Deschutes”). Second, the race to build a railroad up the Deschutes River encouraged land speculation and added excitement and urgency to attempts to grab the forests (e.g., W. Carlson, “The great railroad building race up the Deschutes River,” in *Little-known tales from Oregon history*, 4:74–77 [Bend, OR: Sun Publishing, 2001]).

9. In 1916, two large mill complexes, Shelvin-Hixon and Brooks-Scanlon, opened along the Deschutes River (Robbins, *Landscapes of promise*, 233). Shelvin-Hixon sold out in 1950, while an expanded Brooks-Scanlon continued (Robbins, *Landscapes of conflict* [cited in chap. 3, n. 5], 162). Brooks-Scanlon merged with Diamond International Corporation in 1980 (Cogswell, “Deschutes,” 259).

10. Robbins (*Landscapes of conflict*, 152) quotes the *New York Times* in 1948: “More and more, lumber operators are looking to national and state-owned forests to fill out their operations.” In the eastern Cascades, the fact that valuable timber remained mainly in national forests stimulated mill consolidation in 1950. Phil Brogan, *East of the Cascades* (Hillsboro, OR: Binford and Mort, 1964), 256.

11. Hirt, *Conspiracy* (cited in chap. 3, n. 5).

12. Robbins, *Landscapes of conflict*, 14.

13. Writing about ponderosa in Oregon and northern California, Fiske and Tappeiner write, “Herbicide use started in the 1950’s with adaptation of agricultural

aerial application techniques of the phenoxy herbicides. Later, appropriate use of a much broader range of herbicides was established.” John Fiske and John Tappeiner, *An overview of key silvicultural information for Ponderosa pine* (USDA Forest Service General Technical Report PSW-GTR-198, 2005).

14. Znerold, “New integrated forest resource plan for ponderosa pine” (cited in chap. 3, n. 6), 3.

15. Indented quotations in this section are from the Klamath Tribes website, <http://www.klamathtribes.org/background/termination.html>.

16. Donald Fixico’s *The invasion of Indian country in the twentieth century* (Niwot: University Press of Colorado, 1998) tells the Klamath story in the context of other terminations and seizures.

17. Crown-Zellerbach, a pulp-and-paper company, was able to buy ninety thousand acres of reservation land for timber (<http://www.klamathtribes.org/background/termination.html>). In 1953, Crown-Zellerbach possessed the second-largest timber holdings in the West, after Weyerhaeuser (Harvard Business School, Baker Library, Lehman Brothers Collection, http://www.library.hbs.edu/hc/lehman/industry.html?company=crown_zellerbach_corp).

18. Edward Wolf, *Klamath heartlands: A guide to the Klamath Reservation forest plan* (Portland, OR: Ecotrust, 2004). The Klamath Tribes employ specialists in forestry to monitor projects slated for reservation land. In 1997, the Tribes successfully appealed a proposed national forest timber sale, which led to a 1999 memorandum of agreement on forest management (Vaughn and Cortner, *George W. Bush’s healthy forests*, 98–100).

19. Robbins (*Landscapes of conflict*, 163) notes that Brooks-Scanlon had already begun to cut some lodgepole in 1950 to augment its decreasing ponderosa supplies.

20. Znerold, “New integrated forest resource plan for ponderosa pine,” 4.

21. Jerry Franklin and C. T. Dyrness, *Natural vegetation of Oregon and Washington* (Portland, OR: Pacific Northwest Forest and Range Experiment Station, U.S.D.A. Forest Service, 1988), 185.

22. This ability to quickly colonize open lands impressed novice forester Thornton Munger, who was sent by the Forest Service in 1908 to study the encroachment of lodgepole pine on ponderosa territory. Munger considered lodgepole “a practically worthless weed”; he also thought the problem for ponderosa was too many fires, which, he thought, killed ponderosa and advantaged lodgepole. He promoted the prevention of forest fires to preserve ponderosa. This is almost the opposite of what foresters argue today. Even Munger later changed his mind: “It has since struck me how audacious or naïve it was for the Washington Office to assign a forest assistant with no experience, who had not even seen the two species before” (Munger quoted in Les Joslin, *Ponderosa promise: A history of U.S. Forest Service research in central Oregon* [General Technical Report PNW-GTR-711, Portland, OR: U.S.D.A. Forest Service, Pacific Northwest Research Station, 2007], 7).

23. Fujita, “Succession of higher fungi” (cited in chap. 12, n. 28).

24. Fumihiko Yoshimura, interview, 2008. Dr. Yoshimura has seen matsutake with trees as young as thirty years old.

25. Fungal underground bodies have a more sustained presence than fruiting bodies. In boreal Europe, mycorrhizal fungi remain in the soil after fires, re-infecting pine seedlings (Lena Jonsson, Anders Dahlberg, Marie-Charlotte Nilsson, Olle Zackrisson, and Ola Karen, “Ectomycorrhizal fungal communities in late-successional Swedish boreal forests, and their composition following wildfire,” *Molecular Ecology* 8 [1999]: 205–215).

26. As early as 1934, long before lodgepole was considered a commercial species, foresters in the eastern Cascades experimented with thinning lodgepoles to speed up wood production. Only after World War II, however, when lodgepole became a resource for pulp and paper, as well as for poles, box shooks, and even lumber, did its silviculture become an important interest of the eastern Cascades Forest Service. In 1957, a lodgepole pulp mill was opened near Chiloquin. Joslin, *Ponderosa promise*, 21, 51, 36.

CHAPTER 15. RUIN

1. In viewing Japan’s environment through tropical deforestation, I follow Dauvergne, *Shadows* (cited in chap. 8, n. 11). (For regulatory and conservation responses, see Anny Wong, “Deforestation in the tropics,” in *The roots of Japan’s international environmental policies*, 145–200 [New York: Garland, 2001].) Most scholarship on Japan’s environmental problems, in contrast, focuses on industrial pollution (Brett Walker, *Toxic archipelago: A history of industrial disease in Japan* [Seattle: University of Washington Press, 2010]; Shigeto Tsuru, *The political economy of the environment: The case of Japan* [Cambridge: Cambridge University Press, 1999].)

2. I am indebted to Mayumi and Noboru Ishikawa for these insights. As researchers in Sarawak, they saw the destruction of the forest and wondered about Japan’s responsibility. Back in Japan, they connected this with the ruin of the domestic forest industry. Earlier environmental historians, in contrast, saw only Japan’s “green archipelago” (Totman, *Green archipelago* [cited in chap. 13, n. 8]).

3. For Japan’s forest policies, I rely particularly on Yoshiya Iwai, ed., *Forestry and the forest industry in Japan* (Vancouver: UBC Press, 2002).

4. Michael Hathaway, *Environmental winds: Making the global in southwest China* (Berkeley: University of California Press, 2013).

5. Miyamoto et al., “Changes in forest resource utilization” (cited in chap. 11, note 14), 90. Burning had been conventional for the maintenance of grasslands and for creating forest openings, such as for shifting cultivation (Mitsuo Fujiwara, “Silviculture in Japan,” in *Forestry*, ed. Iwai, 10–23, on 12). Now some local forest associations also prohibited burning (Koji Matsushita and Kunihiro Hirata, “Forest owners’ associations,” in *Forestry*, ed. Iwai, 41–66, on 42).

6. Stephen Pyne, *Fire in America* (Seattle: University of Washington Press, 1997), 328–334. Pyne argues that the Tillamook fire inaugurated U.S. industrial forest plantations by making replanting standard practice.

7. Steen, *U.S. Forest Service*; Robbins, *American forestry* (both cited in chap. 2, n. 5).

8. Iwai, *Forestry*.

9. Many forest owners had less than five hectares. All had to participate in coordinated forest management, including timber control, reforestation, and the prevention of fire. Matsushita and Hirata, “Forest owners’ associations,” 43.

10. The incident is recalled as the Lookout air raids; in 1944 and 1945, it was followed by Japanese attempts to launch fire balloons into the jet stream (http://en.wikipedia.org/wiki/Fire_balloon). Frida Knoblock’s *The culture of wilderness* (Raleigh: University of North Carolina Press, 1996) describes the militarization of the U.S. Forest Service that followed. See also Jake Kosek, *Understories* (Durham, NC: Duke University Press, 2006).

11. Robbins, *Landscapes of conflict* (cited in chap. 3, n. 5), 176.

12. *Ibid.*, 163.

13. Matsushita and Hirata, “Forest owners’ associations,” 45.

14. Scott Prudham analyzes the industrialization of Oregon’s Douglas fir forestry from the 1950s (“Taming trees: Capital, science, and nature in Pacific slope tree improvement,” *Annals of the Association of American Geographers* 93, no. 3 [2003]: 636–656). For a prehistory of this industrial turn, see Emily Brock, *Money trees: Douglas fir and American forestry, 1900–1940* (Corvallis: Oregon State University Press, 2015).

15. Interview with forest workers conducted by Mayumi and Noboru Ishikawa, Wakayama prefecture, 2009.

16. Fujiwara, “Silviculture in Japan,” 14.

17. Ken-ichi Akao, “Private forestry,” in *Forestry*, ed. Iwai, 24–40, on 35. Akao further explains that after 1957, the government reduced subsidies to 48 percent for conversion of natural forest to tree plantation.

18. Quoted in Robbins, *Landscapes of conflict*, 147. The Oregon timber industry was then diversifying to plywood, particleboard, and pulp and paper. Less desirable timber had become usable, encouraging clear-cutting. Gail Wells, “The Oregon coast in modern times: Postwar prosperity,” Oregon History Project, 2006, http://www.ohs.org/education/oregonhistory/narratives/subtopic.cfm?subtopic_id=575.

19. The Imperial Japanese Army had confiscated these forests in 1939, while nevertheless confirming traditional access rights. U.S. occupying forces took the area from the Japanese; Japanese Self-Defense Forces reclaimed it from the Americans. Margaret McKean, “Management of traditional common lands in Japan,” in *Proceedings of the conference on common property resource management April 21–26, 1985*, ed. Daniel Bromley, 533–592 (Washington, DC: National Academy Press, 1986), 574.

20. Akao, “Private forestry,” 32; Yoshiya Iwai and Kiyoshi Yukutake, “Japan’s wood trade,” in *Forestry*, ed. Iwai, 244–256, on 247, 249.

21. Akao, “Private forestry,” 32.

22. *Ibid.*, 33.

23. Robbins, *Landscapes of conflict*, xviii.

24. In the 1980s, Indonesia restricted exports of raw logs and built a plywood processing industry. Japanese trading companies began buying more logs from Sarawak and Papua New Guinea. Easy pickings did not last long in any place, but trading companies kept moving to new supply areas. The matsutake forests I visited in Yunnan, China, felled in the 1970s for foreign exchange, were part of this 1970s Japanese import boom. Since I do not find China on Iwai and Yukutake's table of imported logs, I assume those logs entered Japan without full papers. Iwai and Yukutake, "Japan's wood trade," 248.

25. See Totman, *Green archipelago* (cited in chap. 13, n. 8).

26. Fujiwara, "Silviculture in Japan," 20. John Knight recounts how forested villages asked for help to continue to maintain their forests. Knight, "The forest grant movement in Japan," in *Environmental movements in Asia*, ed. Arne Kalland and Gerard Persoon, 110–130 (Oslo: Nordic Institute of Asian Studies, 1998).

CHAPTER 16. SCIENCE AS TRANSLATION

1. "Translation" is a key term for the actor-network theory conceived by Bruno Latour and John Law, where it refers to articulations between humans and those nonhumans working with humans, such as technologies; through translation, in this usage, networks of action emerge that include humans and nonhumans equally. An early and influential exposition of this position is Michel Callon, "Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St. Bruic Bay," in *Power, action and belief*, ed. John Law, 196–223 (London: Routledge, 1986).

2. The question of translation here forms part of a larger scholarly discussion about "modernity." European common sense, which science studies too often takes for granted, shows us a modernity formed of Western thought, which has become universal. In contrast, that postcolonial theory that emerged from Asia in the late twentieth century showed modernity formed in power-laden interchanges between the global north and south. The emergence of modernity as a project is best understood in the first instance outside the West—for example, in the kingdom of Siam or colonial India. In these places, one sees the play of power, events, and ideas in which organizational and ideational complexes are formed (Thongchai Winichatukul, *Siam mapped: A history of the geo-body of a nation* [Honolulu: University of Hawaii Press, 1994]; Dipesh Chakrabarty, *Provincializing Europe* [Princeton, NJ: Princeton University Press, 2000]). This does not mean that modernity was not taken up in Europe and North America, and with distinctive variations. But to penetrate the smokescreen of West-is-all dreams, one must learn to see Western versions as derivative and exotic. From those Other places, it is easy to grasp modernity projects as partial and contingent, rather than overdetermined by a single cultural logic. This is the insight needed for science studies. (To complicate the situation, however, a new postcolonial theory emerging from Latin America requires sharply drawn

West-versus-Other cosmological distinctions, e.g., Eduardo Viveiros de Castro, “Economic development and cosmopolitical reinvolvement,” in *Contested ecologies*, ed. Lesley Green, 28–41 [Cape Town, SA: HSRC Press, 2013].)

3. Satsuka, *Nature in translation* (cited in chap. 4, n. 2).

4. Itty Abraham’s *Making of the Indian atomic bomb* (London: Zed Books, 1998) shows how postwar Indian physics emerged in the political conjunctures that created “India.”

5. For an example of Korean research, see Chang-Duck Koo, Dong-Hee Lee, Young-Woo Park, Young-Nam Lee, Kang-Hyun Ka, Hyun Park, Won-Chull Bak, “Ergosterol and water changes in *Tricholoma matsutake* soil colony during the mushroom fruiting season,” *Mycobiology* 37, no. 1 (2009): 10–16.

6. For an example of such collaboration, see S. Ohga, F. J. Yao, N. S. Cho, Y. Kitamoto, and Y. Li, “Effect of RNA-related compounds on fructification of *Tricholoma matsutake*,” *Mycosystema* 23 (2004): 555–562.

7. Nicholas Menzies and Chun Li (“One eye on the forest, one eye on the market: Multi-tiered regulation of matsutake harvesting, conservation, and trade in north-western Yunnan Province,” in *Wild product governance*, ed. Sarah Laird, Rebecca McLain, and Rachel Wynberg, 243–263 [London: Earthscan, 2008]) review regulations to show how flexible enforcement enters at each scale.

8. Ohara Hiroyuki, “A history of trial and error in artificial production of matsutake fruitings” [in Japanese], *Doshisha Home Economics* 27 (1993): 20–30.

9. The shiro is an alternative unit to the “genet” of non-Japanese researchers for counting “individual” fungal organisms. The shiro, the dense mycelial mat, is determined by morphological observation. The genet, the genetic individual, is sometimes described as synonymous to the shiro (e.g., Jianping Xu, Tao Sha, Yanchun Li, Zhi-wei Zhao, and Zhu Yang, “Recombination and genetic differentiation among natural populations of the ectomycorrhizal mushroom *Tricholoma matsutake* from southwestern China,” *Molecular Ecology* 17, no. 5 [2008]: 1238–1247, on 1245). But the term implies genetic homogeneity, an assumption contradicted by Japanese research (Hitoshi Murata, Akira Ohta, Akiyoshi Yamada, Maki Narimatsu, and Norihiro Futamura, “Genetic mosaics in the massive persisting rhizosphere colony ‘shiro’ of the ectomycorrhizal basidiomycete *Tricholoma matsutake*,” *Mycorrhiza* 15 [2005]: 505–512). Technical sophistication is sometimes less productive than the inclusion of peasant knowledge.

10. Timothy Choy and Shiho Satsuka, writing as Mogu-Mogu, have written about this turn in Dr. Hamada’s research. “Mycorrhizal relations: A manifesto,” in “A new form of collaboration in cultural anthropology: Matsutake worlds,” ed. Matsutake Worlds Research Group, *American Ethnologist* 36, no. 2 (2009): 380–403.

11. Interviews, 2005, 2006, 2008. See Ogawa, *Matsutake* (cited in chap. 3, n. 4).

12. See, for example, Ito Takeshi and Iwase Koji, *Matsutake: Kajuen Kankaku de Fuyasu Sodateru* [Matsutake: Increase and nurture as in an orchard] (Tokyo: Nosangyoson Bunka Kyokai, 1997).

13. See, for example, Hiroyuki Ohara and Minoru Hamada, “Disappearance of bacteria from the zone of active mycorrhizas in *Tricholoma matsutake* (S. Ito et Imai) Singer,” *Nature* 213, no. 5075 (1967): 528–529.

14. Ito and Iwase, *Matsutake*.

15. In 2004, the team stimulated a mycorrhiza in a mature pine root (Alexis Guerin-Laguette, Norihisa Matsushita, Frédéric Lapeyrie, Katsumi Shindo, and Kazuo Suzuki, “Successful inoculation of mature pine with *Tricholoma matsutake*,” *Mycorrhiza* 15 [2005]: 301–305). Soon afterward, Dr. Suzuki retired, and the team disbanded. He subsequently became president of the Forestry and Forest Products Institute.

16. For a much earlier Japanese-U.S. collaboration, see S. M. Zeller and K. Togashi, “The American and Japanese Matsu-takes,” *Mycologia* 26 (1934): 544–558.

17. Hosford et al., *Ecology and management* (cited in chap. 3, n. 4).

18. *Ibid.*, p. 50.

19. There are exceptions, and if matsutake research in the U.S. Pacific Northwest had been allowed to develop, the tradition might have exploded in new directions. Research flourished only between the 1990s and 2006; after that, funding cuts ended grant opportunities, and researchers moved on. One exception to timber-scalable approaches is Charles Lefevre’s dissertation on matsutake host associations in the Pacific Northwest (cited in chap. 12, n. 11). This was relational analysis, and, without any nods to Japan, it touched on common concerns. Lefevre even developed a “smell test” for matsutake mycelia; as in Japanese research, his work used and empowered nonexperts. Lefevre moved on to selling inoculated truffle trees.

20. David Pilz and Randy Molina, “Commercial harvests of edible mushrooms from the forests of the Pacific Northwest United States: Issues, management, and monitoring for sustainability,” *Forest Ecology and Management* 5593 (2001): 1–14.

21. David Pilz and Randy Molina, eds., *Managing forest ecosystems to conserve fungus diversity and sustain wild mushroom harvests* (USDA Forest Service PNW-GTR-371, 1999).

22. James Weigand, “Forest management for the North American pine mushroom (*Tricholoma magnivelare* (Peck) Redhead) in the southern Cascade range” (PhD diss., Oregon State University, 1998).

23. Daniel Luoma, Joyce Eberhart, Richard Abbott, Andrew Moore, Michael Amaranthus, and David Pilz, “Effects of mushroom harvest technique on subsequent American matsutake production,” *Forest Ecology and Management* 236, no. 1 (2006): 65–75.

24. Anthony Amend, Zhendong Fang, Cui Yi, and Will McClatchey, “Local perceptions of matsutake mushroom management in NW Yunnan, China,” *Biological Conservation* 143 (2010): 165–172. This collaboration between American and Chinese scholars criticizes Japanese research from a U.S. point of view. The authors blame Japanese researchers’ site specificity for lack of scalability, i.e., “reliance on site rather than temporal replication . . . [because] stand-level productivity is difficult to test empirically” (167).

25. Socially concerned Chinese scientists take matsutake research in a different direction, asking how land tenure might make a difference. In this discussion, matsutake is still a scalable commodity and a source of income, but this income can be distributed differently (see chapter 19). Some Americans, e.g., David Arora (“The houses that matsutake built,” *Economic Botany* 62, no. 3 (2008): 278–290) are also critics.

26. Jicun Wenyan [Yoshimura Fumihiko], *Songrong cufan jishu* [The technique of promoting flourishing matsutake], trans. Yang Huiling (Kunming: Yunnan keji chubanshe [Yunnan Science and Technology Press], 2008).

CHAPTER 17. FLYING SPORES

1. Interview, 2005.
2. Interview, 2008.
3. See Henning Knudsen’s and Jan Vesterholt’s taxonomy, *Funga nordica* (Copenhagen: Nordsvamp, 2012).
4. Interview, 2009.
5. The name *Tricholoma caligatum* (also *T. caligata*) is used for several quite different fungi, some counted as matsutake. See prologue, n. 11.
6. Interview, 2005.
7. See also Norihisa Matsushita, Kensuke Kikuchi, Yasumasa Sasaki, Alexis Guerin-Laguette, Frédéric Lapeyrie, Lu-Min Vaario, Marcello Intini, and Kazuo Suzuki, “Genetic relationship of *Tricholoma matsutake* and *T. nauseosum* from the northern hemisphere based on analyses of ribosomal DNA spacer regions,” *Mycoscience* 46 (2005): 90–96.
8. Peabody et al., “Haploid vegetative mycelia” (cited in “Tracking” interlude, n. 21).
9. Interview, 2009.
10. Ignacio Chapela and Matteo Garbelotto, “Phylogeography and evolution in matsutake and close allies as inferred by analysis of ITS sequences and AFLPs,” *Mycologia* 96, no. 4 (2004): 730–741.
11. Interview, 2006; Katsuji Yamanaka, “The origin and speciation of the matsutake complex” [in Japanese with English summary], *Newsletter of the Japan Mycology Association, Western Japan Branch* 14 (2005): 1–9.
12. Manos et al., worried about how an American *Lithocarpus* might exist, have moved tanoak to a new genus, *Notholithocarpus*. Paul S. Manos, Charles H. Cannon, and Sang-Hun Oh, “Phylogenetic relations and taxonomic status of the paleoendemic Fagaceae of western North America: Recognition of a new genus *Notholithocarpus*,” *Madrono* 55, no. 3 (2008): 181–190.
13. Interview, 2009.
14. Jianping Xu, Hong Guo, and Zhu-Liang Yang, “Single nucleotide polymorphisms in the ectomycorrhizal mushroom *Tricholoma matsutake*,” *Microbiology* 153 (2007): 2002–2012.
15. Anthony Amend, Sterling Keeley, and Matteo Garbelotto, “Forest age correlates with fine-scale spatial structure of matsutake mycorrhizas,” *Mycological Research* 113 (2009): 541–551.

16. Anthony Amend, Matteo Garbelotto, Zhengdong Fang, and Sterling Keeley, “Isolation by landscape in populations of a prized edible mushroom *Tricholoma matsutake*,” *Conservation Genetics* 11 (2010): 795–802.

17. Interview, 2006.

18. According to Dr. Murata, matsutake does not have a somatic incompatibility system to restrict matings. See Murata et al., “Genetic mosaics” (cited in chap. 16, n. 9).

19. Haploid nuclei in fungal body cells may not combine until production of fruiting bodies, meanwhile producing cells with two (or more) nuclei, each with one copy of the chromosomes. The “di-” refers to fungal body cells with two haploid nuclei.

20. For an opposing view, see Chunlan Lian, Maki Narimatsu, Kazuhide Nara, and Taizo Hogetsu, “*Tricholoma matsutake* in a natural *Pinus densiflora* forest: Correspondence between above- and below-ground genets, association with multiple host trees and alteration of existing ectomycorrhizal communities,” *New Phytologist* 171, no. 4 (2006): 825–836.

INTERLUDE. DANCING

1. See Timothy Ingold, *Lines* (London: Routledge, 2007).

2. Lefevre, “Host associations” (cited in chap. 12, n. 11).

3. My ethnographic present here is 2008. Hiro has since passed away.

PART IV. IN THE MIDDLE OF THINGS

1. Brown founded the Jefferson Center for Education and Research in 1994; the center folded after her death in 2005. After Brown’s opening work, other organizations took over mushroom picker organizing, including the Institute for Culture and Ecology, the Sierra Institute for Community and Environment, and the Alliance of Forest Workers and Harvesters. The project hired “mushroom monitors” from among the pickers. Their job was to identify pickers’ needs, to work with their forms of knowledge, and to help design empowerment programs. Even when monitors stopped being paid, some continued as volunteers. The efforts of many people and organizations came together in the project.

2. Peter Kardas and Sarah Loose, eds., *The making of a popular educator: The journey of Beverly A. Brown* (Portland, OR: Bridgetown Printing, 2010).

3. Beverly Brown, *In timber country: Working people’s stories of environmental conflict and urban flight* (Philadelphia: Temple University Press, 1995).

CHAPTER 18. MATSUTAKE CRUSADERS

1. Dr. Yoshimura’s concern to protect the slope from erosion thus contrasts with Kato-san’s attempt to expose mineral soils through erosion, noted in the opening to part 3.

2. Kokki Goto (edited, annotated, and with an introduction by Motoko Shimagami), “‘Iriai’ forests have sustained the livelihood and autonomy of villagers: Experience of commons in Ishimushiro hamlet in northeastern Japan,” working

paper no. 30, Afrasian Center for Peace and Development Studies, Ryukoku University, 2007, 2–4.

3. *Ibid.*, 16.

4. Haruo Saito, interview, 2005; Haruo Saito and Gaku Mitsumata, “Bidding customs and habitat improvement for matsutake (*Tricholoma matsutake*) in Japan,” *Economic Botany* 62, no. 3 (2008): 257–268.

5. Noboru Kuramoto and Yoshimi Asou, “Coppice woodland maintenance by volunteers,” in *Satoyama*, ed. Takeuchi et al., 119–129 (cited in chap. II, n. 14), on 129.

CHAPTER 19. ORDINARY ASSETS

1. As Michael Hathaway reminds me (personal communication, 2014), privatization in Yunnan sometimes revives pre-Communist tenure relations. The abruptness of changes, rather than their absolute novelty, draws attention to property’s constitutive relations.

2. For discussions of tenure, see Liu, “Tenure” (cited in chap. 13, n. 16); Nicholas Menzies, *Our forest, your ecosystem, their timber: Communities, conservation, and the state in community-based forest management* (New York: Columbia University Press, 2007). After 1981 policies took effect, most forests were divided into three categories: state-owned forest, collective forest, and forest for which individual households were to hold responsibility. In the second category, forest was also divided into individual household contracts. Rights to trees and other forest access were increasingly separated; in 1998, a logging ban was instituted in Yunnan. Regions within Yunnan varied in how things worked. Michael Hathaway and my field site in Chuxiong became known for individual-access arrangements. However, we found that the farmers we interviewed were often confused or dismissive of the niceties of these categories.

3. In the view of the IMF and the World Bank, privatization avoids the “tragedy of the commons,” in which we destroy shared resources. Garrett Hardin, “The tragedy of the commons,” *Science* 162, no. 3859 (1986): 1243–1248.

4. For some English-language entries, see Jianchu Xu and Jesse Ribot, “Decentralisation and accountability in forest management: A case from Yunnan, southwest China,” *European Journal of Development Research* 16, no. 1 (2004): 153–173; X. Yang, A. Wilkes, Y. Yang, J. Xu, C. S. Geslani, X. Yang, F. Gao, J. Yang, and B. Robinson, “Common and privatized: Conditions for wise management of matsutake mushrooms in northwest Yunnan province, China,” *Ecology and Society* 14, no. 2 (2009): 30; Xuefei Yang, Jun He, Chun Li, Jianzhong Ma, Yongping Yang, and Jianchu Xu, “Management of matsutake in NW-Yunnan and key issues for its sustainable utilization,” in *Sino-German symposium on the sustainable harvest of non-timber forest products in China*, ed. Christoph Kleinn, Yongping Yang, Horst Weyerhaeuser, and Marco Stark, 48–57 (Göttingen: World Agroforestry Centre, 2006); Jun He, “Globalised forest-products: Commodification of the matsutake mushroom in Tibetan villages, Yunnan, southwest China,” *International Forestry Review* 12, no. 1 (2010): 27–37; Jianchu Xu and David R. Melick, “Rethinking the effectiveness of

public protected areas in southwestern China,” *Conservation Biology* 21, no. 2 (2007): 318–328.

5. Su Kai-mei, Yunnan Academy of Agricultural Sciences, interview, 2009. See also Yang Yu-hua, Shi Ting-you, Bai Yong-shun, Su Kai-mei, Bai Hong-fen, Mu Li-qiong, Yu Yan, Duan Xing-zhou, Liu Zheng-jun, Zhang Chun-de, “Discussion on management model of contracting mountain and forest about bio-resource utilization under natural forest in Chuxiong Prefecture” [in Chinese], *Forest Inventory and Planning* 3 (2007): 87–89; Li Shu-hong, Chai Hong-mei, Su Kai-mei, Zhing Ming-hui, and Zhao Yong-chang, “Resources investigation and sustainable suggestions on the wild mushrooms in Jianchuan” [in Chinese], *Edible Fungi of China* 5 (2010).

6. See X. Yang et al., “Common and privatized,” and Y. Yang et al., “Discussion on management model.” Very different governance over matsutake harvesting—with much more communal control—characterizes the Diqing Tibetan area of Yunnan, where most foreign researchers gravitate. Menzies, *Our forest*; Emily Yeh, “Forest claims, conflicts, and commodification: The political ecology of Tibetan mushroom-harvesting villages in Yunnan province, China,” *China Quarterly* 161 (2000): 212–226.

7. Other researchers in this region usefully describe the disjunction between management policies and local practices as an issue of different scales of governance. Liu, “Tenure”; Menzies and Li, “One eye on the forest” (cited in chap. 16, n. 7); Nicholas K. Menzies and Nancy Lee Peluso, “Rights of access to upland forest resources in southwest China,” *Journal of World Forest Resource Management* 6 (1991): 1–20.

8. I was unable to go on this trip; Michael Hathaway kindly described what happened.

9. David Arora (“Houses” [cited in chap. 16, n. 25]) saw matsutake change hands eight times in two hours in a Yunnan mushroom market. My experience watching matsutake in dedicated mushroom markets was similar; exchanges were constant.

10. The contrast between this buying scene and the much more competitive local matsutake markets Michael Hathaway studied in the Tibetan area of Yunnan is instructive. There, Tibetan pickers sell to Han Chinese merchants; the buying scene is intensely competitive from the first. In the area I am describing, both the bosses and the pickers are of Yi nationality. Ties of kinship and residence also link pickers and buyers.

11. Brian Robinson’s account of “the tragedy of the commons” for Yunnan matsutake admits that picking mushrooms in the commons may not hurt the fungus. He focuses instead on the problem of reduced income. Brian Robinson, “Mushrooms and economic returns under different management regimes,” in *Mushrooms in forests and woodlands*, ed. Anthony Cunningham and Xuefei Yang, 194–195 (New York: Routledge, 2011).

12. I am in debt to Michael Hathaway’s sharp perceptions for noticing this plaque.

CHAPTER 20. ANTI-ENDING

1. <http://www.matsiman.com/matsiman.htm>.
2. Lu-Min Vaario, Alexis Guerin-Laguette, Norihisha Matsushita, Kazuo Suzuki, and Frédéric Lapeyrie, “Saprobic potential of *Tricholoma matsutake*: Growth over pine bark treated with surfactants,” *Mycorrhiza* 12 (2002): 1–5.
3. For related research, see Lu-Min Vaario, Taina Pennanen, Tytti Sarjala, Eira-Maija Savonen, and Jussi Heinonsalo, “Ectomycorrhization of *Tricholoma matsutake* and two major conifers in Finland—an assessment of in vitro mycorrhiza formation,” *Mycorrhiza* 20, no. 7 (2010): 511–518.
4. Heikki Jussila and Jari Jarviluoma discuss tourism in depressed contemporary Lapland: “Extracting local resources: The tourism route to development in Kolari, Lapland, Finland,” in *Local economic development*, ed. Cecily Neil and Markku Tykkäläinen, 269–289 (Tokyo: United Nations University Press, 1998).
5. Another world, indeed, is forming. Through the recruiting activities of Thai women married into depressed rural Finland, a network of Thai pickers has entered the forest, picking berries, and, recently, mushrooms. Pickers come independently, using their own funds. Like pickers in Oregon, they sell what they pick and pay their own expenses. They crowd into abandoned schoolhouses in the shrinking villages of Finland’s countryside; they maintain their own forms of living, sometimes bringing their own cooks—and even some of their own food. Unlike their recruiters, the pickers are not from Bangkok, but from impoverished Lao-speaking northeast Thailand. Perhaps they are distant cousins of Lao pickers in the United States. The resemblance makes one wonder: How will Finnish foresters and community builders speak with these new pickers? Will their experience and expertise come into dialogue?

SPORE TRAIL. THE FURTHER ADVENTURES OF A MUSHROOM

1. Ursula Le Guin, “The carrier bag theory of fiction,” in *Dancing at the edge of the world*, 165–170 (New York: Grove Press, 1989), on 167–168.

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