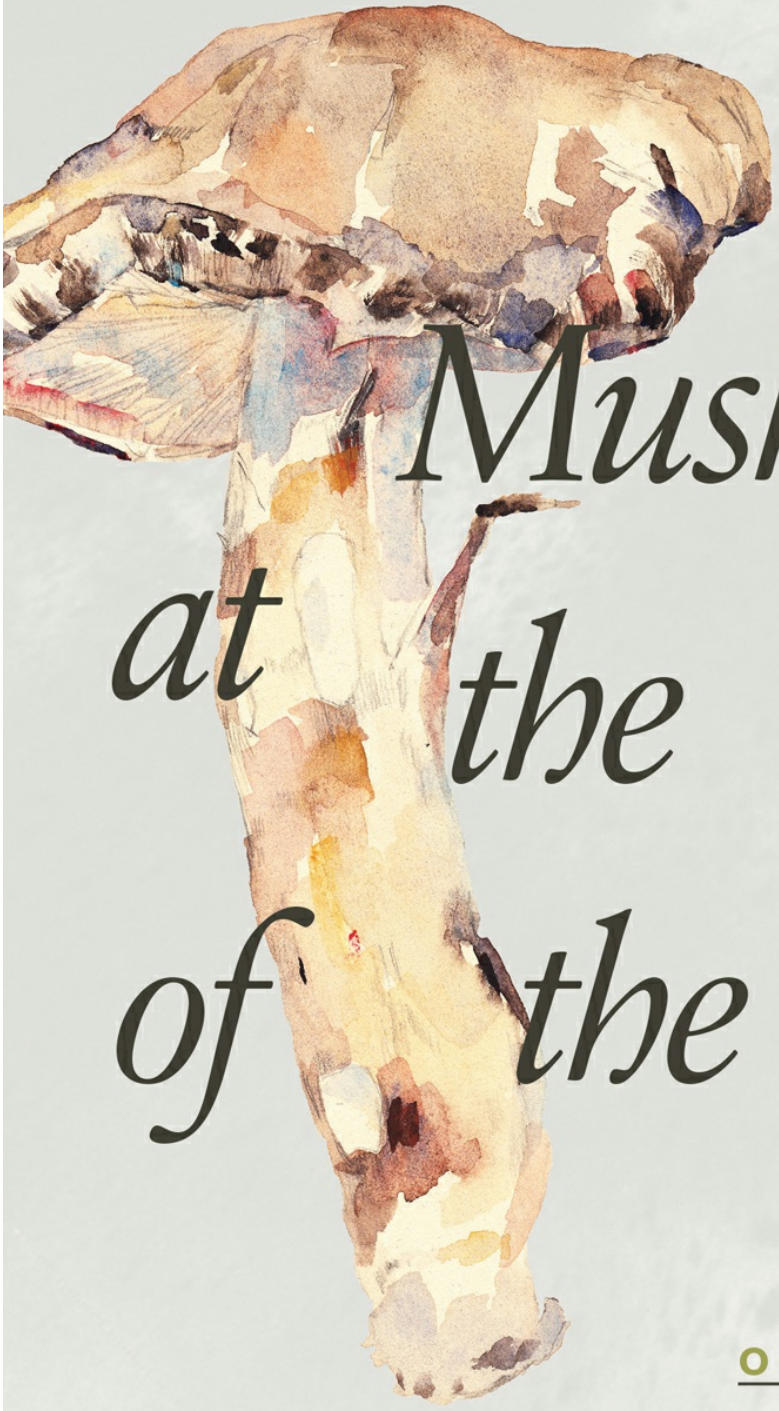
ANNA LOWENHAUPT TSING



The Mushroom at the End of the World

ON THE POSSIBILITY OF LIFE IN CAPITALIST RUINS

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Contents

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 Hjorleifur 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, foraged 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 antimodernity.[4] Yet for twentieth-century scientists, progress also unselfconsciously 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. Hillsides 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.
>
> —YAMAGIJCHI SODO (1642–1716)[14]

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.

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 nonliving 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 **M**oua, "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 firs 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. Hjorleifur 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 plantationlike 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 nonscalable in forms of capitalism in which scalable accounting allows nonscalable 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.


300g

Elusive life, Tokyo. A chef examines, smells, and prepares matsutake, grilled and presented with a slice of kabosu *lime. Smell is the presence of another in ourselves. Hard to describe, yet vivid, smell leads into encounter—and indeterminacy.*

Interlude
Smelling

"What leaf? What mushroom?"

—John Cage's translation of a classic poem by Basho

WHAT IS THE STORY OF A SMELL? NOT AN ETHNOGRAPHY of smelling, but the story of the smell itself, wafting into the nostrils of people and animals, and even impressing the roots of plants and the membranes of soil bacteria? Smell draws us into the entangled threads of memory and possibility.

Matsutake guides not just me but many others. Moved by the smell, people and animals across the northern hemisphere brave wild terrain searching for it. Deer select matsutake over other mushroom choices. Bears turn over logs and excavate ditches searching for it. And several Oregon mushroom hunters told me of elk with bloody muzzles from uprooting matsutake from the sharp pumice soil. The smell, they said, draws elk from one patch straight to another. And what is smell but a particular form of chemical sensitivity? In this interpretation, trees too are touched by the smell of matsutake, allowing it into their roots. As with truffles, flying insects have been seen circling underground caches. In contrast, slugs, other fungi, and many kinds of soil bacteria are repulsed by the smell, moving out of its range.

Smell is elusive. Its effects surprise us. We don't know how to put much about smell into words, even when our reactions are strong and certain. Humans breathe and smell in the same intake of air, and describing smell seems almost as difficult as describing air. But smell, unlike air, is a sign of the presence of another, to which we are already responding. Response always takes us somewhere new; we are not quite ourselves any more—or at least the selves we were, but rather ourselves in encounter with another. Encounters are, by their nature, indeterminate; we are unpredictably transformed. Might smell, in its confusing mix of elusiveness and certainty, be a useful guide to the indeterminacy of encounter?

Indeterminacy has a rich legacy in human appreciation of mushrooms. American composer John Cage wrote a set of short performance pieces called *Indeterminacy*, many

of which celebrate encounters with mushrooms.[1] Hunting wild mushrooms, for Cage, required a particular kind of attention: attention to the here and now of encounter, in all its contingencies and surprises. Cage's music was all about this "always different" here and now, which he contrasted to the enduring "sameness" of classical composition; he composed to get the audience to listen as much to ambient sounds as composed music. In one famous composition, *4′33″*, no music is played at all, and the audience is forced to just listen. Cage's attention to listening as things occurred brought him to appreciate indeterminacy. The Cage quotation with which I began this chapter is his translation of seventeenth-century Japanese poet Matsuo Basho's haiku, "matsutake ya shiranu ki no ha no hebari tsuku," which I have seen translated as "Matsutake; And on it stuck / The leaf of some unknown tree."[2] Cage decided that the indeterminacy of encounter was not clear enough in such translations. First he settled on "That that's unknown brings mushroom and leaf together," which nicely expresses the indeterminacy of encounter. But, he thought, it is too ponderous. "What leaf? What mushroom?" can also take us into that open-endedness that Cage so valued in learning from mushrooms.[3]

Indeterminacy has been equally important in what scientists learn from mushrooms. Mycologist Alan Rayner finds the indeterminacy of fungal growth one of the most exciting things about fungi.[4] Human bodies achieve a determinate form early in our lives. Barring injury, we'll never be all that different in shape than we were as adolescents. We can't grow extra limbs, and we're stuck with the one brain we've each got. In contrast, fungi keep growing and changing form all their lives. Fungi are famous for changing shape in relation to their encounters and environments. Many are "potentially immortal," meaning they die from disease, injury, or lack of resources, but not from old age. Even this little fact can alert us to how much our thoughts about knowledge and existence just assume determinate life form and old age. We rarely imagine life without such limits—and when we do we stray into magic. Rayner challenges us to think with mushrooms, otherwise. Some aspects of our lives are more comparable to fungal indeterminacy, he points out. Our daily habits are repetitive, but they are also open-ended, responding to opportunity and encounter. What if our indeterminate life form was not the shape of our bodies but rather the shape of our motions over time? Such indeterminacy expands our concept of human life, showing us how we are transformed by encounter. Humans and fungi share such here-and-now transformations through encounter. Sometimes they encounter each other. As another seventeenth-century haiku put it: "Matsutake / Taken by someone else / Right in front of my nose."[5] What person? What mushroom?

The smell of matsutake transformed me in a physical way. The first time I cooked them, they ruined an otherwise lovely stir-fry. The smell was overwhelming. I couldn't eat it; I couldn't even pick out the other vegetables without encountering the smell. I threw the whole pan away and ate my rice plain. After that I was cautious, collecting but not eating. Finally, one day, I brought the whole load to a Japanese colleague, who was head over heels in delight. She had never seen so much matsutake in her life. Of course she prepared some for dinner. First, she showed me how she tore apart each mushroom, not touching it with a knife. The metal of the knife changes the flavor, she

said, and, besides, her mother told her that the spirit of the mushroom doesn't like it. Then she grilled the matsutake on a hot pan without oil. Oil changes the smell, she explained. Worse yet, butter, with its strong smell. Matsutake must be dry grilled or put into a soup; oil or butter ruins it. She served the grilled matsutake with a bit of lime juice. It was marvelous! The smell had begun to delight me.

Over the next few weeks, my senses changed. It was an amazing year for matsutake, and they were everywhere. Now, when I caught a whiff, I felt happy. I lived for several years in Borneo, where I had had a similar experience with durian, that marvelously stinky tropical fruit. The first time I was served durian I thought I would vomit. But it was a good year for durian, and the smell was everywhere. Before long I found myself thrilled by the smell; I couldn't remember what had sickened me. Similarly, matsutake: I could no longer remember what I had found so disturbing. Now it smelled like joy.

I'm not the only one who has that reaction. Koji Ueda runs a beautifully trim vegetable shop in Kyoto's traditional market. During the matsutake season, he explained, most people who come into the store don't want to buy (his matsutake are expensive); they want to smell. Just coming into the store makes people happy, he said. That's why he sells matsutake, he said: for the sheer pleasure it gives people.

Perhaps the happiness factor in smelling matsutake is what pressed Japanese odor engineers to manufacture an artificial matsutake smell. Now you can buy matsutake-flavored potato chips and matsutake-flavored instant miso soup. I've tried them, and I can sense a distant memory of matsutake at the edge of my tongue, but it's nothing like encountering a mushroom. Still, many Japanese have only known matsutake in this form, or as the frozen mushrooms used in matsutake rice or matsutake pizza. They wonder what the fuss is all about and feel indulgently critical toward those who go on and on about matsutake. Nothing can smell all that good.

Matsutake lovers in Japan know this scorn and cultivate a defensive exuberance about the mushroom. The smell of matsutake, they say, recalls times past that these young people never knew, much to their detriment. Matsutake, they say, smells like village life and a childhood visiting grandparents and chasing dragonflies. It recalls open pinewoods, now crowded out and dying. Many small memories come together in the smell. It brings to mind the paper dividers on village interior doors, one woman explained; her grandmother would change the papers every New Year and use them to wrap the next year's mushrooms. It was an easier time, before nature became degraded and poisonous.

Nostalgia can be put to good uses. Or so explained Makoto Ogawa, the elder statesman of matsutake science in Kyoto. When I met him, he had just retired. Worse yet, he had cleaned out his office and thrown away books and scientific articles. But he was a walking library of matsutake science and history. Retirement had made it easier for him to talk about his passions. His matsutake science, he explained, had always involved advocacy for both people and nature. He had dreamed that showing people how to nurture matsutake forests might revitalize connections between city and countryside—as urban people became interested in rural life, and villagers had a valuable product to sell. Meanwhile, even as matsutake research could be funded by

economic excitement, it had many benefits for basic science, especially in understanding relations among living things in changing ecologies. If nostalgia was a part of this project, so much the better. This was his nostalgia too. He took my research team to see what once was a thriving matsutake forest behind an old temple. Now the hill was alternately dark with planted conifers and choked with evergreen broadleaf trees, with only a few dying pines. We found no matsutake. Once, he recalled, that hillside was teeming with mushrooms. Like Proust's madeleines, matsutake are redolent with *temps perdu*.

Dr. Ogawa savors nostalgia with considerable irony and laughter. As we stood in the rain beside the matsutake-less temple forest, he explained the Korean origin of Japanese regard for matsutake. Before you hear the story, consider that there is no love lost between Japanese nationalists and Koreans. For Dr. Ogawa to remind us that Korean aristocrats started Japanese civilization works against the grain of Japanese desire. Besides, civilization, in his tale, is not all for the good. Long before they came to central Japan, Dr. Ogawa related, Koreans had cut down their forests to build temples and fuel iron forging. They had developed in their homeland the human-disturbed open pine forests in which matsutake grow long before such forests emerged in Japan. When Koreans expanded to Japan in the eighth century, they cut down forests. Pine forests sprung up from such deforestation, and with them matsutake. Koreans smelled the matsutake—and they thought of home. The first nostalgia: the first love of matsutake. It was in longing for Korea that Japan's new aristocracy first glorified the now famous autumn aroma, Dr. Ogawa told us. No wonder, too, that Japanese abroad are so obsessed with matsutake, he added. He ended with a funny story about a Japanese American matsutake hunter he met in Oregon who, in a badly garbled mixture of Japanese and English, saluted Dr. Ogawa's research, saying, "We Japanese are matsutake crazy!"

Dr. Ogawa's stories tickled me because they situated nostalgia, but they also drove home another point: matsutake grows only in deeply disturbed forests. Matsutake and red pine are partners in central Japan, and both grow only where people have caused significant deforestation. All over the world, indeed, matsutake are associated with the most disturbed kinds of forests: places where glaciers, volcanoes, sand dunes—or human actions—have done away with other trees and even organic soil. The pumice flats I walked in central Oregon are in some ways typical of the kind of land matsutake knows how to inhabit: land on which most plants and other fungi can find no hold. On such impoverished landscapes, the indeterminacies of encounter loom. What pioneer has found its way here, and how can it live? Even the hardiest of seedlings is unlikely to make it unless it finds a partner in an equally hardy fungus to draw nutrients from the rocky ground. (What leaf? What mushroom?) The indeterminacy of fungal growth matters too. Might it encounter the roots of a receptive tree? A change in substrate or potential nutrition? Through its indeterminate growth, the fungus learns the landscape.

There are humans to encounter as well. Will they inadvertently nurture the fungus while cutting firewood and gathering green manure? Or will they introduce hostile plantings, import exotic diseases, or pave the area for suburban development? Humans

matter on these landscapes. And humans (like fungi and trees) bring histories with them to meet the challenges of the encounter. These histories, both human and not human, are never robotic programs but rather condensations in the indeterminate here and now; the past we grasp, as philosopher Walter Benjamin puts it, is a memory "that flashes in a moment of danger."[6] We enact history, Benjamin writes, as "a tiger's leap into that which has gone before."[7] Science studies scholar Helen Verran offers another image: Among Australia's Yolngu people, she relates, the recollection of the ancestors' dreaming is condensed for present challenges in a rite at the climax of which a spear is thrown into the center of the storytellers' circle. The toss of the spear merges the past in the here and now.[8] Through smell, all of us know that spear's throw, that tiger's leap. The past we bring to encounters is condensed in smell. To smell childhood visits with one's grandparents condenses a great chunk of Japanese history, not just the vitality of village life in the mid-twentieth century, but the nineteenth-century deforestation that came before, denuding the landscape, and the urbanization and abandonment of the forests that later followed.

While some Japanese may smell nostalgia in the forests made by their disturbances, this is not, of course, the only feeling that people bring to such wild places. Consider the smell of matsutake again. It is time to tell you that most people of European origin can't stand the smell. A Norwegian gave the Eurasian species its first scientific name, *Tricholoma nauseosum*, the nauseating Trich. (In recent years, taxonomists made an exception to usual rules of precedence to rename the mushroom, acknowledging Japanese tastes, as *Tricholoma matsutake*.) Americans of European descent tend to be equally unimpressed by the smell of the Pacific Northwest's *Tricholoma magnivelare*. "Mold," "turpentine," "mud," white pickers said, when I asked them to characterize the smell. More than one moved our conversation to the foul smell of rotting fungi. Some were familiar with California mycologist David Arora's characterization of the smell as "a provocative compromise between 'red hots' and dirty socks."[9] Not exactly something you would want to eat. When Oregon's white pickers prepare the mushroom as food, they pickle it or smoke it. The processing masks the smell, making the mushroom anonymous.

It is not surprising, perhaps, that U.S. scientists have studied the smell of matsutake to see what it repels (slugs), but Japanese scientists have studied the smell to consider what it attracts (some flying insects).[10] Is it the "same" smell if people bring such different sensibilities to the encounter? Does that problem stretch to slugs and gnats as well as people? What if noses—as in my experience—change? What if the mushroom too can change through its encounters?

Matsutake in Oregon associate with many host trees. Oregon pickers can distinguish the host tree with which a particular matsutake has grown—partly from the size and shape, but partly from the smell. The subject came up one day when I examined some truly bad-smelling matsutake being offered for sale. The picker explained that he found these mushrooms under white fir, an unusual host tree for matsutake. Loggers, he said, call white fir "piss fir" because of the bad smell the wood emits when you cut it. The mushrooms smelled as bad as a wounded fir. To me, they did not smell like matsutake at

all. But wasn't this smell some piss fir-matsutake combination, made in the encounter?

There is an intriguing nature-culture knot in such indeterminacies. Different ways of smelling and different qualities of smell are wrapped up together. It seems impossible to describe the smell of matsutake without telling all the cultural-and-natural histories condensed together in it. Any attempt at definitive untangling—perhaps like artificial matsutake scent—is likely to lose the point: the indeterminate experience of encounter, with its tiger's leap into history. What else is smell?

The smell of matsutake wraps and tangles memory and history—and not just for humans. It assembles many ways of being in an affectladen knot that packs its own punch. Emerging from encounter, it shows us history-in-the-making. Smell it.


MUSHROOM
BUYER

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 **S**atsuka, "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. Hjorleifur Jonsson's book *Slow anthropology: Negotiating difference with the lu 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 **O**kamura Toshihisa, *Matsutake no bunkashi* [*The cultural history of matsutake*] (Tokyo: Yama to Keikokusha, 2005). Fusako **S**himura 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; **N**eda Hitoshi, *Kinoko hakubutsukan* [*Mushroom museum*] (Tokyo: Yasaka Shobô, 2003).

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

9. Haruo **S**hirane 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 **M**urata, Yuko **O**ta, Muneyoshi **Y**amaguchi, Akiyoshi **Y**amada, Shinichiro **K**atahata, Yuichiro **O**tsuka, Katsuhiko **B**abasaki, and Hitoshi **N**eda, "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?

1. For mushroom lovers: This was *Tricholoma focale*.

Chapter 1. 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 Claeyssens, "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/collideascape/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 lu-Mien refugee identity* (New York: Routledge, 1997).

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

10. William Smalley, Chia Koua **V**ang, and Gnia Yee **V**ang, *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 **L**ee, ed., *The impact of globalization and transnationalism on the Hmong* (St. Paul, MN: Center for Hmong Studies, 2006).

14. Personal communication, 2007.

15. Hjorleifur 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 **O**gawa 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=XNzVQ8wRCBo.

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., 11 (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. **K**yorai 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 magnivelare*," *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.