The Less Selfish Gene

Forest Altruism, Neoliberalism, and the Tree of Life

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Abstract Why have millions of readers and viewers become magnetized by the hitherto arcane field of plant communication? The article argues that the contemporary appeal of plant communication is rooted in a quest for alternative modes of being to neoliberalism, modes more accommodating of the coexistence of cooperation and competition in human and more-than-human communities. This ascendant understanding of plant communication and forest dynamics offers a counternarrative of flourishing, a model of what George Monbiot has called, in another context, "private sufficiency and public wealth."

Keywords plant communication, plant intelligence, altruism, neoliberalism, sociobiology, network theory, wood wide web

There are no individuals. There aren't even separate species. Everything in the forest is the forest.
—Richard Powers, *The Overstory*

All flourishing is mutual.
—Robin Wall Kimmerer (Potawatomi), *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants*

Why at this point in history have millions of readers and viewers become magnetized by the once arcane idea of plant communication? The past decade has given rise to a vast literature that interprets for popular audiences botanical research into forest sentience, forest suffering, and the capacity of plants to commune with one another. One possible explanation for this booming interest is the parlous state of Earth's forests, which are disappearing at an alarming rate. Between 2014 and 2018 the planet lost tree cover equivalent in size to Texas and California combined. Yet an awareness that forests are metaphorically suffering does not require a belief that forests are literally suffering, that is, have a capacity to feel pain. Nor does an awareness

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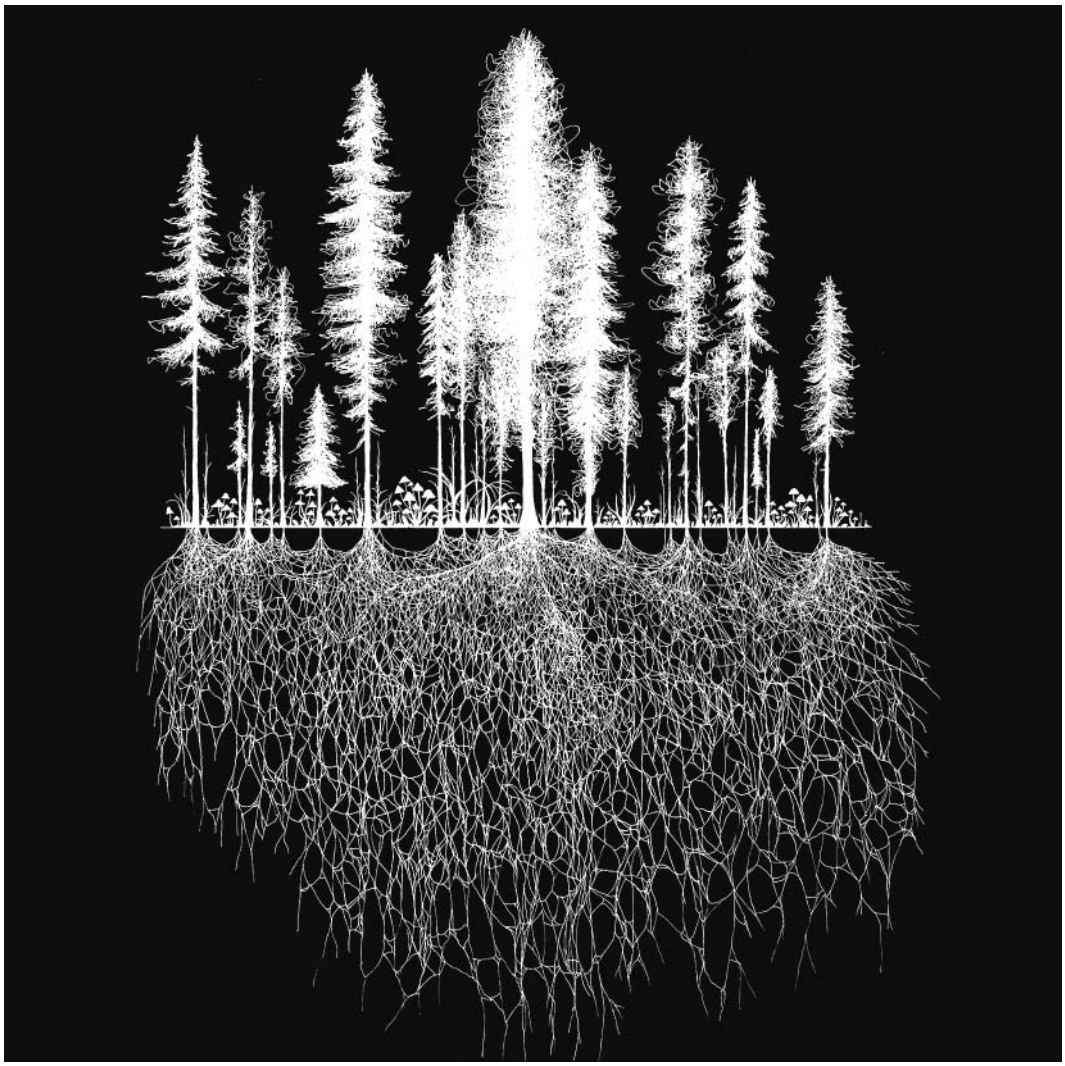

Forest, by Katie Holten. Ink on paper, 2019–20. This artwork was made in collaboration with the poet Forrest Gander and was originally commissioned for the trees issue of *Emergence Magazine*.

of forest decline require a belief that trees have the ability to convey distress to their arboreal neighbors.[1]

What if writers, film makers, readers, and viewers are turning en masse to the social forest for illumination and consolation? What if the forest seems to offer ways of reimagining the balance between self-interest and shared flourishing that in most human societies is badly out of whack? Could the current allure of forest science exemplify what Indigenous scientist Robin Wall Kimmerer describes as humans seeking guidance

1. See, for example, plant cell biologist Fratisek Baluska's insistence on botanical suffering: "If plants are conscious, then, yes, they should feel pain. If you don't feel pain, you ignore danger and you don't survive. Pain is adaptive." Quoted in Pollan, "The Intelligent Plant."

from other, older species?[2] For the contemporary science of plant communication reveals hidden botanical networks of what anthropologist Anna Tsing calls "collaborative survival."[3] But the question remains, why now? How precisely does the science of the suffering, healing, cooperative forest suggest alternative avenues of systemic possibility, there at the crossroads where human and more-than-human communities meet and mingle?

The Canadian ecologist Suzanne Simard emerges as a pivotal figure in all of this. Working in British Columbia Simard uncovered an intricate fungal network that enables trees to connect with other trees, plants, and fungi. This network allows the parties involved to trade nutrients, genetic materials, and other resources fundamental to survival. Simard's TED Talk, "How Trees Talk to Each Other," has been viewed 4.4 million times and has been translated into thirty-two languages. From the perspective of public science writing Simard's crucial coinage was the "wood wide web," which has since become a meme. That meme has proved essential for stimulating public interest in forest dynamics—more specifically in the vital work of what scientists call mycorrhizal networks (mykos = fungus; riza = roots). The filaments that constitute these networks are exquisitely fine; hundreds of miles of fungi may lie beneath a single footstep. Yet these networks play a critical role in maintaining the forest's collective health. By some estimates they link 90 percent of terrestrial plants.

The wood wide web's great corridors of being allow robust, older trees to steer sugars toward vulnerable saplings or stricken neighbors. Conversely, dying trees can send their residual resources back into the network to benefit healthy trees, fortifying the latter's chances of survival.[4] The underground webs help brace trees in a storm and enable them to share water and nutrients. One tree may transmit chemical and electrical signals through the mycorrhizal network to alert adjacent trees of impending threats.

Simard's research helped inspire Richard Powers's immensely popular sylvan novel, *The Overstory*, which won the 2019 Pulitzer Prize for fiction, was a number one New York Times best seller and a Man Booker Prize finalist.[5] A pivotal character in the novel, Dr. Pat Westerford, is a forest ecologist. Her prescient research in the 1970s demonstrates that insect-assailed maples send out biochemical signals to forewarn neighboring trees against the invaders. She concludes that "the biochemical behavior of individual trees

2. Kimmerer, *Braiding Sweetgrass*, 9.

3. Tsing argues that the pericapitalist circuits of the matsutake mushroom trade—a trade involving second-growth forests and informal human economies—can serve as an allegory of "collaborative survival." Tsing, *The Mushroom at the End of the World*, 4.

4. See Macfarlane, *Underland*, 87–116, for an eloquent account of these processes.

5. *The Overstory* was also chosen as a best book of the year by the *Washington Post*, *Newsweek*, *Chicago Tribune*, *Kirkus Reviews*, *Time*, and *Oprah Magazine*. Powers dramatizes the belated success of Patricia Westerford's book on forest cooperation to good effect. Indeed, we may read Powers's book within a book—his foray into mise en abyme—as a sly wager that his own book about tree communication would become, like that written by his character, an international triumph and a number one national best seller.

may make sense only when we see them as members of a community."[6] The male forestry establishment ridicules her findings, derailing her career. But decades later the new science of the communicative forest vindicates Dr. Westerford's research. Professionally revived she writes a national best seller about the capacity of trees to defend one another biochemically and to share resources. Her nonfictional book about plant communication—embedded in Powers' fiction on the same subject—is called *The Secret Forest*.

Simard's findings on the wood wide web also feature prominently in Robert Macfarlane's public science best seller, *Underland*.[7] Her research, moreover, helped inspire the smash hit, *The Hidden Life of Trees: What They Feel, How They Communicate—Discoveries from a Secret World* by German forester Peter Wohlleben. *The Hidden Life of Trees* has been translated into twenty languages. We see the imprint of Simard's work—sometimes acknowledged, sometimes not—in a succession of influential titles: Colin Tudge's *The Secret Life of Trees*, David Haskell's *The Songs of Trees: Stories from Nature's Great Connectors*, and Eduardo Kohn's *How Forests Think,* one of the past decade's social science sensations.[8] At a certain point the tumbling titles start to blur: *The Secret Network of Nature*; *The Secret Life of Plants*; *What a Plant Knows*; *Thus Spoke the Plant*; *The Language of Plants*; *Brilliant Green: The Surprising History and Science of Plant Intelligence; Can You Hear the Trees Talking? Discovering the Hidden Life of the Forest*.[9]

Neoliberalism and the Allegorical Forest

In 1987 Margaret Thatcher famously declared: "there is no such thing as society. There are individual men and women and there are families."[10] Less than a year later James Hansen, director of NASA's Goddard Institute, delivered a historic address calling for collective action to avert climate change.[11] Hansen testified at US congressional hearings that climate science was 99 percent unequivocal: the world was warming. We needed to act collaboratively to reduce emissions. But Hansen's call to humanity to tackle the climate crisis with collective resolve collided with the political ascendancy

6. Powers, *The Overstory*, 126.

7. Macfarlane is just one of many influential public science writers to have been entranced by the dynamics of plant communication and tree sentience. Other notable public science writers who have taken up the issue include Robin Wall Kimmerer, Elizabeth Kolbert, David Quammen, Michael Pollan, and Anna Tsing.

8. Tudge, *The Secret Life of Trees*; Haskell, *The Songs of Trees*; Kohn, *How Forests Think*.

9. Wohlleben, *The Secret Network of Nature*; Tompkins and Bird, *The Secret Life of Plants*; Chamovitz, *What a Plant Knows*; Gagliano and Simard, *Thus Spoke the Plant*; Gagliano, Ryan, and Vieira, *The Language of Plants*; Mancuso and Viola, *Brilliant Green*; Wohlleben, *Can You Hear the Trees Talking?* For another eloquent engagement with plant communication, see Ferris Jabr, "The Social Life of Forests."

10. Margaret Thatcher, "No Such Thing as Society." In what feels like a conscious inversion of Thatcher's pronouncement, a character in *The Overstory* declares: "There are no individuals. There aren't even species. Everything in the forest is the forest." Powers, *The Overstory,* 173.

11. Klein, *This Changes Everything*, 87.

of neoliberalism, an ideology hostile to the very idea of society.[12] Neoliberals promoted a culture of hyperindividualism and hyperconsumption that conflated freedom with atomized consumer choice. Government was vilified as freedom's adversary and the idea of the public good receded in favor of individual consumer goods. The net result: a clash between a scaled-up climate crisis that demanded urgent, collaborative action and a scaled-down commitment to the social collective.

Thatcher, Ronald Reagan, and many right-wing think tanks represented the individual as the sacrosanct, foundational unit of existence. Why fund social services if society itself is a phantasm? For Reagan "the nine most terrifying words in the English language are: I'm from the government and I'm here to help."[13] The spirit of Reagan's remark has continued to spread: witness leaders, from Trump to Bolsonaro and Duterte, who appoint lackeys to oversee the dismantling of the very governmental institutions they've been chosen to lead.[14]

In society after society rulers have embraced a scaled-back democracy that cultivates exclusion, widening the circles of disenfranchisement. Autocracy and plutocracy blend and fuse. People find themselves both globalized and atomized, abandoned to conditions of compounded vulnerability. Many of those abandoned crave an alternative to government by the few for the few, an alternative to mega-mergers for the wealthy and community fracture for the rest. The successful have effectively seceded, leaving in their wake disguised democracies that are shadows of what democracy should be. Brazil, Hungary, Indonesia, the Philippines, South Africa, Russia, Turkey, the United Kingdom, the United States, and many more are all countries where to varying degrees the divide between democratic and plutocratic rule has become diaphanously thin. Leaders declare war on participatory democracy, slash voter rolls, hack elections, intimidate voters, and stoke moral panics on social media. The powerful harass, imprison, torture, and even murder nonviolent protestors, journalists, and classes of humanity deemed expendable. Meanwhile, surveillance capitalism herds people into siloed online "communities," where they become complicit in their own policing. Long after neoliberalism's Reagan-Thatcher years, we are witnessing the rise of a surveillance capitalism that, by harnessing the powers of algorithms, redefines the meaning of both privacy and community.

Quinn Slobadian observes that from the outset the neoliberal project has perceived democracy as a threat to be contained. Crucially, during the decolonizing world

12. For another insightful account of the mismatch between a hegemonic individualism and the collective need to act to address the climate emergency, see Ghosh, *The Great Derangement*, 81.

13. Reagan, "The President's News Conference," August 12, 1986.

14. To head the EPA, under Trump, for example, meant to shrink the staff, sack career scientists, and wield a wrecking ball to the institution's scientific values and pools of expertise. Of course, neoliberals' declared public hostility to government was something of a sleight of hand. For neoliberals have actively sought to strengthen government legislation that inhibits or even outlaws democratic constraints on extreme capitalist accumulation.

of the 1970s, neoliberals sought to fortify transnational institutions that would curtail sovereignty among emerging nations. A model of what Jan-Werner Müller dubbed "constrained democracy" took hold.[15] Offshore outposts, cross-border manufacturing zones, structural adjustment and related measures were prioritized. The goal? To safeguard capital against democratic clamors for social and environmental justice, egalitarian redistribution, progressive taxation, collective bargaining, public ownership, affordable housing, fair competition, and the safeguarding of the commons. To suppress such appeals, the "prophets of the small state" strove to inhibit democracy through varieties of supranational governance.[16] In the United States, as Nancy MacLean has dramatically documented, James M. Buchanan—an economist from the Jim Crow South who won the 1986 Nobel Prize for Economics—became a powerful neoliberal influence. Many of Buchanan's strategies for shrinking access to democracy in the face of changing US demographics persist in the Republican Party of today. Once Charles Koch discovered Buchanan's ideas, he compounded the latter's influence by bankrolling think tanks and politicians that embraced his passion for union busting, minority disenfranchisement, the gutting of social programs, deregulation, and the privatization of social security.[17]

Today fearful multitudes abandoned to market "efficiencies" have swung right and left. Some seek redemption in so-called strongmen. Others pursue a politics that acknowledges government obligations to protect the most vulnerable among us from climate breakdown, pandemics, homelessness, and preventable destitution. In this context the allure of the cooperative forest makes increasing sense: the forest serves as biological precedent and loose allegory for a shared survival from which the self cannot be disentangled.[18]

If a tension emerged between Hansen's call for collective climate action and the neoliberal hostility to collectives in general, a similar tension arose in the domain of environmental time. A crisis that demanded collaboration for long-term human flourishing was ill-fitted to the accelerated pursuit of immediate wealth by mega-corporations answerable primarily to the quarterly report. The largest of those corporations became more mobile, wealthier, and more powerful than most of the societies—particularly decolonizing societies—in which they operated. All this has had profound implications for environmental justice during the so-called Great Acceleration, as the crisis of environmental futurity has become inextricable from the neoliberal crisis of soaring inequality.[19]

15. Müller, *Contesting Democracy*, 5.

16. Slobadian, *Globalists,* 92.

17. In 1948 Buchanan received his PhD in economics from the University of Chicago, where Hayek and Friedman taught and held sway.

18. While it is beyond the scope of this article, one notes a deeper history to efforts to link biological theories of mutualism to radical politics, not least in the work of Peter Kropotkin. Kropotkin's writings assumed a particular resonance in the United States and much of Europe during the Gilded Age, another period of acute inequality. See especially *Mutual Aid: A Factor of Evolution*.

19. See Steffen, Crutzen, and McNeill, "The Anthropocene"; Nixon, "The Anthropocene."

After the 2007–2008 global financial crash the appeal to forest life as allegory and analog took a particularly urgent turn. The crash intensified challenges to neoliberal economic orthodoxy; even politicians who had ignored the inequality crisis could do so no longer. The 1 percent became a meme. How could an economic ideology that branded itself as rational have delivered such dangerously inequitable growth? After the crash billions who felt they had achieved a toehold of security saw their prospects disintegrate. Given neoliberalism's hostility to safety nets, if you slipped you did not fall, you plummeted. The COVID-19 pandemic reprised that experience of ordinary people discovering that daily life had given way to new levels of vulnerability and structural abandonment.

In the decade following the financial crash we have seen a pronounced preoccupation with this question: How do we remedy growth so unequal that it is socially destabilizing and ecologically ruinous? Populist uprisings protesting inequality and climate change have grown in frequency and intensity. Since the crash we have seen heightened efforts to rethink relations between self-interest and shared flourishing. It is surely no coincidence that during this period we have witnessed a public outpouring of writing about the collaborative dimensions to forest life. For the science of the wood wide web speaks to a widespread yearning for systemic changes that reduce social abandonment and allow more people to achieve a dignity of being. The forest networks that Simard's research illuminate can thus be read as a counter to what anthropologist Julie Livingston calls the economics of "self-devouring growth?"[20]

The Market and the Forest: A Clash of Minds?

Friedrich Hayek, Austrian economist and foundational figure in neoliberal thought, argued that the "mind" of the market made competition the principal doctrine for organizing human life.[21] Lawrence Summers, former Chief Economist of the World Bank, has extolled Hayek's idea of the price system as a mind, calling it "the most penetrating and original idea microeconomics produced in the 20th century." The idea of the market-mind, Summers argues, is "the single most important thing to learn from an economics course today."[22] For Hayek and his followers no human mind could approximate the omniscient authority of the market's price system.[23]

20. Livingston, *Self-Devouring Growth*. The early roots of neoliberalism in Europe before World War II and the many fissures within neoliberal thought are beyond the scope of this article. For a more detailed analysis, see especially Slobodian, *Globalists*; Steger and Roy, *Neoliberalism*; and Harvey, *A Brief History of Neoliberalism*.

21. Hayek did the groundwork of articulating a set of neoliberal practices, although the term "neoliberalism" itself was coined much later.

22. Quoted by Metcalf, "Neoliberalism."

23. The American journalist Walter Lippmann, a fan of Hayek's ideas, contrasted the all-knowing mind of the market with the partial truths available to mere humans: "No human mind has ever understood the whole scheme of a society. . . . At best a mind can understand its own version of the scheme, something much thinner, which bears to reality some such relation as a silhouette to a man." Quoted in Metcalf, "Neoliberalism."

But from the perspective of the disenfranchised, what happens when the mind of the market goes mental? When the dictates of that mind make no rational sense? Where can people find more inclusive, cooperative ways of being to counter the primacy of winner-takes-all competition? If Hayek's disciples conflate the entire human value system with market-driven price—if price becomes a synonym for worth—what place is there for values such as compassion and empathy, justice and equity? As pyschoanalyst Sally Weintrobe observes, neoliberal economics has mounted a sustained assault on the ethos and structures of care, thereby undermining our institutional and mental readiness to mitigate global threats from climate breakdown to COVID.[24]

Some scientific proponents of vegetative intelligence maintain that the forest has a mind of its own. But as blueprints for being, the market and the forest—both projected as metaphorical megaminds—offer radically divergent pathways. Plant physiologist Stefano Mancuso believes that our brain-fixated assumptions about what constitutes intelligence are biased against the kinds of cognition, learning, pain perception, and communication that plants exhibit. Biological intelligence, he maintains, is "simply the ability to solve problems."[25] And such problem solving is typically not conducted in isolation.

Mancuso's research suggests that a plant may boast a repertoire or "vocabulary" of as many as 3,000 chemical signals vital to its interactive powers. Like Simard, Mancuso argues for a distributed vegetative intelligence—that an interconnected forest possesses a vast networked brain surrogate without a brain.[26] But even that phrasing feels tendentious. For the point is not to insist that plants are brainier than we thought, but that human intelligence and plant intelligence are essentially incomparable. The Society for Plant Neurobiology, which Mancuso cofounded, was later renamed the Society for Plant Signaling and Behavior. That renaming was a prudent attempt to ward off misreadings of the group's research. For they were not claiming that human and vegetative varieties of intelligence are homologous. They have been careful to speak of "plant-specific pain perception" rather than arguing that plants display feelings, semiotic powers, and a braininess that make them more human than we thought. A forest can be both brainless and super smart. In this way Mancuso and his allies seek to sidestep the charge of sentimental anthropomorphism.[27]

24. Weintrobe, *Psychological Roots of the Climate Crisis*, 33.

25. Mancuso, *The Revolutionary Genius of Plants*, 27.

26. See Mancuso, *The Revolutionary Genius of Plants,* 77: "The entire root system guides the plant like a sort of collective brain or, better still, a distributed intelligence on a surface that can be huge."

27. Wohlleben has been hailed and ridiculed for anthropomorphizing trees. "Though duly impressed with Mr. Wohlleben's ability to capture the public's attention, some German biologists have questioned his use of words, like 'talk' rather than the more standard 'communicate,' to describe what goes on between trees in the forest. But this, says Mr. Wohlleben, as he invites readers to imagine what a tree might feel when its bark tears ('Ouch!'), is exactly the point. 'I use a very human language,' he explained. 'Scientific language removes all the emotion, and people don't understand it anymore. When I say, "Trees suckle their children," everyone knows immediately what I mean'" (McGrane, "German Forest Ranger Finds That Trees Have Social Networks, Too").

Humans, in much Western thought, are elevated above and segregated from other species, while plants are exiled to evolution's lower rungs. Plants in this view are dumb: mute, incapable of intelligence, and burdened by a primitive immobility. Plants have failed to develop specialist organs—heart, brain, liver, kidneys. However, while plants may be incapable of fleeing they can survive levels of predation that would obliterate a human.[28] Because a tree has no unique, irreplaceable organs it has more leeway for self-regeneration—sometimes even if insects have consumed 90 percent of it. By contrast, a human whose brain or heart gets eaten will cease to exist, even if the bulk of that person's body suffers no predation. In their decentralized morphologies, plants, compared to humans, possess a very different, more diffuse evolutionary intelligence.

Plants have evolved sophisticated forms of chemical signaling to compensate for their stationary vulnerabilities. Chemical shielding may render them repellant to herbivores. Some plants, moreover, have developed chemical vocabularies that warn neighbors of incoming threats. When a giraffe starts devouring an acacia, the tree will send signals through its root system to warn adjacent acacias of the assault.[29] Forewarned, they can emit chemicals unpalatable to the giraffe, driving it elsewhere. This kind of neighborhood watch is energy efficient, saving the group from squandering precious chemical resources at times when no threat is present. Plants thus flex their chemical repertoires to communicate with both foe and friend.

Trees are social beings that may exhibit nurturing behavior toward not only offspring but also neighbors—even, at times, neighbors belonging to different species. We are only beginning to comprehend the complexity of the sharing dimensions to forest dynamics. Why, for example, do some trees continue to nourish the ancient stumps of neighbors, felled centuries ago, by feeding them a sugar solution through their roots?

Hayek saw the omniscient mind of the market as driving competition forward. Much of the new writing about forest networks deploys a similar idiom, while pointing in the opposite political direction. Wohlleben portrays the forest as a superorganism that constitutes a kind of mind. Simard speaks of a collective "forest wisdom," a distributed intelligence that operates as if the constitutive plants were "a single organism."[30] Neoliberal economics and cooperative biology thus converge on the same systemic metaphor. But as blueprints for being the two great allegories of mind chart very different paths.

Self-Interested Altruism and Networks of Survival

At the heart of Simard's revelatory research stands a paradox, what we might call self-interested altruism. This particular variety of altruism transcends species lines. Simard

28. Some plant communities can migrate in response to threats such as a shifting aridity line or climate change. However, compared to mammals, birds, reptiles, and insects, plants are only capable of relocating themselves very, very slowly.

29. Mortenson, 5.

30. Wohlleben, *The Secret Network of Nature*, 3; Simard, "How Trees Talk to Each Other." Pollan recounts how when researchers placed four varieties of sea-rockets in a single pot, "the plants restrained their usual competitive behaviors and shared resources" (Pollan, "The Intelligent Plant").

observed how Canadian foresters culled "junk" paper birch from a mixed forest to create growing room for commercially prized Douglas fir. But granted extra living room, many of the firs, counterintuitively, spiraled into decline. Severed from their interspecies networks they became isolated and undernourished. The birch and firs, Simard discovered, existed in a complex state of blended cooperation and competition. Below ground the trees were "conversing not only in the language of carbon but also in the language of nitrogen, phosphorus, water, defense signals, hormones, and allele chemicals."[31] That trees and fungi communicated across species lines—indeed, across whole kingdoms of life—proved a crucial observation, for it precluded kin selection as an evolutionary rationale for such cooperative behavior.

The wood wide web exemplifies that subset of symbiosis called mutualism. With parasitism the benefits are skewed toward one party; with mutualism both parties gain from their association, the fungi as well as the trees. Fungi are incapable of photosynthesis yet need sugars to survive. In the well-lit canopy trees turn sunlight and carbon dioxide into sugars, some of which reach the fungi through their networked relationship with the arboreal root system.

Wohlleben celebrates how fungal filaments "network an entire forest." Kohn portrays rainforests as "vast networks of relations among beings both visible and invisible," beings that include trees and fungi.[32] Simard speaks of trees benefiting from "social networks" that enhance their resilience. A BBC article, "How Plants Talk to Each Other Using an Internet of Fungus," portrays the wood wide web as an "information superhighway."[33] Fungus specialist Paul Stamets dubs the mycorrhizal networks "Earth's natural internet."[34] And mycologist Merlin Sheldrake, in his brilliant, exuberant book *Entangled Life*, notes how network metaphors bridge biology and technology.[35]

In all this we can recognize an ancillary reason for the contemporary fascination with plant-to-plant communication, namely, the simultaneous surging interest in the wood wide web and network theory. As a trope, the wood wide web speaks to our current obsession with clustered communication—social media, crowd sourcing, swarm behavior, and the hive mind. Moreover, many contemporary social movements—from Black Lives

31. Simard, "How Trees Talk to Each Other." Given that 1 percent of global energy use goes toward manufacturing synthetic nitrogen, better understanding the collaborative dynamics between bacteria and crops is vital for the future of agricultural productivity. For suggestive research into the pathways of nitrogen fluxes, see Van Deynze et al., "Nitrogen Fixation in a Landrace of Maize"; Yan et al., "Rethinking Sources of Nitrogen to Cereal Crops."

32. Kohn, "Forest for the Trees."

33. Fleming, "Plants Talk to Each Other Using an Internet of Fungus."

34. Stamets, *Mycelium Running*, 35. Mancuso also likens the wood wide web to the internet. Mancuso, *The Revolutionary Genius of Plants*, 81. He depicts the wood wide web as a loose approximation of the human nervous system. See also Thomas Packenham's portrait of the wood wide web as an "arboreal Internet" (Pakenham, "What the Trees Say"). Wohlleben argues similarly that "for a tree it's a disaster when the social network collapses" (Dordel and Tölke, *Intelligent Trees*, 35:10).

35. Sheldrake, Merlin. *Entangled Life: How Fungi Make Our Worlds, Change Our Minds and Shape Our Futures*. New York: Random House, 2020.

Matter, MeToo, and Idle No More to Extinction Rebellion, Occupy, to Hong Kong's Umbrella Movement, to name just a few—are largely internet driven. Crucially, they favor modular networks over organizational structures that depend on vertical hierarchies and top-down leadership. Through all this the wood wide web acquires a very contemporary resonance. On biological, cultural, and political fronts, we are only beginning to comprehend the intricate dynamics between networked competition, altruistic self-interest, and collective resilience, all of which are enabled by permeable corridors of being.

Biological Thatcherism and the Porous Self

The survival of the fittest is not a zero-sum game.[36] Competition—within and among species—is far more complex than often presupposed. As we have seen, one marker of forest intelligence is the capacity of fungi, trees, and other vegetation to temper competitive behavior. By redistributing resources trees and mycorrhizal networks can enhance the collective environment that encourages biota to flourish. This raises a profound ontological question: If we envisage the forest as a superorganism, where does the individual tree end and the tangled web of non-tree life begin?

The answer most congruent with neoliberalism is to deny such connectivity. Indeed, many long-standing conservative traditions view the individual as a unit of being defined almost entirely by competitive self-interest.[37] But as feminists like Anne McClintock have pointed out, individualism as an Enlightenment ideal was never intended to be universal, but gave hierarchical precedence to men from the middle and upper classes who were white, heterosexual, literate, and propertied.[38] Yes, social activism has enabled the once marginalized to claim some of the economic and political benefits that individualism bestows. But even in democracies the legacy of unequal access to individualism persists.

By the 1970s neoliberal ideologues of competitive self-interest had found a new ally. They turned to sociobiology to reinforce their ranks.[39] Eminent sociobiologists were arguing that the self's ruthless drive to compete is hardwired and irrefutable.[40] Small

36. Many neoliberals have embraced a deterministic and distorting neoDarwinism, shrinking Darwin's complex theories to the "survival of the fittest." There is of course a long, fraught history of bigots, fascists, and colonialists appealing to such competitive "fitness" to vindicate policies that range from genocide to quotidian discriminations. The result, in Kennedy Warne's phrase, has been "an epistemological reign of terror for those judged "unfit"' (personal communication, November 27, 2020).

37. George C. Williams's classic of evolutionary thought, *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought*, was particularly influential in dismissing notions of group selection and evolutionary progress. His book laid the foundations for subsequent critiques of neoDarwinism's rapprochement with neoliberalism.

38. McClintock, *Imperial Leather*, 45

39. For a prescient critique of sociobiology, see Ross, *Strange Weather*.

40. Some earlier twentieth-century thinkers of course had advanced the neoDarwinian idea that humans are hardwired to compete. What was new in the 1970s about this argument was the surge in sociobiology's intellectual prominence and neoliberalism's shift, in the United States and the United Kingdom, from the halls of academe into the corridors of political power.

wonder that free market fundamentalists started invoking sociobiology in an effort to naturalize an economic model premised on selfishness. If unfettered capitalism has a genetic rationale—if it is the economic system most compatible with the dictates of our deep time DNA—that weakens the case for any system that seeks to offset or temper the self's acquisitive drive.

We can track the powerful tag team of neoliberalism and sociobiology back to the cusp of neoliberalism's ascent within Anglo-American politics, from where it spread to other societies and global institutions. The mid-seventies saw the publication, in quick succession, of two sociobiology blockbusters: E. O. Wilson's *Sociobiology: The New Synthesis* (1975) and Richard Dawkins's *The Selfish Gene* (1976).[41] During this period the most influential neoliberal theorists, Hayek and Milton Friedman, were awarded the Nobel Prize for economics, in 1974 and 1976 respectively. The year 1974 also saw the creation of the influential Centre for Policy Studies—Thatcher and Sir Keith Joseph, a zealous convert to Hayek and Friedman's ideas, were cofounders.[42] The establishment of the anti-Keynesian think tank and lobbying group, the Adam Smith Institute, followed in 1976. All these developments helped shape the cultural milieu that contributed to Thatcher's rise to power in 1979 and Reagan's in 1980.[43]

The contest over the meaning of freedom became critical in all of this. For Karl Polanyi a core problem of neoliberalism was that "the freedom that regulation creates is denounced as unfreedom; the justice, liberty, and welfare it offers are decried as a camouflage of slavery." The notion of freedom thereby "degenerates into a mere advocacy of free enterprise."[44] George Monbiot puts the matter bluntly: "Complete freedom for billionaires means poverty, insecurity, pollution and collapsing public services for everyone else. . . . The choice we face is between unfettered capitalism and democracy. You cannot

41. Wilson, *Sociobiology*; Dawkins, *The Selfish Gene*.

42. In 1981 Thatcher appointed Joseph as her Secretary of State for Education and Science. Joseph was open about dividing people into the genetically fit and the genetically unfit. The latter should be discouraged from breeding. He declared that "a high and rising proportion of children are being born to mothers least fitted to bring children into the world. . . . Some are of low intelligence, most of low educational attainment. They are unlikely to be able to give children the stable emotional background, the consistent combination of love and firmness. . . . They are producing problem children. . . . The balance of our human stock, is threatened" ("Speech at the Grand Hotel, Birmingham," October 19, 1974).

43. In terms of transforming neoliberalism from a marginal ideology to a set of governmental practices the overthrow of the democratically elected president of Chile, Salvador Allende, in 1973 was a crucial precursor. Milton Friedman advocated energetically for Allende's overthrow in the name of market freedoms. Chile was also very much on Hayek's mind as he weighed the dangers of unchecked democracy. Of the Chilean coup he observed: "a dictatorship may be a necessary system for a transitional period. Personally, I prefer a liberal dictatorship to democratic government devoid of liberalism." Neoliberal politicians in the United Kingdom and the United States faced a very different set of challenges, given that military overthrow of the state was not an option. Thatcher and Reagan had to find ways to limit democracy rather than abolishing it (Caldwell and Montes, "Friedrich Hayek and His Visits to Chile," 298).

44. Polanyi, *The Great Transformation*, 258.

have both."[45] Once competition was enshrined as the primary human virtue and the overriding human instinct, neoliberal politicians sought to immunize the market against democratic threats. In this view freedom could best be achieved by adhering to the omniscient wisdom of the free market, which has to be shielded from the dissident forces of participatory democracy.

As far back as the 1980s the feminist philosopher Mary Midgley questioned the reactionary alliance between sociobiology and neoliberalism. Midgley found sociobiology's naturalizing of extreme capitalism deeply suspect. She dismissed Dawkins's views on evolution as politically motivated: "The ideology Dawkins is selling is the worship of competition. It is projecting a Thatcherite take on economics onto evolution. It's not an impartial scientific view; it's a political drama."[46] Indeed, she saw the entire field of sociobiology as corrupted by a kind of "biological Thatcherism."[47]

What if the economic law of the market and the evolutionary law of the selfish gene were both suspect? Midgley challenged the alliance between neoliberal economists and sociobiologists for whom an innate selfishness dictates the conditions of human survival.[48] She questioned selfishness as a catchall term for the underlying biological-cum-economic principle of life:

> *Selfish* is an odd word because its meaning is almost entirely negative. It does *not* mean "prudent, promoting one's own interest." It means "not promoting other people's" or, as the dictionary puts it, "devoted to or concerned with one's own advantage *to the exclusion of regard for others*." . . . Just as there would be no word for white if everything was white, there could surely be no word for selfish if everyone was always.[49]

Thus, a tendentious scientific metaphor accrued a political logic that helped shape the agendas of global economic institutions.

Midgley was not alone in questioning the theory of the selfish gene. Evolutionary biologist David Sloan Wilson was another prominent skeptic. Contra Dawkins, Wilson and Elliot Sober argued that "the strong form of individual selection itself is a metaphor that creates a misleading picture of nature as inherently exploitative and competitive."[50] Wilson contended that the "'unselfish' relationship between genes in individuals can legitimately be extended to individuals in groups and species in communities."[51] In this context Wilson revived the idea of the superorganism as a unit of evolutionary change.

45. Monbiot, "How Do We Get out of This Mess?"

46. Midgley, "Against the Grain."

47. Midgley, "Against the Grain."

48. In a single year, 2019, the world's billionaires became, on average, 25 percent wealthier. Graeme and Kollewe, "Davos 2020."

49. Midgley, "Hobbes's *Leviathan*, Part 3"; *The Solitary Self: Darwin and the Selfish Gene*.

50. Wilson and Sober, "Reviving the Superorganism," 338.

51. Wilson and Sober, "Reviving the Superorganism," 353.

While he did not write expressly about interdependent forest networks, he did illuminate ways in which natural selection can operate at the level of the superorganism, as in the case of eusocial insects like ants and bees. Human communities possess, for Wilson, cooperative features associated with a superorganism, rather than being reducible to the sum total of individualized, dog-eat-dog struggles to survive.

Dawkins would later regret that he had not called the "selfish gene" the "immortal gene" or, even more radically, the "cooperative gene." But by then it was too late—his metaphor had bolted from the barn.[52] By then neoliberalism was twinned with a neo-Darwinism that misconstrued Darwin.[53] Together this ideological tag team advanced the notion that the atomistic individual has evolved to exist in a state of relentless competition. Yet much of the science of selfhood has been pulling in the opposite direction. Charles Otis Whitman has insisted on our "composite individuality."[54] And as early as the 1970s Lewis Thomas was arguing that "a good case can be made for our nonexistence as entities . . . we are shared, rented, occupied. My cells are ecosystems more complex than Jamaica Bay."[55]

This countervailing science of selfhood emphasizes permeability, offering alternative pathways to notions of the self that are incompatible with the dominant strains of neoliberal thought.[56] Neoliberals sought to recast *Homo sapiens* as *Homo economicus*, arguing that society is reducible to the economy.[57] But *Homo sapiens* is also *Homo microbius*—and sapiens would be unwise to forget that. The Human Microbiome Project has determined that, at a cellular level, any given person is only between 1 and 10 percent human.[58] In this view, the self is a shape-shifting convocation, a gathering place of life forms, some benign, some hostile. The colon—the body's so-called "second brain"—depends on a jostling microbial crowd without which it would cease to function. Amid the ever-changing arrangement of microorganisms and fungi that help constitute the self, the individual emerges as incorrigibly plural.

52. Garrett Hardin, likewise, would come to regret that instead of "The Tragedy of the Commons" he had not called his formative essay "The Tragedy of the Unmanaged Commons." But as with Dawkins, Hardin's regrets came too late for him to control the metaphor he had released into the world. Hardin, like Dawkins, was embraced by influential neoliberal thinkers, not least for Malthusian tendency to view the "unfit" poor as disposable.

53. Darwin incorporated elements of cooperation into his evolutionary theory, although he did express fears at times that the prevalence of cooperation might call his theory into question.

54. Whitman, "Specialization and Organization," quoted in Maasen, Mendelsohn, and Weingart, *Biology as Society, Society as Biology*. For another prescient account of the relations between composite identity and the politics of individuality, see Mitman, "Defining the Organism in the Welfare State."

55. Thomas, *Lives of a Cell*.

56. I am grateful to Adriana Petryna for emphasizing this particular formulation.

57. This view was more typical of Hayek than of Friedman, who did allow for some forms of social life that were not reducible to economic determinations.

58. As Jamie Lorimer observes, the large variation between 1 and 10 percent depends on whether one assesses the essentially human element of the self by cellular or genetic measurements (Lorimer, "Gut Buddies").

The science of dispersed selfhood meshes with the notion of the wood wide web as a collaborative entity. But it also meshes with other biological instances of distributed sentience and cooperation that have recently garnered great public interest. We have seen, for example, a surging fascination with cephalopods.[59] Two thirds of an octopus's neurons reside in the arms and body. The octopus's neural self is thus centrifugal, allowing limbs to operate semiautonomously through a kind of networked consciousness, independent of directives from a centralized brain.

We are likewise witnessing a lively interest in coral bleaching as an allegory for humanity's failure to appreciate the delicate, cooperative dynamics that animate life on Earth.[60] The great coral ramparts depend on an elaborate alliance between invertebrate animals and algae. Tiny, tentacled coral polyps host algae that possess an indispensable power, photosynthesis, that the coral lacks. The algae feed the polyps, freeing them to secrete calcium carbonate that, as new coral replaces old, builds limestone deposits. The coral, in turn, provides the algae with carbon dioxide, completing the symbiosis. To survive a living reef must incessantly rebuild in this collaborative manner to counter the corrosive effects of pummeling waves, predatory fish, and boring worms. But our failure to contain CO_2 emissions is now stressing the animal-algae partnership. More acidic and warmer waters prompt the coral host to evict its algae tenants, to the detriment of both parties. The result: an underwater mortuary of bleached reefs that serves as a ready allegory of sundered symbiosis.

In short, it is a biological and ontological error to construe the individual and the collective as polar opposites. For the self is always already symbiotic, social, collectivized. To return to the idiom of forests, the tree is not an aloof tower of competitive self-sufficiency. A tree is interdependent, a permeable life form that persists through deep entanglements. In the words of professor of Global Ecology and Symbiosis Douglas Zook, "plants were never really plants—they were plant-fungal consortia."[61] Contra the pronouncements of the biological Thatcherites, some of those entanglements surface as self-interested altruism. Others, as we will see, manifest at an even deeper, genetic level.

59. Prominent examples of the recent fascination with cephalopod intelligence include Pippa Ehrlich and James Reed's award-winning documentary, *My Octopus Teacher*; Brenda Shaughnessy's prize-winning poetry collection, *The Octopus Museum*; and several best-selling public science books, most notably Peter Godfrey-Smith's *Other Minds: The Octopus, the Sea, and the Deep Origins of Consciousness*; Sy Montgomery's *The Soul of an Octopus*; and *Octopus: The Ocean's Intelligent Invertebrate* by Jennifer A. Mather et al.

60. Jason deCaires Taylor's much-celebrated seafloor statues are particularly striking, as he recruits the coral as collaborators in the creation of his art. On the one hand his statues anticipate the drowned worlds to come. On the other his statues also have a pragmatic dimension, serving as artificial reefs that are colonized and cocreated by the coral itself. His work thus underscores both human impacts and coral agency, bringing to life novel ecosystems that depend for their existence on a creative alliance between humans and invertebrates. For other explorations of blighted reefs as allegories of ruptured symbiosis, see Kolbert, *The Sixth Extinction*; Orlowski, *Chasing Coral*; McCalman, *The Reef*.

61. Quoted in Feldman, *Symbiotic Earth*, 1:25.05.

Troubling the Tree of Life

Scientific metaphors may open new avenues of research, but they may also impede iconoclastic thought.[62] Figurative language can harden into unexamined doctrine. "The tree of life," like the "selfish gene," has become a master metaphor that exerts an outsize power. The tree of life promotes a particular vision of evolutionary history, a vision so commonplace that its figurative roots are difficult to discern. McClintock has unpacked the centuries-long tradition of what she calls the invention of imperial nature, whereby the combined figures of the tree of life and the white "family of man" became vital to the production of hierarchies of difference, both social and biological. Forces seeking to legitimize their violent actions, she argues, have often appealed to nature or the family to represent such actions as "the progressive unfolding of natural decree."[63] McClintock's foundational insights can be adapted to research by Lynn Margulis and others into interspecies fusion. For the discovery of endosymbiosis as a key evolutionary mechanism poses this question: What if the family tree is not nearly as familial as presupposed? And what if the putatively natural individual is a travesty of nature?

The vertical assumptions about evolution inherent in the tree of life belie the genetic complexity of the compound self. Margulis, Tsutomu Watanabe, Carl Woese, and W. F. Doolittle, among others, have all argued that evolution happens not only vertically but also laterally through the movement of genes across species lines—a process called horizontal gene transfer.[64] This radical line of research challenges, in David Quammen's words, "the traditional certitude that genes flow only from parents to offspring, and can't be traded sideways across species boundaries."[65] Over time bacteria may evolve into cellular organs in a host species. This morphing generates profound forms of interspecies fusion. Thus, the compound self has even deeper biological roots than is commonly assumed. If cooperation—that is, altruistic self-interest—may strengthen biotic resilience, that resilience may also be shaped through interspecies cellular incorporation over great expanses of evolutionary time.

Margulis's iconoclastic work on endosymbiosis proved crucial for broadening our understanding of cellular entanglement. What she illuminated was a form of symbiosis whereby complex cells can develop from the fusion of diverse life forms. Captured bacteria may gradually morph into organelles inside the host, thereby helping generate new species. Seen in these terms the self is not just involved in symbiotic interactions with other selves; rather, at a cellular level, the self is already the result of amalgamated

62. Londa Schlebinger has documented how in the eighteenth century metaphors profoundly shaped the questions and conclusions of Enlightenment science. See Schlebinger, *Nature's Body*.

63. McClintock, *Imperial Leather*, 45. On the power that accrues from invoking nature's authority, see also Williams, "Nature," 184–89.

64. Doolittle, "Uprooting the Tree of Life."

65. Quammen, *The Tangled Tree*, xi.

entities. The horizontal dimensions to endosymbiosis unsettle the status of the tree of life as all-encompassing evolutionary trope.[66]

By extension, endosymbiosis offers an alternative biological idiom through which to question the assumption of individual life as a state of merciless competition. For by positing that all life is horizontally entangled, endosymbiosis disturbs a world view that neoliberals have sought to naturalize by invoking three pervasive figures of speech: "the selfish gene," "the tree of life," and the "mind of the market."[67] All three naturalize competitive individualism as the only game in town, downplaying cooperation and evolutionary endosymbiosis.

Sociobiology and neoliberalism both skew toward vertical models. As Arundhati Roy has observed, neoliberalism's vertiginous levels of inequality enable "the vertical secession of the rich."[68] But if the aloof, self-standing self is a biological fallacy, we can remove a powerful genetic determinant from neoliberal efforts to root an economic ideology in the towering tree of evolution. Instead, by downplaying horizontal entanglements and responsibilities neoliberalism contradicts the basic biology of flourishing. For we all exist in states of conjoined survival that involve—in ways we are just starting to understand—a complex duet between competition and cooperation.

To insist as much is not to deny competition, but to temper our understanding of it with a more complex set of life relations. The forest is not some Shangri-la, some tree-on-tree love fest—tree hugging where the huggers are the trees themselves. What emerges, rather, is an ecosystem rife with competition but also replete with this: abundant cooperative gestures from cocreators of regenerative worlds.[69]

66. See mycologist Merlin Sheldrake's remark to Robert Macfarlane that fungi partake in "a wildly promiscuous horizontal transfer of genetic material" (Macfarlane, *Underland,* 93).

67. We should add to this list two political metaphors launched by the conservative ecologist Garrett Hardin in the late 1960s and early '70s. Hardin's most influential essays, "The Tragedy of the Commons" and "Lifeboat Ethics: The Case Against Helping the Poor," both make figurative arguments that came to mesh with the arguments that helped rationalize sociobiology and neoliberalism. "The Tragedy of the Commons" and "Lifeboat Ethics" used metaphor to argue for privatizing the commons and for dismantling social welfare systems. Hardin further contended that immigration from and foreign aid to the Global South were both undesirable and threats to Western democracy. He considered such practices socially self-destructive and environmentally ruinous. As Hardin's racist, anti-immigrant, and anti-poor environmentalism gained popular traction, prominent environmental organizations such as the Sierra Club remained strongly influenced by his metaphoric thought and by his "competitive exclusion principle." That principle, invoked by white nationalists from apartheid-era South Africa to the American South, holds that when two populations compete, there is only one winner and one loser—in contradistinction to the kinds of networked survival that Simard's research has unearthed. See Amend, "Blood and Vanishing Topsoil." See also Nixon, "Neoliberalism, Genre, and 'The Tragedy of the Commons.'"

68. Arundhati Roy, "India Is Colonising Itself."

69. The scientific literature on fused cooperation and competition is by now immense. For an illuminating account of research into both competition and cooperation as evidenced by diverse root systems, see Hedin, "Building the Biosphere." Hedin notes that in South Africa's endemic fynbos we find some of the earliest examples of fungal symbiosis, which allows constitutive plants to compete through collaboration. See also Ma et al., "Evolutionary History Resolves Global Organization of Root Functional Traits."

Conclusion: Tangled Roots, Braided Lives

In 1979, the year Thatcher rose to power, Monty Python's *Life of Brian* took the movie circuit by storm. At one point Brian addresses an adoring crowd crammed into an alleyway. "Say after me," he declares, "we are all individuals." A chorus echoes from below: "We are all individuals."

Then a solitary hand shoots up: "I'm not."[70]

Four decades after the Reagan-Thatcher neoliberal revolution, billions of people feel stretched thin between hyperindividualism and hyperglobalization, disempowered on both fronts. On the one hand we are caught up in a lonely churn of self-optimization driven by our algorithmic overlords; on the other we feel overexposed to forces so global they feel impossible to grasp far less transform. To many the neoliberal insistence on short-term profit and unregulated, inequitable growth feels futureless. It has the ring of an ecological death rattle.

People pine for a fealty to something larger than the barricaded self but smaller than the global marketplace. The climate and COVID crises have both intensified a yearning to repair a threadbare social fabric, which is always also environmental. Many hunger for empathy, affinity, connection, alliance; for less creative destruction, more palliative care.[71] To help offset systemic abandonment by a hollowed out state many communities have resorted to compensatory networks of mutual aid.[72] And despite the predatory assaults of a globalized neoliberalism communal property regimes persist as forms of collective understanding, particularly among Indigenous communities.

It is in this context that we can read the contemporary allure of cooperative biology and Indigenous knowledge systems. Both tend to figure personal and group survival differently from how neoliberalism represents them. For despite many divergences cooperative biology and Indigenous epistemologies typically underscore the collaborative dimensions to resilience. Both knowledge systems embrace interdependence as fundamental to the nature and persistence of life itself. In many Indigenous communities that conviction has endured for millennia, predating not only neoliberalism but also the long arc of colonialism of which neoliberalism is a late manifestation.

We can see the dramatic impress of Indigenous cosmologies on some of the new botany of cooperation. In, for example, *Thus Spoke the Plant*, by evolutionary ecologist Monica Gagliano. After determining through her scientific research that plants possess subjectivity, volition, consciousness, and bioaccoustic powers, Gagliano immerses herself in Indigenous traditions that have long acknowledged such powers when most Enlightenment thought dismissed them. We see a kindred spirit at work in anthropologist

70. Jones, *Monty Python's Life of Brian*.

71. For a creative adaptation of the notion of end-of-life palliative care to architectural structures that must be ceded to rising oceans, see DeSilvey, *Curated Decay*, 155–75.

72. Arguably another reason for the current fascination with biological mutualism is the receding memory of Soviet bloc state socialism. Younger generations are much less likely than their elders to respond negatively to the word socialism, in all its variable meanings.

Eduardo Kohn's *How Forests Think*, where he grapples with the forest's nonverbal communicative powers. Kohn turns to the Indigenous animism of Ecuador's Runa people as a way of entering the spirit life that animates "the thinking forest."[73] For Kohn that Amazonian world of being—interdependent and richly communicative—offers a hopeful counter to a Western emphasis on the bounded self, which he construes as exacerbating ecological destruction. Simard, too, acknowledges a debt to Indigenous understandings of the forest's cooperative dimensions: "I'm standing on the shoulders of thousands of years of knowledge. I think it's so important that we all recognize this. . . . I have come full circle to encounter these Indigenous ideals, with their long-standing recognition that everything is connected."[74]

Kimmerer's work assumes a special pertinence here. Much of her thinking arises from a place where Indigenous lifeways and evolutionary pathways converge. Her double perspective as an Indigenous scientist helps establish a rapprochement between the domains of ecological science and elder knowledge, of botanical research and spirited matter. This affords her complementary prisms through which to view the lively social forest. We see this in her consideration of how trees converse to synchronize their actions during masting.[75] Every few years a tree species—pecans, for example—collectively generates a great outpouring of nuts, a synchronized abundance so vast that it often crosses state and national boundaries.[76] Masting on that scale requires advance communication, vindicating, in Kimmerer's view, the elders' insistence—long ridiculed by science—that trees "talk."

Kimmerer's explanation of masting shares some common ground with Simard's account of the wood wide web: extensive subterranean networks—fungal bridges—connect one tree with another, thereby communicating, from tree to tree, the impulse to mast in concert. Assisted by fungal bridges, the carbon surplus finds expression in a collective cascade of nuts that Kimmerer likens to the actions of Robin Hood: "They

73. Kohn, "Forest for the Trees."

74. Emmanuel Vaughan-Lee, "Finding the Mother Tree."

75. Kimmerer, *Braiding Sweetgrass,* 19–20. Masting may increase a species' chances of survival as a sudden abundance of nuts exceeds the capacity of predators to consume them.

76. A coordinated eruption of nuts or acorns cannot be triggered by environmental conditions alone, which vary greatly across the large swathes of territory involved. Research by ornithologist David Blockstein into the relationship between masting events, the twentieth century rise of Lyme disease and the extinction of the Passenger Pigeon offers a fascinating example of the unintended public health consequences of environmental degradation. Passenger Pigeons were once the most numerous bird species in the United States with a peak population of an estimated 5 billion. They were also voracious consumers of acorns, competing with white-footed mice and white-tailed deer, key carriers in the life cycle of the black-legged tick. In the two years after a masting event, a region will typically experience a rise in mouse and deer numbers and in the incidence of Lyme disease. Blockstein contends that in the absence of competition from Passenger Pigeons, the mice, the deer, and the Lyme-carrying ticks have all proliferated. Together, he argues, the extinction of the forest-dependent pigeons and forest fracture have created more favorable circumstances for the spread of Lyme disease. See Blockstein, "Lyme Disease and the Passenger Pigeon?"; see also Johnson, "What Does the Passenger Pigeon Have to Do with Lyme Disease?".

take from the rich and give to the poor so that all the trees arrive at the same carbon surplus at the same time. Through unity, survival. All flourishing is mutual."[77]

By invoking Robin Hood, Kimmerer suggests a larger commitment to a redistributive politics, to an insistence that the survival of the fittest is a scientifically skewed figure of speech. Kimmerer, Simard, and Mancuso offer an alternative set of linked metaphors: the wood wide web, fungal bridges, and mycorrhizal networks all dramatize interconnectedness rather than centering agency in a bounded, sovereign self.

The work of Kimmerer and kindred Indigenous thinkers refuses a damaging species exceptionalism.[78] That refusal runs deep in most Indigenous cultures—and long predates the failures and inequities of the neoliberal age. Settler colonial cultures have repeatedly sought to impose on Indigenous lifeways a hierarchical world view in which Cartesian dualism and utilitarian economics prevail. From a pervasive colonial perspective human ingenuity grants Nature meaning by imbuing hitherto dumb matter with economic value. In these terms inert Nature only accrues value when humans convert raw material into commodities. Those commodities acquire vitality and worth by entering the dynamics of the market.

But trees are more than timber-in-waiting. They are lively actors, shaping Earth's life systems. Trees exemplify Margulis's insistence that "life is matter that chooses."[79] Trees are, moreover, for Kimmerer our evolutionary seniors and potential guides.[80] Her perspective encourages us to rethink evolutionary wisdom so as to allow for certain suggestive (though always partial) alignments with the findings of Simard et al.[81] Mancuso, for instance, depicts humans as "existing on a continuum with the acacia, the radish, and the bacterium. Intelligence is a property of life."[82] Significant differences of course exist between Indigenous and non-Native perspectives; they also exist from one scholar and one First Nation to the next. But Indigenous epistemologies and the botany of cooperation do share some affinities, including this: they spurn the notion of *Homo sapiens* as standing above ecosystems in a posture of Earth mastery that vindicates Earth plunder. Kimmerer, Simard, and Mancuso all reject a supremacist, separatist ideology of biotic hubris. These affinities, however partial, remain vital, for it is out of such alignments that coalitions for deep change arise.

The interactive forest suggests an alternative path forward to that promulgated by neoliberal politicians and think tanks. The reconceived forest offers a scientifically informed allegory of a more just society in which redistribution favors communal survival. And in which long-term collective resilience depends on tempering short-term

77. Kimmerer, *Braiding Sweetgrass*, 20.

78. One senses some suggestive affinities between Native refusals of human exceptionalism and what Italo Calvino once called "Anthropocentric parochialism" (Calvino, "Lightness").

79. Feldman, *Symbiotic Earth*, 2:05.

80. Kimmerer, *Braiding Sweetgrass*, 9.

81. To gesture toward these tentative and always limited affinities is not to gainsay the profound power differentials between institutionalized science and Indigenous cultures.

82. Pollan, "The Intelligent Plant."

greed. This ascendant understanding of forest dynamics provides a counternarrative of flourishing, a model of what Monbiot has called, in another context, "private sufficiency and public luxury."[83]

The stakes in all of this are huge. For as environmental writer Kennedy Warne observes: "it is precisely by challenging the philosophical boundary between sentient human and insentient Earth that ecological repair becomes possible."[84] Undertaking such repair demands that we reimagine the boundaries of being with a fluid, scientifically informed generosity. That is, with a generosity that has long been evident in many Indigenous cosmologies but that neither neoliberal economists nor biological Thatcherites can entertain.

Small wonder, then, that the animating energies of self-interested altruism have become a source of public fascination well beyond Indigenous communities. Small wonder that in the second decade of the twenty-first century defenders of the greater public good should be drawn to the science of resilience-through-sharing. And small wonder that, as neoliberalism rends the social fabric and the web of life, forest defenders are reaching out to build vital coalitions of repair.

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83. Monbiot, "For the Sake of Life on Earth, We Must Put a Limit on Wealth."

84. Warne, "Place as Person, Landscape as Identity."

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