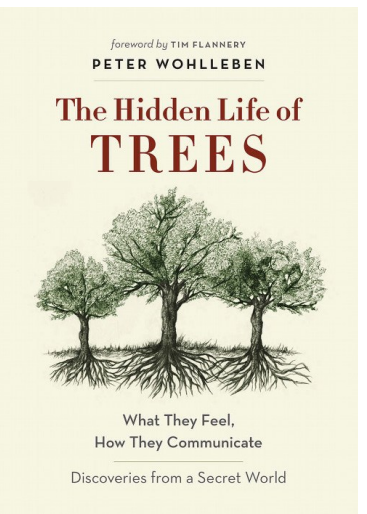
The Secret Life of Trees: The Astonishing Science of What Trees Feel and How They Communicate

> "A tree can be only as strong as the forest that surrounds it."

BY MARIA POPOVA



Trees dominate the world's the oldest living organisms. Since the dawn of our species, they have been our silent companions, permeating our most enduring tales and never ceasing to inspire fantastical cosmogonies. Hermann Hesse called them "the most penetrating of preachers." A forgotten seventeenth-century English gardener wrote of how they "speak to the mind, and tell us many things, and teach us many good lessons."

But trees might be among our lushest metaphors and sensemaking frameworks for knowledge precisely because the richness of what they say is more than metaphorical — they speak a sophisticated silent language, communicating complex information via smell, taste, and electrical impulses. This fascinating secret world of signals is what German forester **Peter Wohlleben** explores in ***The Hidden Life of Trees: What They Feel, How They Communicate*** (*public library*).

Wohlleben chronicles what his own experience of managing a forest in the Eifel mountains in Germany has taught him about the

astonishing language of trees and how trailblazing arboreal research from scientists around the world reveals "the role forests play in making our world the kind of place where we want to live." As we're only just beginning to understand nonhuman consciousnesses, what emerges from Wohlleben's revelatory reframing of our oldest companions is an invitation to see anew what we have spent eons taking for granted and, in this act of seeing, to care more deeply about these remarkable beings that make life on this planet we call home not only infinitely more pleasurable, but possible at all.

Illustration by Arthur Rackham for a rare 1917 edition of the Brothers Grimm fairy tales

But Wohlleben's own career began at the opposite end of the caring spectrum. As a forester tasked with optimizing the forest's output for the lumber industry, he self-admittedly "knew about as much about the hidden life of trees as a butcher knows about the emotional life of animals." He experienced the consequence of what happens whenever we turn something alive, be it a creature or a work of art, into a commodity — the commercial focus of his job warped how he looked at trees.

Then, about twenty years ago, everything changed when he began organizing survival training and log-cabin tours for tourists in his forest. As they marveled at the majestic trees, the enchanted curiosity of their gaze reawakened his own and his childhood love of nature was rekindled. Around the same time, scientists began conducting research in his forest. Soon, every day became colored with wonderment and the thrill of discovery — no longer able to see trees as a currency, he instead saw them as the priceless living

wonders that they are. He recounts:

> Life as a forester became exciting once again. Every day in the forest was a day of discovery. This led me to unusual ways of managing the forest. When you know that trees experience pain and have memories and that tree parents live together with their children, then you can no longer just chop them down and disrupt their lives with large machines.

The revelation came to him in flashes, the most eye-opening of which happened on one of his regular walks through a reserve of old beech tree in his forest. Passing by a patch of odd mossy stones he had seen many times before, he was suddenly seized with a new awareness of their strangeness. When he bent down to examine them, he made an astonishing discovery:

> The stones were an unusual shape: they were gently curved with hollowed-out areas. Carefully, I lifted the moss on one of the stones. What I found underneath was tree bark. So, these were not stones, after all, but old wood. I was surprised at how hard the "stone" was, because it usually takes only a few years for beechwood lying on damp ground to decompose. But what surprised me most was that I couldn't lift the wood. It was obviously attached to the ground in some way. I took out my pocketknife and carefully scraped away some of the bark until I got down to a greenish layer. Green? This color is found only in chlorophyll, which makes new leaves green; reserves of chlorophyll are also stored in the trunks of living trees. That could mean only one thing: this piece of wood was still alive! I suddenly noticed that the remaining "stones" formed a distinct pattern: they were arranged in a circle with a diameter of about 5 feet. What I had stumbled upon were the gnarled remains of an enormous ancient tree stump. All that was left were vestiges of the outermost edge. The interior had completely rotted into humus long ago — a clear indication that the tree must have been felled at least four or five hundred years earlier.

How can a tree cut down centuries ago could still be alive? Without leaves, a tree is unable to perform photosynthesis, which is how it converts sunlight into sugar for sustenance. The ancient tree was clearly receiving nutrients in some other way — for hundreds of

years.

Beneath the mystery lay a fascinating frontier of scientific research, which would eventually reveal that this tree was not unique in its assisted living. Neighboring trees, scientists found, help each other through their root systems — either directly, by intertwining their roots, or indirectly, by growing fungal networks around the roots that serve as a sort of extended nervous system connecting separate trees. If this weren't remarkable enough, these arboreal mutualities are even more complex — trees appear able to distinguish their own roots from those of other species and even of their own relatives.

Art by Judith Clay from *Thea's Tree*

Wohlleben ponders this astonishing sociality of trees, abounding with wisdom about what makes strong human communities and societies:

> Why are trees such social beings? Why do they share food with their own species and sometimes even go so far as to nourish their competitors? The reasons are the same as for human communities: there are advantages to working together. A tree is not a forest. On its own, a tree cannot establish a consistent local climate. It is at the mercy of wind and weather. But together, many trees create an ecosystem that moderates extremes of heat and cold, stores a great deal of water, and generates a great deal of humidity. And in this protected environment, trees can live to be very old. To get to this point, the community must remain intact no matter what. If every

> tree were looking out only for itself, then quite a few of them would never reach old age. Regular fatalities would result in many large gaps in the tree canopy, which would make it easier for storms to get inside the forest and uproot more trees. The heat of summer would reach the forest floor and dry it out. Every tree would suffer.
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> Every tree, therefore, is valuable to the community and worth keeping around for as long as possible. And that is why even sick individuals are supported and nourished until they recover. Next time, perhaps it will be the other way round, and the supporting tree might be the one in need of assistance.
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One can't help but wonder whether trees are so much better equipped at this mutual care than we are because of the different time-scales on which our respective existences play out. Is some of our inability to see this bigger picture of shared sustenance in human communities a function of our biological short-sightedness? Are organisms who live on different time scales better able to act in accordance with this grander scheme of things in a universe that is deeply interconnected?

To be sure, even trees are discriminating in their kinship, which they extend in varying degrees. Wohlleben explains:

> Every tree is a member of this community, but there are different levels of membership. For example, most stumps rot away into humus and disappear within a couple of hundred years (which is not very long for a tree). Only a few individuals are kept alive over the centuries… What's the difference? Do tree societies have second-class citizens just like human societies? It seems they do, though the idea of "class" doesn't quite fit. It is rather the degree of connection — or maybe even affection — that decides how helpful a tree's colleagues will be.

These relationships, Wohlleben points out, are encoded in the forest canopy and visible to anyone who simply looks up:

> The average tree grows its branches out until it encounters the

> branch tips of a neighboring tree of the same height. It doesn't grow any wider because the air and better light in this space are already taken. However, it heavily reinforces the branches it has extended, so you get the impression that there's quite a shoving match going on up there. But a pair of true friends is careful right from the outset not to grow overly thick branches in each other's direction. The trees don't want to take anything away from each other, and so they develop sturdy branches only at the outer edges of their crowns, that is to say, only in the direction of "non-friends." Such partners are often so tightly connected at the roots that sometimes they even die together.

Art by Cécile Gambini from *Strange Trees* by Bernadette Pourquié

But trees don't interact with one another in isolation from the rest of the ecosystem. The substance of their communication, in fact, is often about and even to other species. Wohlleben describes their particularly remarkable olfactory warning system:

> Four decades ago, scientists noticed something on the African savannah. The giraffes there were feeding on umbrella thorn acacias, and the trees didn't like this one bit. It took the acacias mere minutes to start pumping toxic substances into their leaves to rid themselves of the large herbivores. The giraffes got the message and moved on to other trees in the vicinity. But did they move on to trees close by? No, for the time being, they walked right by a few trees and resumed their meal only when they had moved about 100 yards away.

> The reason for this behavior is astonishing. The acacia trees that were being eaten gave off a warning gas (specifically, ethylene) that signaled to neighboring trees of the same species that a crisis was at hand. Right away, all the forewarned trees also pumped toxins into their leaves to prepare themselves. The giraffes were wise to this game and therefore moved farther away to a part of the savannah where they could find trees that were oblivious to what was going on. Or else they moved upwind. For the scent messages are carried to nearby trees on the breeze, and if the animals walked upwind, they could find acacias close by that had no idea the giraffes were there.

Because trees operate on time scales dramatically more extended than our own, they operate far more slowly than we do — their electrical impulses crawl at the speed of a third of an inch per second. Wohlleben writes:

> Beeches, spruce, and oaks all register pain as soon as some creature starts nibbling on them. When a caterpillar takes a hearty bite out of a leaf, the tissue around the site of the damage changes. In addition, the leaf tissue sends out electrical signals, just as human tissue does when it is hurt. However, the signal is not transmitted in milliseconds, as human signals are; instead, the plant signal travels at the slow speed of a third of an inch per minute. Accordingly, it takes an hour or so before defensive compounds reach the leaves to spoil the pest's meal. Trees live their lives in the really slow lane, even when they are in danger. But this slow tempo doesn't mean that a tree is not on top of what is happening in different parts of its structure. If the roots find themselves in trouble, this information is broadcast throughout the tree, which can trigger the leaves to release scent compounds. And not just any old scent compounds, but compounds that are specifically formulated for the task at hand.

The upside of this incapacity for speed is that there is no need for blanket alarmism — the recompense of trees' inherent slowness is an extreme precision of signal. In addition to smell, they also use taste — each species produces a different kind of "saliva," which can be infused with different pheromones targeted at warding off a specific predator.

Wohlleben illustrates the centrality of trees in Earth's ecosystem with a story about Yellowstone National Park that demonstrates "how our appreciation for trees affects the way we interact with the world around us":

> It all starts with the wolves. Wolves disappeared from Yellowstone, the world's first national park, in the 1920s. When they left, the entire ecosystem changed. Elk herds in the park increased their numbers and began to make quite a meal of the aspens, willows, and cottonwoods that lined the streams. Vegetation declined and animals that depended on the trees left. The wolves were absent for seventy years. When they returned, the elks' languorous browsing days were over. As the wolf packs kept the herds on the move, browsing diminished, and the trees sprang back. The roots of cottonwoods and willows once again stabilized stream banks and slowed the flow of water. This, in turn, created space for animals such as beavers to return. These industrious builders could now find the materials they needed to construct their lodges and raise their families. The animals that depended on the riparian meadows came back, as well. The wolves turned out to be better stewards of the land than people, creating conditions that allowed the trees to grow and exert their influence on the landscape.

Art by William Grill from *The Wolves of Currumpaw*

This interconnectedness isn't limited to regional ecosystems. Wohlleben cites the work of Japanese marine chemist Katsuhiko

Matsunaga, who discovered that trees falling into a river can change the acidity of the water and thus stimulate the growth of plankton — the elemental and most significant building block of the entire food chain, on which our own sustenance depends.

In the remainder of ***The Hidden Life of Trees***, Wohlleben goes on to explore such fascinating aspects of arboreal communication as how trees pass wisdom down to the next generation through their seeds, what makes them live so long, and how forests handle immigrants. Complement it with this wonderful illustrated atlas of the world's strangest trees and an 800-year visual history of trees as symbolic diagrams.

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