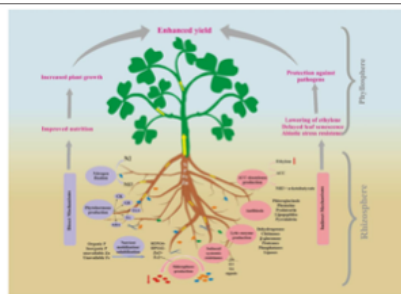


Interbeing and the Rhizosphere

An Address to White Heron Sangha Jan. 16, 2022



1. Interbeing

Thich Nhat Hanh¹ coined the word interbeing as a modern label for the traditional doctrine of Dependent Origination or */pratityasamutpada/* a doctrine taught in all schools of Buddhism and purportedly espoused by Buddha himself.

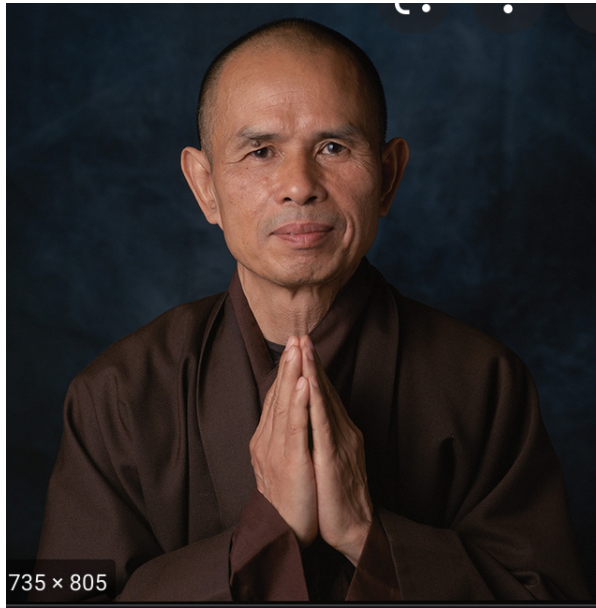
The term Dependent Origination has two associated but distinct references in different Buddhist traditions.



For the Theravada it refers to a chain of causation known as the twelve *nidanas* that accounts for the descent from nirvana and wholeness through various spiritual and mental states into the material world of illusion, procreation, life and death known as *samsara*.²

In the Mahayana tradition dependent origination has a more general reference signifying “the mutual containment and interpenetration of all phenomena,” and “a cosmos of infinite realms upon realms, mutually containing one another.”³

In developing his practical philosophy of “engaged buddhism,” Thich Nhat Hahn draws more on this tradition.



Here is how he arrived at the word Interbeing:

About thirty years ago I was looking for an English word to describe our deep interconnection with everything else. I liked the word “togetherness,” but I finally came up with the word “interbeing.” The verb “to be” can be misleading, because we cannot be by ourselves, alone. ... To inter-be and the action of interbeing reflects reality more accurately. We inter-are with one another and with all life.⁴

He defines interbeing as the awareness that “no phenomenon has independent existence. Whatever is, comes into existence because of factors and conditions created by other phenomena. When factors and conditions no longer support that existence, then that thing ceases to exist.

He relates that idea to words attributed directly to The Buddha in Assutava Sutta

When this is, that is.
From the arising of this comes the arising of that.
When this isn't, that isn't.
From the cessation of this comes the cessation of that.

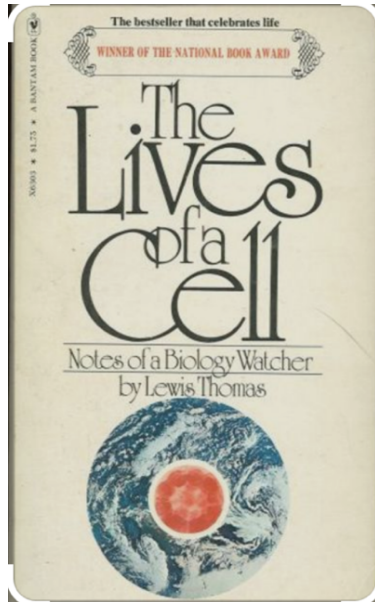
The point is that all of existence is a vast nexus of causes and conditions, constantly changing, and everything is interconnected to everything else. All phenomena inter-exist.

This idea is both counter-intuitive and yet obvious, especially in the context of modern science, whose technological instruments allow for access to realities great and small, all of which reveal interconnections at scales far beyond the reach of human senses.

One of the things that makes Thich Nhat Hanh's teachings attractive to a wide audience is his affirmation of scientific knowledge

Personally, learning about science has helped me to understand Buddhism more deeply. I agree with Einstein that if there is a religion that can go along with science, it is Buddhism. That is because Buddhism has the spirit of nonattachment to rules. You may have a view that you consider to be the truth, but if you cling to it, then that is the end of your free inquiring. You have to be aware that with the practice of looking deeply, you may see things more clearly. That is why you should not be so dogmatic about what you have found; you have to be ready to release your view in order to get a higher insight. That is very exciting.⁵

Back in 1974, long before I'd heard of Thich Nhat Hanh, I came across a book called *Lives of Cell* that transformed my high school biology understanding of all living systems. As indicated by its title, it explained that many of the functions of microscopic living cells are carried out by a complex community of much smaller living beings inside each of them called organelles.



So I was intrigued by Thich Nhat Hanh's reference to that work in his book, *The Heart of the Buddha's Teaching*:

There is a biologist named Lewis Thomas, whose work I appreciate very much. He describes how our human bodies are “shared, rented, and occupied” by countless other tiny organisms, without whom we couldn’t “move a muscle, drum a finger, or think a thought.” Our body is a community, and the trillions of non-human cells in our body are even more numerous than the human cells. Without them, we could not be here in this moment. Without them, we wouldn’t be able to think, to feel, or to speak. There are, he says, no solitary beings. The whole planet is one giant, living, breathing cell, with all its working parts linked in symbiosis.⁶

In addition to the multiple lives that make up each cell, a further example of interbeing or dependent origination is found in the microbiome—the vast collections of cells like bacteria, fungi, and viruses found on and in our human bodies that each have their own dna and carry out essential functions of our lives.

The convergent implications of these examples of interbeing/dependent origination are summarized by Scott Sampson, paleontologist and Director of Science World, British Columbia:

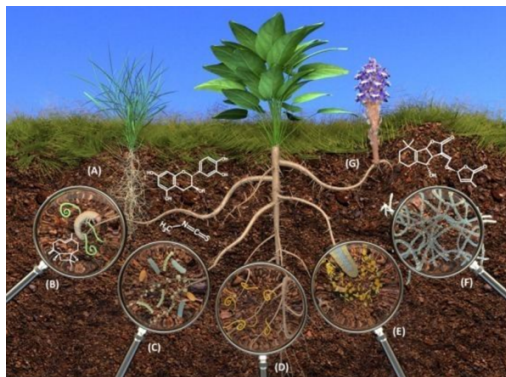
The interbeing perspective encourages us to view other life forms not as objects but subjects, fellow travelers in the current of this ancient river. On a still more profound level, it enables us to envision ourselves and other organisms not as static "things" at all, but as processes deeply and inextricably embedded in the background flow.⁷

2. Rhizome and rhizosphere

Recent research has called attention to yet another microbiome, not the one which inhabits our bodies but one which exists outside them in the soil that serves as the source of all plant and animal life. According to David McNear, Professor of Rhizosphere Science

Soil is one of the last great scientific frontiers and the rhizosphere is the most active portion of that frontier in which biogeochemical processes influence a host of landscape and global-scale processes.⁸

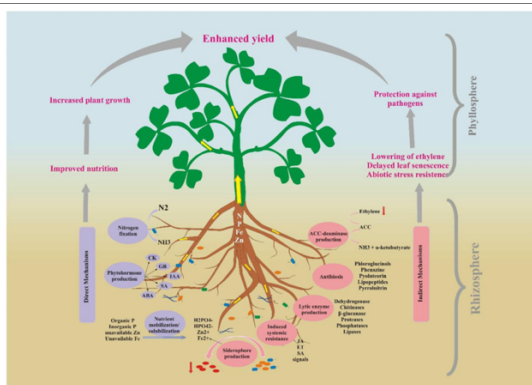
The word rhizosphere derives from the Greek word, “rhiza,” signifying root. It was coined in 1904 by the German agronomist and plant physiologist Lorenz Hiltner to describe the plantroot interface with the surrounding below-ground environment of the soil and its dense microbial communities.



The rhizosphere is now seen as a hotspot for interaction and communication among microscopic animals, plants, bacteria, and fungi.

In addition to local exchanges between organisms, it extends into an immense subsurface network drawing all its inhabitants into a unified ecological system.

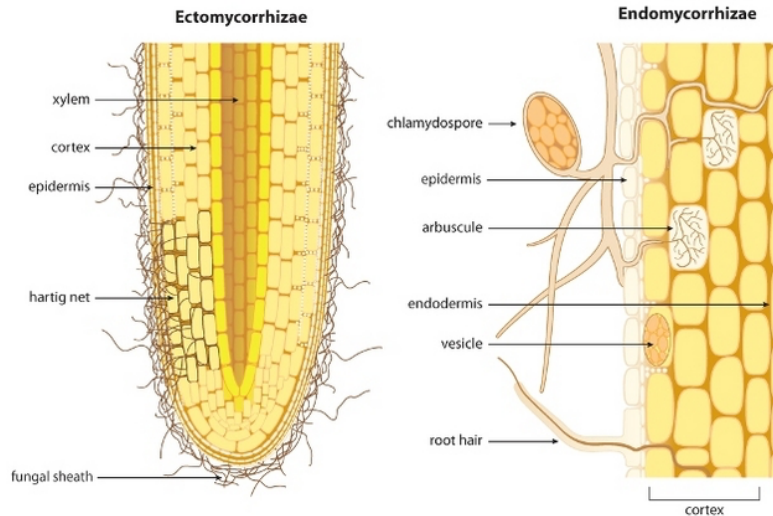
A salient characteristic of the rhizosphere is Mutualism—a symbiotic exchange of resources that fulfill needs of each of its inhabitants. The microorganisms assist plants in uptake of nutrients like organic nitrogen and amino acids that stimulate plant growth, stress-tolerance and resistance to pathogens. The plants feed the microorganisms with necessary carbon-rich carbohydrates and sugars which they cannot create themselves.



Plants manufacture these compounds through photosynthesis in their leaves, where, fueled by the sun, they draw down atmospheric carbon dioxide. Known as “exudates,” such secretions share 10-40% of the plant’s total production with soil microbes. A long-familiar example of mutualism is found in the interactions between legumes, like beans and peas, and nitrogen-fixing bacteria housed in root nodules which are visible to the naked eye.

More recently, scientists have discovered rhizosphere mutualism not only in legumes but in 90% of all plant species. This exchange takes place among plant roots and fungi, known as mycorrhizae, a word derived from “mico” for mushroom, and “rhizome.”

Branching tentacles of the fungi called “hyphae” grow on and into root hairs, extending their surface area and capacity to absorb water and essential mineral nutrients



The ancient fossil record suggests that all land plants evolved largely as a result of such mycorrhizal associations with aquatic vegetation.

In addition to nutrient exchange the rhizosphere hosts a dense mycorrhizal communication network that has been categorized as an “information super-highway.” Data is transmitted to nearby receptors through electrical signals and reactions among what are called “infochemicals.” Both plants and fungi alter their behavior based on such signals of attraction or threat.

On the largest scale, the rhizosphere’s carbon cycling interactions among plants, soil and atmosphere regulate whole-ecosystem processes that either promote or reduce climate change.⁹

3. Forestry

The themes of interbeing and the rhizosphere come together in the work of Suzanne Simard, a Canadian forest ecologist whose recent personal and professional autobiography, *Finding the Mother Tree: Discovering the Wisdom of the Forest*, has attracted widespread attention.



FINDING THE MOTHER TREE

Discovering the
Wisdom of the Forest

SUZANNE SIMARD

I was first introduced to her as a memorable fictional character named Virginia Westerford, in *The Overstory*, Richard Powers' 2018 novel about trees and their protectors. There she appears as reticent researcher who discovers that trees in a forest communicate and cooperate by way of mycorrhizal networks in the rhizosphere.

Simard's combined account of her discoveries and her personal experiences exceeds the fiction in drama, scientific scope, and philosophical implication. In vivid fluent prose, she describes her upbringing in a Canadian wilderness community where her father and grandfather practiced sustainable selective logging. Her early love for the woods led her to train as a researcher for the British Columbia Forest Service. But she soon learned that, in league with large corporations, the government not only encouraged, but required clear cuts destroying vast areas of rich biodiversity.



These were followed up with practices intended to promote fast profits: planting monocultural stands of seedlings of single species favored by the market, and eliminating all other vegetation construed as competition to the cash crop, through slash burning, mechanical pruning and application of herbicides.



Reading her account recalled my own horror while working in the woods of British Columbia as a tree planter and tree poisoner to earn a living during our family's residence there in the 1970s.

Simard suspected that this approach was misguided, even in terms of its limited profit motives, so she set up test-plot experiments using chemical and radioactive tracers and DNA analysis. Her published findings showed that the presence of mixed species led to more vigorous regrowth and disease resistance than did their exclusion. Her experiments also revealed that forest ecology involved more cooperation than competition among trees and species, through the exchange of water, nutrients and alarm signals--all facilitated by mycorrhizal interactions in the rhizosphere. Her work challenged dominant scientific assumptions about Darwinian mechanisms of adaptation, natural selection and fitness, and for many years it was dismissed by most of her colleagues. But in 1997, the prestigious

international scientific journal, “Nature,” published her article entitled “Net transfer of carbon between ectomycorrhizal tree species in the field,” and that started to bring her recognition and influence.¹⁰



This story of innovation and resistance exemplifies Thich Nhat Hanh’s insight that genuine scientific inquiry requires readiness “to release your view in order to get a higher insight.”

Since then, Simard has published over 200 peer-reviewed articles, her work has inspired the film, *Avatar*, and her current book is going into production as a Hollywood movie starring Amy Adams and Jake Gyllenhall.

4. Soil food web

In a phrase that has stuck ever since, the editors of *Nature* referred to what Simard discovered in the rhizosphere as “the wood-wide web.” Recent scientific research has drawn attention to the importance of another arena of interbeing in the rhizosphere known as “the soil-food web.” This takes place where most agricultural products are grown: the topsoil.

As in forests, plants growing in the topsoil of farmland capture carbon dioxide from the air and, energized by sunlight, combine it with water and chemicals from the soil to create the carbohydrates and sugars, called “photosynthates,” that they need to carry out their life processes. And as in forests, a substantial portion of

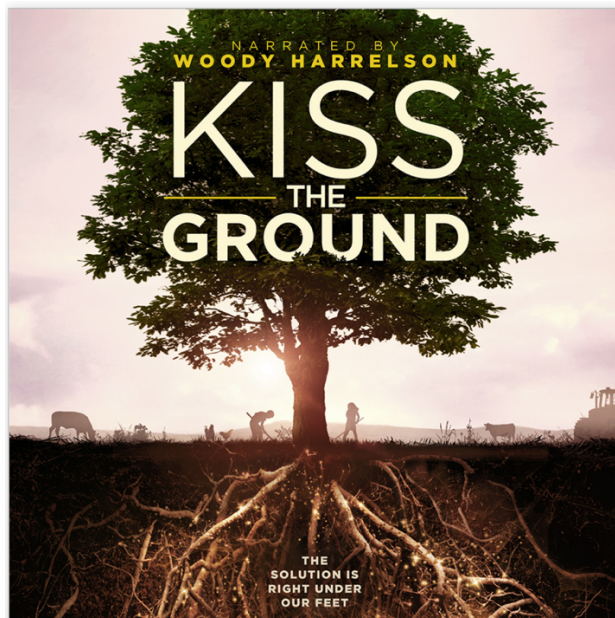
those photosynthates are moved through their roots as “exudates” into the soil, where they sustain the fungal mycorrhiza that extend the plant’s ability to absorb water and mineral nutrients.

In addition, the network of fungal hyphae connecting plant roots has a major impact on soil quality by promoting soil aggregate formation and stability—that is structures of attached particles and spaces that increase soil aeration and water infiltration, crucial for plant growth and health as well as for reducing erosion.¹¹

However, much of the agricultural soil in the earth’s rhizosphere is unhealthy. According to the United Nations, a third of it is severely degraded, largely by destructive farming practices.¹² These include input of artificial fertilizers, pesticides and weed killers and by excessive plowing and tilling, all of which contribute to the destruction of microbial life and the increase of water and wind erosion.

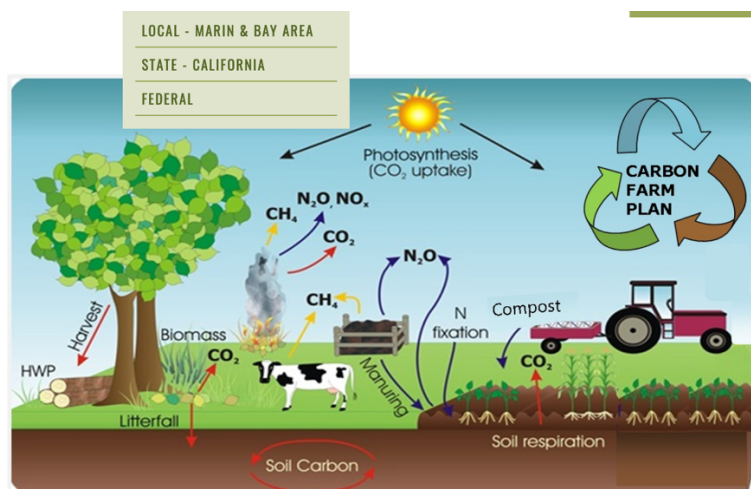
5. Regenerative Agriculture

In recent years a set of alternative practices, collectively known as Regenerative Agriculture, has been implemented both on large and small farms. An engaging introduction to Regenerative Agriculture can be found in the 2020 feature film, *Kiss the Ground*:



Traditional farming relies heavily on plowing and tillage to turn over and break up soil before planting to reduce compaction and to control weeds. Regenerative

farming, by contrast, requires no-till or low-till cultivation that leaves soil structure intact. To nourish microbial life, it employs cover-cropping, intense compost application, and managed rotational grazing of ruminant animals like cattle, sheep and goats. These practices promote the vitality and interdependence of multiple life forms in the rhizosphere.



Such regenerative practices are also referred to as “Carbon Farming.” Rather than releasing large amounts of carbon stored in soil into the atmosphere as greenhouse gases, they achieve sequestration of atmospheric carbon in the soil, thereby converting agricultural lands from carbon emitters to carbon sinks.

Around the time the film was released in 2020, Atascadero resident, Tim Lasalle, a co-founder of the Center for Regenerative Agriculture and Resilient Systems in Chico CA, introduced these regenerative practices to San Luis Obispo residents in a series of local lectures and workshops. At City Farm San Luis Obispo, we have implemented them with encouraging results both above and below ground.



One innovation developed at the Center is production of fungally rich compost from wood chips, leaves and water in a home built “Bioreactor.” A supplement to conventional organic compost and vermicompost, this mixture ripens for a year and then is used to inoculate seedling roots and vegetable beds with enhanced mycorrhizal life.

City Farm manager Shane Lovell has built two of the reactors, for our own use and for distribution of its product to farmers and gardeners.



Just as Suzanne Simard’s scientific discoveries about forest management seemed outlandish 25 years ago, Regenerative Agriculture’s profound transformation of traditional approaches to soil management based on new understanding of the soil-food web faces resistance today,

6. Mother Trees

In the final portion of her autobiography, Suznne Simard recounts the later stages of her career, when, as a recognized authority, she “was enjoying the freedom to ask riskier questions”(259).

Her discovery of cooperative exchanges of resources among trees and fungi led to further experiments revealing mechanisms by which large and established trees act as hubs in fungal networks and convey larger amounts of carbon and other exudates to more fragile younger trees and seedlings than any benefits they receive in return.



She named such mature individuals “Mother trees” and claimed that they act as providers, caregivers and elders--for instance, by absorbing nitrogen in the remains of spawning salmon in creeks and transmitting it through mycorrhizal “networks to other trees deeper in the forest”(289). Released from conventional scientific prohibitions of anthropomorphizing or humanizing natural processes, she has moved toward integrating scientific and metaphorical thinking.

Also unafraid to write frankly about her personal life, Simard describes the breakdown of her early marriage to another forest ecologist as her career advanced. She recounts falling in love with Mary, a physical chemist with whom she hikes and camps, combining recreation with research. And she details how her partner teamed with the rest of her family and hometown friends to provide the support she needed during a years-long ordeal with breast cancer.

She also attributes her recovery to the chemotherapy drug, *paclitaxel*, derived from yew trees growing in Northwest forests and traditionally used by first nations, native-american people for medicinal purposes.

She reports walking in the woods with her two daughters and indigenous elder, Mary Thomas “to learn the ways of the forest and to see if the ecosystem really was a place where all were connected as one”(279). “Mary Thomas’s people,” she says “...had known this...from living in the forest...and learning from all living things, respecting them as equal partners”(282).

She speaks of learning from her: “a way of knowing the earth...knowing that we are tied to the land—the trees and animals and soil and water—and to one

another...of showing humility and tolerance, for we all are connected within this circle of life”(294). She urges that “we expand...our epistemology and scientific methodologies so that they complement, build on, and align with Aboriginal roots”(295).

She acknowledges: “I have come full circle to stumble on some indigenous ideals: everything in the universe is connected”(283).

Here she echoes a familiar quotation of John Muir, scientist, visionary and activist, the founder of the Sierra Club: "When we try to pick out anything by itself, we find it hitched to everything else in the Universe."¹³

7. Conclusion

In a rousing 2-page epilogue to her book, Simard writes about applying the lessons of her scientific investigations and her profound human experiences to a project that confronts the greatest crisis of our time:

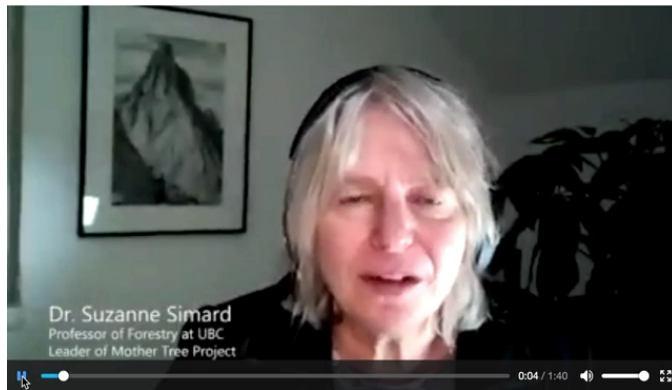
“I began the Mother Tree Project in 2015, during my rebirth after cancer. It is the biggest experiment I’ve ever conducted, with a guiding principle of retaining Mother Trees and maintaining connections within forests to keep them regenerative, especially as the climate changes.

The Mother Tree Project consists of nine experimental forests located across a “climate rainbow” in British Columbia...Our goal is to further develop an emergent philosophy: complexity science. Based on embracing collaboration in addition to competition—indeed working with all of the multifarious interactions that make up the forest—complexity science can transform forestry practices into what is holistic and away from what has been overly authoritarian and simplistic.

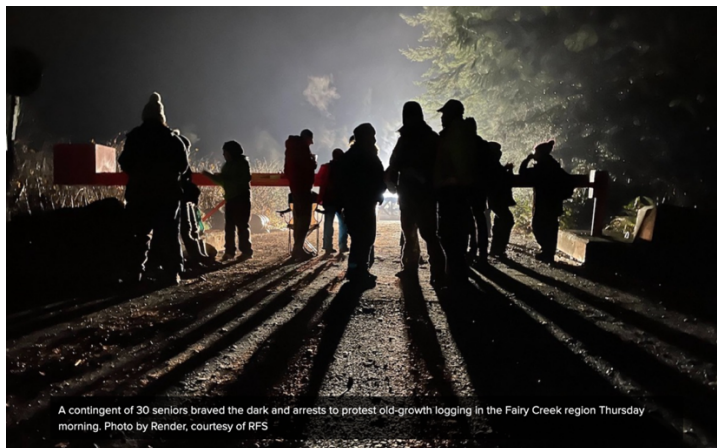
The understanding of Complexity science she is now pioneering aligns with the one envisioned by Thich Nhat Hanh and the tradition he represents.

The scientific, indigenous and spiritual approaches that converge here also lead to engagement, advocacy and activism. As has Thich Nhat Hahn throughout his life, so does Simard use her influence to work with others trying to “shift course.”

Here is a 90 second video of her recent appeal to the Premier of British Columbia urging him to stop the logging of the old growth mother trees at Fairy Creek, one of the last ancient forests in North America.¹⁴



And here is a picture of elders out in the woods in the winter rain and snow last month, lying in the way and joining the 1200 people already arrested there:¹⁵



And finally, here is Thich Nhat Hanh teaching the need for change:

Birds' songs express joy, beauty, and purity, and evoke in us vitality and love. So many beings in the universe love us unconditionally. The trees, the water, and the air don't ask anything of us; they just love us. Even though we need this kind of love, we continue to destroy them. By destroying the animals, the air, and the trees, we are destroying ourselves. We must learn to practice unconditional love for all beings so that the animals, the air, the trees, and the minerals can continue to be themselves.¹⁶

¹ Six days after this address Thich Nhat Hanh died at age 94.

² O'Brien, Barbara. "Interbeing." Learn Religions, Aug. 26, 2020, learnreligions.com/interbeing-3866931.

³ O'Brien, Barbara. "Interbeing." Learn Religions, Aug. 26, 2020, learnreligions.com/interbeing-3866931.

⁴ <https://www.garrisoninstitute.org/blog/insight-of-interbeing/>

⁵ In Melvin McLeod (ed.), 'Love without Limit: An Interview with Thich Nhat Hanh', *The Best Buddhist Writing* 2007 (2007), 74.

⁶ Thich, Nhat Hanh. 1999. New York: Broadway Books.

⁷ <https://www.edge.org/response-detail/10866>

⁸ <https://www.nature.com/scitable/knowledge/library/the-rhizosphere-roots-soil-and-67500617/>

⁹ <https://www.nature.com/scitable/knowledge/library/the-rhizosphere-roots-soil-and-67500617/>

¹⁰ <https://www.nature.com/articles/41557>

¹¹ https://www.researchgate.net/publication/7011574_Mycorrhizas_and_soil_structure

¹² <https://regenerationinternational.org/bioreactor/>

¹³ *My First Summer in the Sierra* (Boston: Houghton Mifflin, 1911), on page 110 of the Sierra Club Books 1988 edition. Simard's path here brings her into striking proximity with the life and work of Robin Wall Kimmerer, a member of the Powah-tony Nation and Professor of Botany, whose book, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants* also merits being paired with that of Thich Nhat Hahn

¹⁴ https://m.facebook.com/watch/?v=373454597451762&_rdr

¹⁵ <https://www.nationalobserver.com/2021/12/06/news/seniors-arrested-fairy-creek-blockade-digs-winter>

¹⁶ *Love in Action: Writings on Nonviolent Social Change* (1993), 131-132.