

Feeding on Light  
Eva-Fiore Kovacovsky



## An Encounter with Leaves

### Sina Ribak

<sup>1</sup>  
The Between Us and Nature—A Reading Club has its home base at Zabriskie–Buchladen für Kultur und Natur. <https://zabriskie.de/between-us-and-nature-reading-club/>

<sup>2</sup>  
I borrow from Italian philosopher and writer Emanuele Coccia who proposes to analyse all elements of life from the position of plants. His book *The Life of Plants: A Metaphysics of Mixture* ends with the chapter “On Speculative Autotrophy”: “Au fond, la vraie connaissance du monde ne peut qu’être une forme d’autotrophie spéculative [...].” (Ultimately, true knowledge of the world can only be a form of speculative autotrophy). Emanuele Coccia, *La vie des plantes—Une métaphysique du mélange*, Éditions Payot & Rivages, Paris, 2017, 146.

**Autotroph** = any organism capable of self-nourishment by using inorganic materials as a source of nutrients and using photosynthesis or chemosynthesis as a source of energy, as most plants and certain bacteria and protists.

*The following essay emerged from our conversations sprouting in the Between Us and Nature—A Reading Club, that we have been running together in Berlin since 2017.<sup>1</sup> Over the years, reading and discussing texts about seeds, bacteria, fungi and multinaturalist narratives, our working partnership has grown into a sympoietic practice and a friendship. Getting familiar with a variety of authors, our interests and curiosity have taken us to works, quotes and notes by mostly female writers and researchers. Eva’s wish to write down some of the common research for *Feeding on Light* led to the piece composed by Sina in which she blends references from the Reading Club with her perspectives of agro-ecological justice. The evolutionary theorist, biologist, author and professor Lynn Margulis has become one of our main protagonists. Through Margulis’ emblematic book *Symbiotic Planet*, we have gained an intimate understanding of biological processes such as endosymbiosis, fusing and entanglement. These and other terms have become charged with meaning to us, to an extent that our individual and collective practices are transformed.*—Eva-Fiore Kovacovsky & Sina Ribak

#### Autotroph Speculation on Eating<sup>2</sup>

It’s a chilly autumn morning on a densely tree-covered shore of the river Havel in Berlin, where I am looking for sunrays. Blinking, I eagerly receive their warmth on my sleepy skin. Unasked, the sunbeams stir my senses. My gaze wanders up the glistening canopy of the black alder tree (*Alnus glutinosa*) unhurriedly absorbing forms and colours of the suspended foliage that the tree has arranged in layers up towards the sky, extending its surface to catch plenty of sunlight. At once frail and gleaming, the green of the leaves gently permeates my perception. Blue and red wavelengths of light are captured by chlorophyll pigments. To the human eye, the reflected wavelengths appear as green

3

Hope Jahren, *Lab Girl: A Story of Trees, Science and Love* (Fleet, 2017), Vintage Books—A Division of Penguin Random House, New York, 2017, 81: “The first real leaf is a new idea.” Geobiologist Jahren shares her passion for botany from a scientific, personal and female perspective. Chapter 7 starts with the above quote, introducing the description of the process of seedling establishment.

4

Lynn Margulis, *Symbiotic Planet: A New Look at Evolution*, Science-writers, Basic Books, Amherst, Massachusetts, 1998, 33.

5

Margulis, 73.

6

Margulis, 29: “A trapped blue-green bacterium that shed its wall to reside and grow comfortably in the cytoplasm of a plant cell, seemed to be exactly the organelle everyone called a chloroplast.” Endosymbiosis = When one organism takes up permanent residence within another, such that the two become a single functional organism.

hues. I struggle to adjust my vision, to grasp that the chlorophyll is not just a dye colouring the leaves green. As a photosynthetic molecule inside the chloroplasts, the chlorophyll is part of living organisms enabling life on Earth as we know it.

### The First Real Leaf Is a New Idea<sup>3</sup>

The microbiologist, professor and writer Lynn Margulis dedicated her career to exploring bacteria and the processes of life. She is considered one of the most important scientists in the fields of biology and evolution theory of the 20<sup>th</sup> century. Her controversial and ground-breaking findings are outlined in her book *Symbiotic Planet* in which she explains that symbiosis—the living together of very different kinds of organisms—is not only common in nature, but that many of evolution’s most important innovations, “the appearance of new bodies, new organs, new species,” are of symbiotic origins.<sup>4</sup> Margulis continues, “The history of any organism is often depicted on a family tree. Family trees usually are grown from the ground up: a single trunk branches off into many separate lineages, each branch diverging from common ancestors. But symbiosis shows us that such trees are idealized representations of the past. In reality, the tree of life often grows in on itself. Species come together, fuse, and make new beings, who start again.”<sup>5</sup>

What struck me most when reading and re-reading Margulis’ writings is the fact that chloroplasts had once been free-living single-celled cyanobacteria with photosynthetic abilities before becoming, at some moment(s) in evolution, part of multicellular organisms such as plant cells and forming a very close kind of symbiotic relation known as endosymbiosis.<sup>6</sup>

For millions of years, the usual behaviour of unicellular organisms was to reproduce or to eat, either by merging and duplicating, or by entirely digesting cells. Some cells, more than a billion years ago, were unable to digest the ingested photosynthetic bacterial cells. The bacterial cell not only survived within the other cell, but the two very different organisms started to cooperate, and hence a new kind of symbiotic organism formed.<sup>7</sup> From a bacterial

7

Margulis, 90: “More than a billion years ago, [when] protoctists evolved by integration of bacterial symbionts into permanent and stable communities [...]”

8

Margulis, 57: “The eukaryotes, the organisms with nucleated cells, all evolved by symbiogenesis. While in a bacterial cell, its DNA floats unbound in the cell fluid” (bacteria are prokaryotes = literally “before the nucleus”), “all other living organisms—protists, plants, animals and fungi—are eukaryotes who have their DNA protected in a membrane-bound nucleus.” Margulis, 7

9

Merlin Sheldrake, *Entangled Life: How Fungi Make Our Worlds, Change Our Minds & Shape Our Futures*, The Bodley Head, London, 2020, 90–92. In his mind-blowing book, the contemporary biologist Merlin Sheldrake weaves together many biological facts, including Margulis’ findings: Symbiogenesis = “becoming by living together” = the process of the formation of new organs, new organisms, new species through long-term permanent symbiosis, was first proposed by Konstantin Mereschkowsky and Boris Mikhaylovich at the beginning of the 20<sup>th</sup> century (note 25 of pages 88–91 in Sheldrake; Margulis, 38).

10

Stephano Stephanowic, *A Few Stumbling Steps Into the Wonderful World of Photosynthesis* (Chapter 1), Berlin: Occulto e, 2013, 47: “Using the sun’s

perspective, to renounce an individual, free-living way of life might have been a strategy for survival or a mere happy accident. Engulfed by a cell membrane, intracellular life offers shelter and relations to the partner. Algae, and later their plant descendants, emerged when photosynthetic cyanobacteria began co-living inside so-called early eukaryotic cells<sup>8</sup>. Integrated into the plant metabolism, the bacteria became chloroplasts containing the chlorophyll. Through fusing or “becoming by living together”, the partner cells acquired the virtue of photosynthesis.<sup>9</sup> In an attempt to embrace the agency of chloroplasts, I speculate on a chance encounter as the beginning of a long-lasting intimate relationship. If cyanobacteria had kept to themselves, a very different story of biological evolution might have unfolded. In symbiotic relationships, the sum is much more than its parts.

The symbiosis within early eukaryotic cells incorporating cyanobacteria brought about enormous powers that enabled the planet’s atmosphere, shaped the climate, altered geological eras, and—whether noted or not—continues to do so to this day.

### Light Harvest

The equation  $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$  describes the process of photosynthesis. I had to look that up. In my day-to-day life, I am mostly unaware of photosynthesis. Impervious to my ignorance, the chlorophyll ceaselessly collects light energy. It sounds like alchemy when sunlight, air and water become sugar. The chloroplasts are the ones capable of splitting water into oxygen and hydrogen, creating the condition to convert the carbon dioxide into chemical energy (glucose).<sup>10</sup> The sugar is then used for metabolic reactions in the photosynthetic organism. According to Stephano Stephanowic, director of the Centre for Fundamental Research in Photosynthesis, regarding the photosynthetic process itself, “oxygen is just a by-product, which can even be annoying to a certain extent”. From a more global perspective he adds: “Nonetheless, almost all of the oxygen present in the Earth’s atmosphere comes from photosynthetic water splitting.”<sup>11</sup>

radiation as an energy source, chloroplasts split water into oxygen and hydrogen, allowing for the reduction of carbon dioxide, fabricating sugar.”

11

Stephanowic, *A Few Stumbling Steps Into the Wonderful World of Photosynthesis (Chapter 2)*, Berlin: Occulto ð, 2015/2016, 45.

Stephanowic has been researching photosynthetic processes both theoretically and experimentally for over 15 years, with a simple, yet unique and original approach. His scientific research and publications, as well as the center where he works, are real, while the alias Stephano Stephanowic, and the proclamation of the Popular Republic of the Photosynthesis, are fictional tools to critique the academic world and get on with the related political struggles.

12

See footnote 2

13

**Heterotroph** = any organism which must consume other organisms (living or dead) to satisfy its energy needs = Consumer. [https://ucmp.berkeley.edu/glossary/glossary\\_C.html](https://ucmp.berkeley.edu/glossary/glossary_C.html)

14

See Rene Fester Kratz & Donna Rae Siegfried, *Biology For Dummies*, 2nd Edition, Indianapolis, Indiana: Wiley Publishing, 2010, 70.

The alders on the Havel’s banks, any plants, algae and some bacteria, through autotrophic assimilation, produce food for themselves and all other living beings. They feed on light.<sup>12</sup> Animals, including humans, do not symbiotically cooperate with chloroplasts (or photosynthetic bacteria). Humans are heterotroph beings, that is, they depend entirely on food generated by autotrophs.<sup>13</sup> Digesting these biological facts, the two modes of nutrition clearly collide with the ubiquitous anthropocentric perspective. Life offers so many rhythms, flavours and options, but autotroph humans seem unimaginable. We would not be the consumers, as usual, but the ones being eaten. Eaten alive, of course.

### Food Web

The invisible processes of photosynthesis are existential. It’s not only the oxygen we breathe. It’s the sugar we eat. The plants use the self-fabricated sugar to build their stems, flowers, and fruits. The chloroplasts in the leaves are like a built-in power plant that enables the plant to grow, to reproduce, simply to be. In a nutshell, plants produce all biomass and create our only biosphere. Sunlight and air become the leaves and the wood of the alder tree. In every sunlit ecosystem, autotrophs are the only organisms introducing self-made energy into the food webs.<sup>14</sup>

Stimulated by those abilities of the plants, I breathe in the humid air produced by the patch of alder swamp forest that I find myself in, trying to grasp those ancient powers in their entirety. My brain signals to me the need for food before it can do any more thinking. It connects to my stomach, calling for a breakfast ultimately made of glucose produced by plants. A scintillating thread crosses my thoughts. No, actually countless translucent filaments float into my field of vision. What are they? Spider webs—so late in the year? There. Tracing the fibre to its end, I discover a pale green caterpillar challenging gravity. Where is it headed? My initial assumption is it has fallen off the alder leaf. I almost want to give it a lift to make the supposedly arduous way up easier. Then I remember how the biologists Margot and Roland Spohn describe in their text *Foliage, Biologically Seen* the habits of organisms living in trees.<sup>15</sup> It’s a larva on its way to the

15

Margot Spohn and Roland Spohn, *Foliage, Biologically Seen*, 2019, see 312

16

Jean-Henri Fabre, *L’air, nécessaire à la vie*, Atelier du Gué, Villelongue-d’Aude, 1997. The quote is part of a nine-page manuscript by Jean-Henri Fabre discovered in Paris in 1982, probably written for a talk he gave in 1860. A German edition: Jean-Henri Fabre, *Die Luft—L’air, nécessaire à la vie*, Berlin: Friede-nauer Presse, 1983.

next stage of development. Over the spring, the larva has been eating through layers of the leaves while they were green, alive, and photosynthesising. After feeding on the biomass produced by the alder, the grown larva is now changing its milieu to start its transformation inside the body of the soil. Impressed, I take a step back, imagining its journey. I am glad that my stupid, yet well-meaning human intention did not intervene in its life cycle.

### Alive Cooking

Unable to directly collaborate with chloroplasts, I am cooperating with people who work the soil, and with plants and other organisms. In Community-Supported Agriculture, known in German speaking regions as SoLawi—solidarity-based agriculture—the cultivation of the land is a collective project. Instead of the few usual monocrops, non-commercial plant species are cultivated based on seasonal possibilities, fostering biodiversity and life without using pollutants. Thanks to good climatic conditions and helpers volunteering when needed, all members benefit from an abundant and diverse harvest. Not only human households, also tiny insects or baby rabbits get to feed on the veggies.

“Nous vivons doublement par les plantes; elles nous assainissent l’atmosphère, elles nous préparent le manger.”—Jean-Henri Fabre

In one short sentence, Jean-Henri Fabre says it all: “We live twofold off plants: They clean the atmosphere and prepare our meal”.<sup>16</sup> Unpacking my share of the harvest in the kitchen, I feel great pleasure in discovering the varieties. Touching the moist leaves, cleaning off the soil, I can see the traces of the living beings who have already fed on the Swiss chard. From time to time, some travel along in the vegetables as stowaways—a caterpillar, some cabbage aphids—creating an unexpected encounter. Carefully, I choose the freshest and most perishable greens, to be enjoyed right away, and wrap the others in kitchen towels. Waste is not an option. Impressed by the upshots of originally tiny seedlings, the least I can do to show respect for the amount of energy that went into them—in the form of light, water, microbial

See Vandana Shiva, *Soil, Not Oil—Climate Change, Peak Oil and Food Insecurity*, ZED book, London, 2007. Shiva is one of my role models: In 1993, the ecofeminist thinker, activist and author received The Right Livelihood Award. She continues to fight for biodiversity and the rights of the commons.

Coccia, *Drifting Continents*, Lecture at ici Berlin Kulturlabor Institute for Cultural Inquiry, October 1, 2018, Berlin.

See footnote 8.

activities, and human labour—is to make good use of all parts of the veg. While my hands do the sorting, I feel the textures. Leafy. Fleshy. Solid. Fragile. Crispy. Holding the parsley to put it in some water, I wonder if the process of photosynthesis continues. But where would the sugar go, considering the root stayed in the ground? How quickly did information of the stem’s cutting reach the chloroplasts?

Tending to vegetables is a sensual experience. I take a bite. Nibbling on oakleaf lettuce, my tongue feels the coolness of the sleek surface. Chewing, I imagine the breaking down of the plant cells with all their components, including the chlorophyll. Eating greens and their symbiotic partners, why don’t we turn green? Silly questions aside, Vandana Shiva’s important statement “We are what we eat” points out that food is political.<sup>17</sup> That keeps ruminating in me. Food sovereignty is a serious issue. At the same time, I propose a twist, speculating on what happens when we ingest the chloroplasts. At best, imagining their interaction with the human body can help us challenge our relations to living matter, and to land.

### Inner Plant

When Emanuele Coccia suggests to “analyse all elements of life from the position of plants,” my response is to zoom into the leaf tissues, into the life-enabling cells—the chloroplasts. Having attended one of Coccia’s talks,<sup>18</sup> I remember his excitement about multicellular organisms—alga, plant, animal including human—all being eukaryotes. Thinking through the categories of these groups, usually their distinctness is emphasised. Coccia’s enthusiasm paired with Margulis’ writings reminds me of how much alga, plant and animal have in common: in particular common bacterial ancestors.

Around fifty years of the history of science have passed since Margulis further developed the earlier idea of symbiogenesis: the origin of the nucleated cell, hence of eukaryotes, evolved by symbiogenesis—organisms belonging to two entirely different kingdoms fusing and forming a new kind of organism.<sup>19</sup> Margulis’ peers, however, were not

Sheldrake, 90: “Over the twentieth century, the concept of inter-kingdom collaboration transformed scientific understanding of how complex life forms evolved.”

Sheldrake, 91: “The endosymbiotic theory, as it came to be known, rewrote the history of life. It was one of the most dramatic shifts in biological consensus.”

Pedro Neves Marques, *Semente Exterminadora (Exterminator Seed)*, Short fiction film. 28 min., 2K video, colour, sound. Portuguese with subtitles, 2017.

See Margaret McFall-Ngai, *Noticing Microbial Worlds: The Postmodern Synthesis in Biology*, In: Anna Lowenhaupt Tsing, Heather Anne Swanson, Elaine Gan, Nils Bubandt (Eds.). *Arts of Living on a Damaged Planet—Ghosts and Monsters of the Anthropocene*, University of Minnesota Press, 2017, G87–G102. This anthology offers an essay by zoologist Margaret McFall-Ngai, one of the most prominent genomics research pioneers. “Cross-species interaction has been shown as essential to development, evolution, and ecology,” driving a paradigm shift in biology, “one that is changing entire disciplines as well as the ways we understand the world.” (Eds., M23)

sparked by curiosity but rather ignored or attacked her hypothesis. Scientific tools and the zeitgeist were not ready to recognise one of biology’s most important paradigm shifts: fusing and symbiosis rather than branching and competition are the prominent processes of the origin and evolution of life on Earth.<sup>20</sup> Finally, genetic tools demonstrated that she had been correct: chloroplasts (and mitochondria) had started off as free-living bacteria. The scientific world could no longer escape the evidence: bacterial processes engaging in endosymbiosis are responsible for evolutionary novelty on planet Earth. Microorganisms are at the origin of multicellular organisms, meaning bacteria are our evolutionary partners.<sup>21</sup> At the beginning of the millennium, I had taken up studies related to natural sciences in order to gain a better understanding of the world, but Margulis’ theories were never brought to my attention. Now, I feel shocked when I think about how narrow my view of planet Earth was during those years.

Wrapping my head around the deep time of past and continuous chemical and biological evolution, my own ideas of relations to living organisms are shifting. Considering that (cyano)bacteria are our ancestors, I think of chloroplasts as our kin. Consequently, can plants be regarded as our ancestors, too? Ywy, a fictional film character created by the artist and writer Pedro Neves Marques, would say so. Every time I enter Marques’ speculative world, I am impressed by their critical vision of biopolitics, technology, and gender. In Marques’ short film *Semente Exterminadora*, amidst monocultural corn plantations, Ywy, an android with the appearance of a woman, engages in a conversation with plants. She reflects on transgenic plants and compares their infertility to her own. When her human companion asks her: “Ywy, do you really believe that plants know? Know that they are humans. Isn’t that what you say?” Ywy’s answer is striking: “It’s only you who doesn’t know.”<sup>22</sup> Embracing such a cosmology tickles my perspective on the history of life. When contemplating modern western biology, I find it deeply fascinating how science has only recently recognised as a fact that cooperation has shaped our planet more than competition<sup>23</sup>, and I daresay that this fact was perpetually embedded in many ancestral knowledges.

See Robert Sanders, *NASA sweetens the pot: Team wins competition to make space sugar*, Berkeley News, Accessed November 20, 2021, <https://news.berkeley.edu/2021/08/24/nasa-sweetens-the-pot-team-wins-competition-to-make-space-sugar/> 25

Donna Haraway, *A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century*, in *Simians, Cyborgs and Women: The Reinvention of Nature*. New York, Routledge, 148: "A cyborg is a cybernetic organism, a hybrid of machine and organism, a creature of social reality as well as a creature of fiction." 26

Kelsey K. Sakimoto, Nikolay Kornienko, & Peidong Yang, *Cyborgian Material Design for Solar Fuel Production: The Emerging Photosynthetic Biohybrid Systems*. Accounts of chemical research, 50 / 3, 2017, 476–481. See also Peidong Yang Group, *Photosynthetic Biohybrids*, Accessed November 2021, <http://nanowires.berkeley.edu/photosynthetic-biohybrids/> 27

In this video, "Team SSWEET (Space-Sugar with Electrochemical Energy Technology) explains their electrochemical process for converting carbon dioxide and water into sugar, which can be fed to microbes genetically engineered to produce more complex chemicals, including food." Accessed May 14, 2022, <https://www.youtube.com/watch?v=ITIKft2Y23w>

## Machines Feeding on Light

In addition to the leaves, new players are engaging in cooperation with chlorophyll. Labs proudly assemble microbes and materials, with the desire to enact an artificial photochemical biosynthesis.<sup>24</sup> The researchers employ the narrative of the symbiotic relationship, promising that the cyborgian design will allow to "surpass the capabilities of the individual components" by combining electronics with genetically modified photosynthetic bacteria.<sup>25</sup> The human-controlled devices take "advantage of the metabolic pathways in living organisms" to produce the CO<sub>2</sub>-derived chemicals.<sup>26</sup> So far, one lab experimenting with cyborged photosynthesis has managed to manufacture "space sugar".<sup>27</sup> A biotechnology that allows (greater) energy gains while using less resources and emitting lower emissions seems attractive. Copying nature for technological uses and human purposes, including the technology of agriculture, is common. However, the benefits of the envisioned renewable sugar production seem entirely unrelated to planetary urgencies such as hunger, biodiversity loss and climate change.

While natural photosynthesis has produced an abundance of nourishing glucose for millions of years, the present plan for patented photosynthetic biohybrid systems is to equip deep-space exploration. I'm afraid this cyborged performance will alight the metabolism of empires rather than life processes.

In the current shift from fossil-fuelled to bioeconomic societies, an anthropocentric view prevails, in which, firstly, all resources are regarded to be primarily meant for human consumption, and, secondly, natural photosynthesis is considered not efficient enough, since the plant leaf's chloroplasts use only a particular spectrum of the sunlight. Despite broadening this spectrum, existing human-made machines such as solar panels do not hold up to the natural chloroplasts' capacity. I am at a loss of words to translate the robustness of natural photosynthesis, so I refer again to Coccia: "The leaf is the paradigmatic form of openness: life capable of being traversed by the world without being destroyed by it."<sup>28</sup>

[com/watch?v=ITIKft2Y23w](https://www.youtube.com/watch?v=ITIKft2Y23w)

28

Coccia, *La vie des plantes*, 42: "La feuille est la forme paradigmatique de l'ouverture : la vie capable d'être traverser par le monde sans être détruite par lui."

29

See Andreas Gigon, *Symbiosen in unseren Wiesen, Wäldern und Mooren: 60 Typen positiver Beziehungen und ihre Bedeutung für den Menschen*, Bern: Haupt, 2021.

30

See Davi Kopenawa & Bruce Albert, *The Falling Sky—Words of a Yanomami Shaman*, Harvard University Press, Cambridge, 2013. The expression *në rope* (or *në ropeyoma*) literally means "value of quickness (of growth)," "value of fertility", it is synonymous with *në wamotimapë*, "value of food".

31

Kopenawa & Albert, 540, footnote 37: "The Yanomami territory is located on both sides of the Serra Parima mountain range, from which the Orinoco and most of the tributaries of the Rio Branco's right bank and Rio Negro's left bank flow."

32

See Felix Creutzig, *Govern land as a global commons*, *Nature*, 546, 2017, 28.

33

See Margulis, *Symbiotic Planet*, 107.

34

Coccia, *La Vie des Plantes*, 146–147.

## Leaves Matter

Plants grow continuously, constantly renewing their organs and leaves. 60 types of positive symbiotic relations among plant, animal, fungi and bacteria species have been described for mid-European meadow, forest and peatland ecosystems.<sup>29</sup> Their extraordinary diversity of life is unmatched by cities, plantations and other zones of extraction. Davi Kopenawa tells us that, in the Amazon, he and the Yanomami people call the richness of the forest *në rope*. Bruce Albert, who wrote down the shaman's stories, explains that *në rope* can be both understood as "value of growth of the forest", and "value of food". I am curious how many more-than-human relations this short expression encompasses.<sup>30</sup>

"The forest did not grow alone, without reason. Its *në rope* value of growth makes it alive and gives it its richness. [...] Our forest is still beautiful and cool, even when the rain becomes scarce. Its *në rope* power of growth keeps the trees alive. [...] Beyond the forest, the white people's territory that surrounds us consists only of wounded lands from which the epidemic fumes come. [...] All they think about is making our land as bare and blazing as the savanna that surrounds their city of Boa Vista. They probably believe that nothing can exhaust it [the forest]. They are wrong. [...] The shamans clearly see that the forest is suffering and sick. They fear that it will finally return to chaos and that all the human beings will be crushed, as it happened once before." — Davi Kopenawa<sup>31</sup>

Farming is one of the heaviest forms of land use, with global consequences in terms of climate change, biodiversity loss, draught, erosion, flooding and pollution. And yet, it also offers the greatest opportunities to restore land.<sup>32</sup> From an autotroph perspective, the land "belongs" to the plants who have populated it since they emerged from the oceans around 450 million years ago.<sup>33</sup>

"Plants," with the assistance of bacteria and fungi, "are capable of transforming into life any piece of earth, air or light."<sup>34</sup> The energy, transformed

Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), *Summary for Policymakers of the IPBES Global Assessment Report on Biodiversity and Ecosystem Services*, Bonn, Germany, 2019, 39: "Substances, objects or other material elements from nature that sustain people's physical existence and the infrastructure needed for the operation of a society or enterprise. They are typically physically consumed in the process of being experienced, such as when plants or animals are transformed into food, energy, or materials for shelter or ornamental purposes."

See IPBES, 10.

Robin Wall Kimmerer, *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants*, Milkweed Editions, Minneapolis, 2014, 176: "I wish I could photosynthesize so that just by being, just by shimmering at the meadow's edge... I could be doing the work of the world while standing silent in the sun. [...] But this generosity is beyond my realm, as I am a mere heterotroph."

As a botanist, Robin Wall Kimmerer has a scientific approach to nature. As a member of the Citizen Potawatomi Nation, plants and animals are her oldest teachers.

See Sheldrake, *Entangled Life*, 90.

by leaves, becomes visible matter. Decomposers, herbivores, and carnivores can see, touch, smell, feel, and share it. Not only humans turn it into fibres, paper, shelter, medicine.<sup>35</sup> Humans and caterpillars alike are part of networks of organisms that consume the matter composed by glucose molecules, eating organic compounds, making use of the value of food, eating one another, passing on energy to one another. We are interdependent in the recycling of energy, sugar, matter and biomass led by chloroplasts. In the absence of (photo)autotrophs, energy would not form the eternal loop of recycling, but would dissipate as heat and the ecological community would collapse. All heterotrophic beings, including us humans, would die in the absence of food.<sup>36</sup>

### Food Forest

Next to philosophers, biologists, farmers, shamans, activists and artists, I also need to consult a botanist, of course—more precisely, Robin Wall Kimmerer, who embodies scientific and indigenous knowledge in one person. Her "notion that plants and animals are our oldest teachers" is one of the important truths for the Reading Club.<sup>37</sup> I can relate to Kimmerer's envy of plants for their ability to photosynthesize. Inspired by her reflections on giving and her heterotroph aspirations, I would like to make a nourishing contribution by shining a light on the coexistence with leaves. Nesting the agency of chlorophyll within biological and artistic research, indigenous wisdom, and Community-Supported Agri-Culture, I understand that the relations of any organism, whether bacterium, animal, plant, alga or fungus, are co-creating knowledge.<sup>38</sup>

Leafing through the food forest crafted by Eva-Fiore, her work sparks in me the image of the memorable mouse Frederick, who continuously and unwaveringly collected colours and sunrays, while the rest of his community gathered food provisions.<sup>39</sup> As a child, I remember cutting out paper leaves, the mice, the grains and the sun for a handmade kindergarten edition of the book. Towards the end of the tale, when the mice's supplies are used up, Frederick shares the stories he had absorbed from his surroundings, bringing warmth and light into the cold and barren winter season.

See Leo Lionni, *Frederick*, Gertraud Mittelhaue Verlag, München, 1985.

"Close your eyes," said Frederick, as he climbed on a big stone. "Now, I send you the rays of the sun. Do you feel how their golden glow...?"—Leo Lionni

Eva-Fiore's collection of leaf portraits is a record of the interrelations of light and organisms. Not only does she visualise the agency of plants and insects, she also interacts with them in a symbio-artistic practice. I take it as an invitation to read the relationships archived in the leaves, which hold knowledge around the interdependency of eating, being eaten, and aliveness. To know the symbiotic story of photosynthesis can help us to live through stretches of incertitude.

Sina Ribak is co-founder of the Between Us and Nature—A Reading Club with Eva-Fiore Kovacovsky. She is a researcher for ecologies and the arts, exploring bioeconomy, land use, soil, biodiversity from a critical, more-than-human perspective. Her transdisciplinary training in land use, nature conservation, Common Agricultural Policy, and landscape gardening intersects with her experiences in cultural management and Collective Practices Research. Rooted in Berlin, Sina embraces several natureculture contexts, having lived and worked in Indonesia, Bolivia, France, and the UK. On the ground, social and ecological justice to her means being a member of a solidarity-based agriculture community and being involved in trans-local ecosystems and collectives aimed at collaboratively shifting paradigms and narratives through gathering, storytelling, trust, sharing, and experimentation.

Edited by Alice Cannavà and Yasmine Ostendorf.