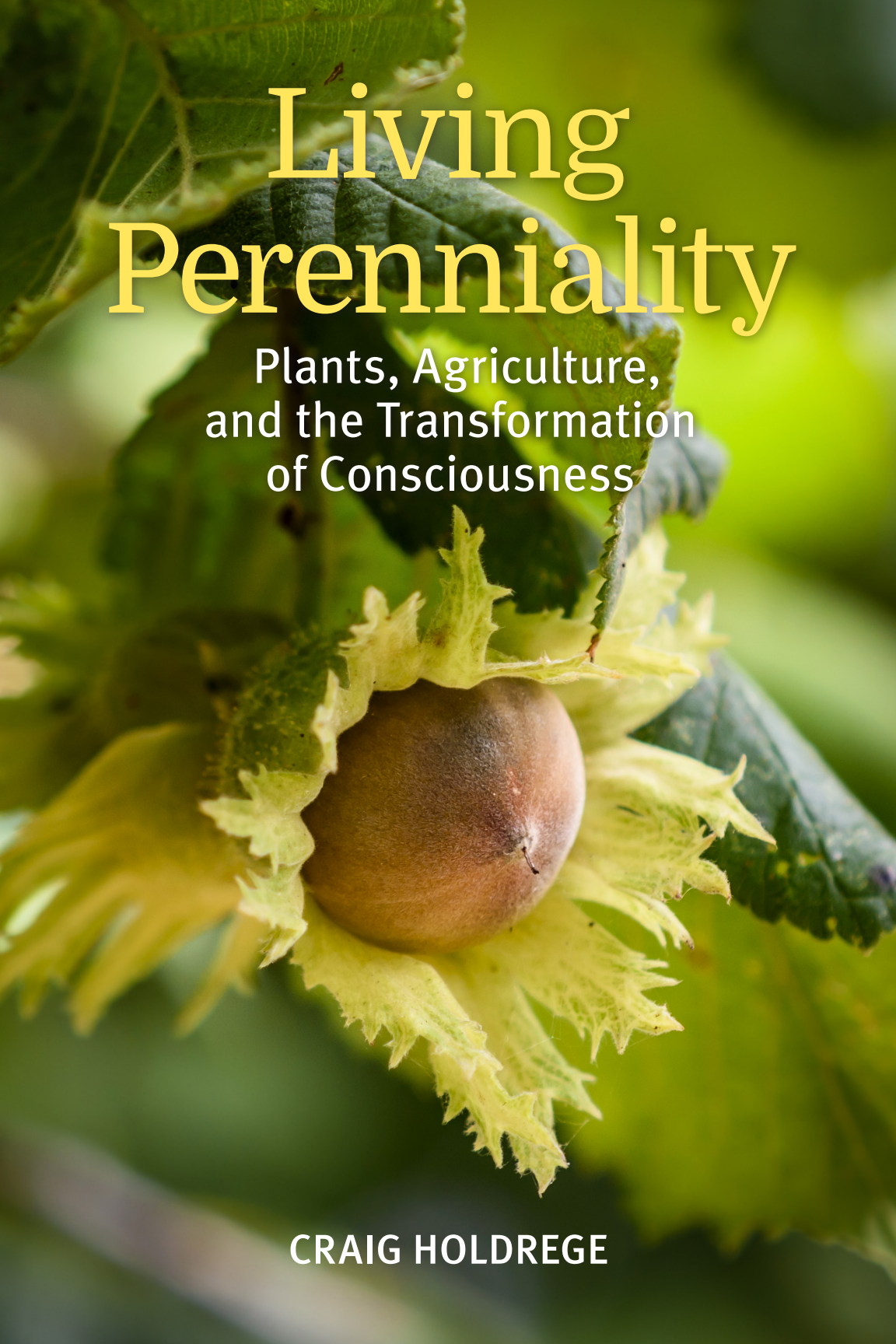
Living
Perenniality
Plants, Agriculture,
and the Transformation
of Consciousness
CRAIG HOLDREGE

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Contents

CHAPTER 1

Prelude

This book weaves together the study of annual and perennial plants, agriculture and its origins, and riddles of human consciousness. The intent that connects these seemingly different topics is my overall striving to discover and articulate ways of moving from learning *about* nature, to learning *through* or *with* nature. I'm concerned with the development of capacities to perceive, think, and act in ways that are in sync with the dynamics of the living world. At a time when human thought and action generate so much that hinders the vibrant and healthy burgeoning of life in all its diversity and fullness, giving attention to how we can develop our own aliveness and our connectedness with the life of the planet is of no small concern.

We can learn a great deal from plants about the nature of life. In my research for this book, I took the notions of annual and perennial plants as lenses to consider how plants live and interact with the larger environment. It is relatively easy to study different plant species and to categorize them: this is an annual and that is a perennial. It is also fairly boring. The research became especially interesting when I started to see ways in which annuals have perennial characteristics and perennials have annual characteristics. "Annual" and "perennial" were then no longer categories (conceptual containers) that stood side by side. Increasingly they showed themselves as relational qualities of life itself. I was able to see the dynamics of plant life in new ways. In Chapter 2, I begin this exploration of annualness and perennialness in wild plants and expand it through the course of the book.

The focus on agriculture begins in Chapter 3 with an overview of annual and perennial food crops. All major grain crops and most staple food crops around the world are annuals. These are plants grown anew from seeds each growing season—and not perennials that live for a few to hundreds of years (think of fruit- and nut-bearing trees). Annual crops have many advantages, such as the short life span allowing flexibility in crop selection and also harvest during or at the end of each growing season. They can also be problematic. When, for

example, fields are plowed each year and soil is laid bare, there is the likelihood of erosion, and in fact huge amounts of the earth's fertile soil are lost each year. The question of the long-term sustainability of agriculture is not only related to what kinds of crops are grown but to how they are grown. Today's industrial agricultural practices encompass both annual and perennial crops and have resulted in remarkable yield increases. This comes at a cost. Monocultures of high-yielding crops need irrigation, applications of chemical fertilizers, pesticides, complex machinery, and more. So while yields rise, there is heavy extraction from the environment (water and fossil fuels) and widespread pollution. This high-input, extractive approach is not sustainable in the short or long term—let alone regenerative. I discuss a variety of approaches that strive to integrate agriculture into the healthy ecology of the earth. One of them is to develop more perennial staple crops.

The stage was set for the dominance of annual crops from the very beginnings of agriculture around 10,000 years ago. When widespread planting of crops began in different parts of the world, it was annuals that became the primary staples—think of wheat in the Middle East and Europe, rice in Asia, millet in Africa, or corn (maize) in America. As I discuss in Chapter 4, this preponderance of annuals is a riddle. It is also a riddle to which there are no clear answers, since the initial development of crops lies in a distant past long before there were any written records.

Many scholars have concerned themselves with the beginnings of agriculture and formulated a variety of theories and conjectures about what led people to shift from hunting and gathering food to growing and breeding crops. Some researchers—often those with natural science backgrounds—emphasize possible external factors such as changing climate, food scarcity, or overpopulation. Others—often cultural anthropologists—point to societal and cultural contexts and what we might call more internal factors such as religion. One thing is clear: there is no consensus about what might have driven (the view from the outside) or motivated (the view from the inside) the beginnings of agriculture.

While considering the wide variety of perspectives, I was struck by the dominant tendency to address the origins of agriculture as a problem to be solved. As agronomist and plant geneticist Jack Harlan writes provocatively: "One problem I have with all the published models is that they are all conceived by middle class, university-educated, Industrial Age pragmatists, all looking for some golden bottom line that will explain it all."[1] While this statement may be a bit exaggerated, especially since there are many researchers today who realize that there is no "one" explanatory framework, Harlan puts his finger on an important issue: the "problem" of the origins of agriculture is conceived in terms that fit a specifically modern mode of viewing the world.

1. Harlan 1998, p. 25.

This mode of explaining and interpreting assumes that ancient people, in essence, had minds that work like ours and confronted a reality that was configured the way we perceive it today. In other words, the way we view things today is imagined to be a reflection of the way things are. With this assumption, agricultural practices would have arisen as strategies to deal with new problems that arose due to changes in external factors, such as changing climate.

Beyond the fact that such "explanations" are highly speculative, they ignore the evidence that ancient people did not experience the world the way most of us do today. Harlan points out that if you had asked someone who lived 5,000 or 10,000 years ago about the origins of agriculture, you would have received—from a modern perspective—a surprising response: "In classical mythologies of all civilizations, agriculture came as a divine gift. A god or goddess came not only to instruct the ignorant in the arts of farming and of agriculture but to enlighten them with respect to law, religion, household arts and proper ways of living."[2] As I show in Chapter 5, the same is essentially true with respect to indigenous agricultural societies that have continued to exist into the recent past and present—inspirations stem from beings who communicate through nature, ceremonies, and dreams.

From an ancient or indigenous perspective (broadly seen, and ignoring for the moment all the nuanced variations), reality consists of a weaving of beings and animate forces. The human being as one being among many is caught up in that weaving. Nature is not an impersonal "out there," separate from a personal "in here." I discuss how the development of modern science since the 17th century consummated a shift in the Western world from experiences of nature as animate and spirit-filled to the conviction that nature, at its foundation, consists of lifeless forces and matter. Impersonal cause-and-effect relations, not beings, rule the universe. Today life is thought to be built up out of mechanisms. The inanimate, not the animate, has become primary.

This contrast opens up the topic of the changing ways in which people experience the world—the transformation of human consciousness. I do not dismiss ancient or indigenous views as superstition—since such a judgment is based on the ungrounded assumption that the modern scientific view reflects the way things are and always have been. While I acknowledge the power of interpreting and manipulating the natural world as if it were a complex mechanism—the dominant approach in science and technology—I also see it as all too narrow to do justice to life.

Once we realize that what we call reality is always related to consciousness, we can also understand that we are always participating in and co-configuring the world as we experience it. This is an epistemological insight and leads me to recognize that connectedness, and not separation, is fundamental in life. In this respect indigenous views resonate with me even though I have a wholly different

2. Harlan 1998, p. 1.

cultural background. My consideration of the origins of agriculture wants to show the limitations of theorizing and takes seriously the transformation of consciousness.

The last chapter of the book addresses the present and looks to the future. At the heart of many efforts to create more ecologically oriented, regenerative approaches to farming lies the question: Instead of imposing an extraction-based, mechanistic framework on nature and food production, can agriculture be modeled after nature's workings? This is a call for a different way of being in the world—it is a call for biocentric or ecocentric approaches. And these can only be gained through a better understanding of living nature, including that part of nature we call ourselves.

Since the mechanistic mindset and the dominant tendency to dissolve living processes into separate factors that one thinks "make things happen" is so strong, it is by no means an easy task to develop truly living ecological and holistic insights. The framework of modern thought leads us to approach life in non-living ways and constrains us from all sides. But I think it is possible to move beyond those constraints, if only we increase our awareness of our own aliveness and focus attention on aliveness in natural phenomena so that they can teach us. I describe this dialogic endeavor here as "living perenniality." I see in it the beginnings of a radical transformation of consciousness that has the potential to let the wisdom of the living world increasingly inform human endeavors.

On knowing that is alive

When I study nature, all my looking is informed by past experience. This includes all the concepts I have learned. Concepts are a two-edged sword. On the one hand, they give me an orientation and focus for my study. On the other hand, they can narrow my view, so that I may tend to fit what I find into preexisting categories. In his journals, Henry David Thoreau expressed in characteristically radical and fresh manner the tension that arises when a person wakefully attends to how ideas inform sensing:

> It is only when we forget all our learning that we begin to know. I do not get nearer by a hair's breadth to any natural object so long as I presume that I have an introduction to it from some learned man. To conceive of it with a total apprehension I must for the thousandth time approach it as something totally strange. If you would make acquaintance with the ferns you must forget your botany.[3]

3. Thoreau's journal entry from October 4, 1859 (Journal XII: 371); in Walls 1999, p. 91.

In this sense, it is only when I try to leave behind what I already know that I become truly open to what is new in sense experience. This is a prerequisite for learning. But at the same time, Thoreau knew out of his own experience how important previous knowledge is:

> The scarlet oak must, in a sense, be in your eye when you go forth. We cannot see anything until we are possessed with the idea of it, and then we can hardly see anything else. In my botanical rambles I find that first the idea, or image, of a plant occupies my thoughts, though it may at first seem very foreign to this locality, and for some weeks or months I go thinking of it and expecting it unconsciously, and at length I surely see it, and it is henceforth an actual neighbor of mine. This is the history of my finding a score or more rare plants which I could name.[4]

The art of knowing involves finding ways to let ideas (concepts) continually grow through new experiences. If I subsume new experiences under already existing notions, then I am boxing those experiences in. If, by contrast, new experiences allow my idea of ferns or scarlet oaks to expand and deepen, I am entering a living dialogue with nature. My perception is then imbued with an attitude of mind that is open to surprises and to the unexpected, and also rooted in a rich field of past experience.

4. Thoreau's journal entry from November 4, 1858 (Journal XI: 285); in Walls 1999, p. 84.

CHAPTER 2

Wild Annuals and Perennials

If there are two rhythms that are most decisive for life on Earth, they are the day and the year. On the equator, each day of the year alternates between 12 hours of daylight and 12 hours of night. In the tropics there is relatively little seasonal variation, especially in those areas that have ample rainfall throughout the year. A tropical tree can form buds, sprout leaves, lose leaves, develop flowers, fruits, and seeds all at the same time.

The further we move from the tropics, the more there are variations in the year that become essential for life. Subtropical regions often have distinct dry and wet seasons, while in temperate zones the annual pendulum swing between short days of cold winter and long days of warm summer is decisive. The farther you move toward the poles, the more radical the difference between winter and summer. On the poles, the day has essentially disappeared, since the sun rises and sets only once a year. (On the north pole, dawn begins in March and on the spring equinox the sun slowly rises above the western horizon. It hugs the horizon and climbs gradually higher in the sky, reaching its greatest height on the summer solstice. It then begins its slow descent, setting on the fall equinox. From then until the spring equinox six months later, the sun is beneath the horizon.)

Every plant is a creature of the light. By exposing its green tissues to the power of light, and taking in carbon dioxide, water, and a small amount of minerals, the plant is able to build up its own organic substance. This is the miraculous process we call photosynthesis. Being children of Sun and Earth, it is no wonder that plants are so deeply entwined with the solar rhythms of day and year, and with their place on the planet. In the course of evolution, myriad plant forms have developed around the globe, each in its own way living in relation to the terrestrial, biotic, and cosmic conditions of its region. The consideration of annual and perennial plants provides one entryway into the manifold life forms of plants.

The categories of annuals and perennials have been used by botanists to express different life histories and life forms that plants can have. An *annual*

plant develops from a seed and in one growing season develops new seeds, while the rest of the plant dies away. *Biennial* plants live for two seasons, usually growing vegetatively in the first year and flowering and going to seed in the second. *Perennial* plants live through more than two or more growing seasons. In *herbaceous perennials*, leaves and aboveground stems die away, but roots, bulbs, or underground stems continue to live. In *woody perennials*—shrubs and trees—the above-ground trunk and branches grow from year to year. Some perennials live only a few years, while a few live for thousands of years.

In the course of my inquiry, I experienced how these concepts began to grow and become more fluid.

Annual plants

Annual plants have a short life cycle. When the seed of an annual finds adequate conditions, it germinates, sends down roots, develops a stem and leaves, and progresses rapidly into flowering, fruiting, and developing new seeds. While the seeds are maturing, the mother plant dies away. The annual plant lives in a continuous movement of transformation—bringing forth new members as old ones die off. Some annuals can develop from germination to seed production in less than two weeks. (See figure 1).

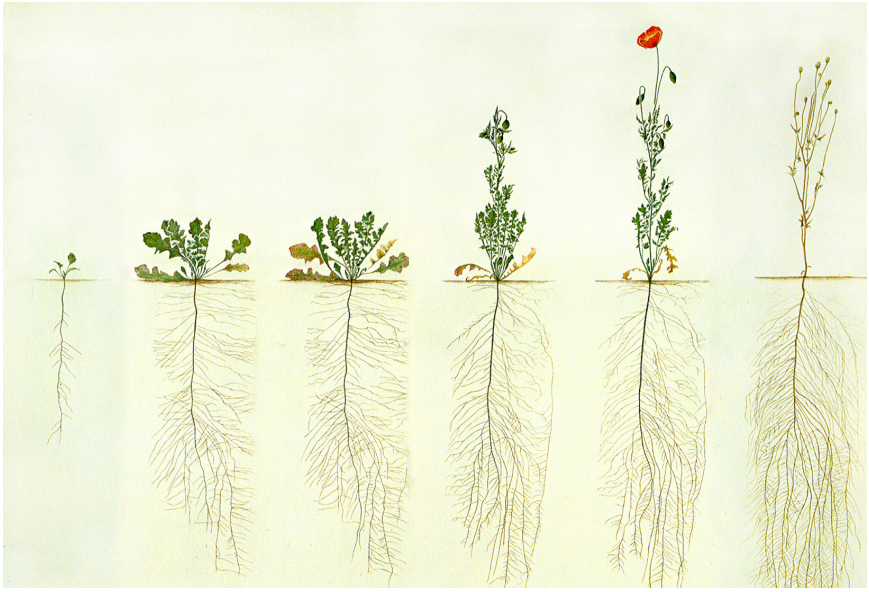

FIGURE 1: Development of the field poppy (*Papaver rhoeas*), an annual plant. This plant developed from seed to seed formation over the course of 13 weeks. There is a two-week interval between each stage depicted. (From Holdrege 2013)

From a physiological perspective, annuals have the capacity to interact with light and carbon dioxide from the air in a way that allows them to carry out photosynthesis at a high rate, so that they grow quickly. They do not form lasting organic substance in their roots and stems. Rather, they put proportionately more substance than perennials into seed formation.[5]

The seed is the most lasting phase of an annual's life, and only the seed carries the species into the next growing season. It may germinate soon after being shed or it may lie dormant for weeks or even years. The seed is a unique stage in the life cycle of any plant. While the whole plant from which the seed develops is rooted in one spot in the earth, the seed becomes an independent entity. It can move—via wind, water, or animals—from place to place. Since many annuals are prolific seed producers, their seeds can spread out into the wider world. Most of them will not germinate, but some will find conditions that allow them to develop through a whole new life cycle. With seed germination and subsequent growth, the plant embeds itself into—and also brings to expression—the conditions of a particular place.

Only about 10 percent of all flowering plant species are annuals. They are most prevalent in sunny environments and in places where other vegetation is sparse. In dry habitats such as deserts, seeds of annuals may lie dormant for many years until adequate rain falls, and then burst into rapid growth; the desert blooms with annual wildflowers.

Most of the "weeds" in gardens or crop fields are annuals. ("Weed" is an anthropocentric designation of wild plants that grow where we want only our domesticated plants to grow.) Through tilling we open up the soil, free it from plants, and in this way provide ideal conditions for wild annuals to thrive. Common groundsel, for example, is one such "weed" that can flower through a good part of the year, and its seeds float off in the wind like those of dandelions. I know groundsel mainly from Europe, and generally found it where the soil had been disturbed and opened up in yards and gardens. Taking hikes that led me far from such gardens into woodlands and through pastures, nowhere did I see groundsel. Then I would come upon a place where foresters had burned tree limbs in the previous year. Virtually without fail many groundsel plants would be just there, growing out of the charcoal-covered soil. Their seeds are everywhere, but they only germinate and take root in specific microenvironments.

This example can give you an impression of the way annuals exist. They have a rapid life cycle, developing from seed to seed within a few weeks to a few months, depending on species and conditions. The seeds spread and most of them will never germinate. But some find conditions, such as a patch of open soil, that allow them to develop through their whole life cycle. They bring plant life to areas that are otherwise open, and suffuse that environment with new growth. In this way they fill out gaps in the mantle of plant growth in a variety of

5. Bazzaz and Morse 1991.

environments. When they die, decomposers break them down, which provides new conditions for other plants to grow. Annuals are often pioneer species in ecological successions.

Where vegetation is dense, such as in a prairie or pasture, or very shady as in the understory of forests, you find very few annuals. If a spot opens up, such as through an animal digging a burrow in a pasture, seeds of annuals may germinate and the plants can develop, but with time perennial grasses or wildflowers that dominate the plant community will replace them. So we can see annuals as plants that "come and go," creating plant cover to barren areas for a short time until a plant community develops that mainly consists of perennials.

In the larger story of plant life on Earth, annuals, on the one hand, re-vegetize disturbed areas, initiating an ecological succession of plant species, and on the other hand, in dry and desert climates they enliven the earth for a short period of time when periodic rains come.

So that we don't get caught in rigid categories, I want to mention that some plant species have populations that develop as annuals, biennials, or perennials. For example, annual bluegrass, *Poa annua*, is a widespread "weed" that is usually an annual. But populations of species exist in which individual plants are biennials or perennials.[6] The perennials can live for a few years by producing new side stems (tillers) that take root and persist. Interestingly, in some instances, the perennial types grow in more dense pasture-like groups, while the annual types grow in places where vegetation is sparser. Another weedy annual, wild rice (*Oryza rufipogon*), also has perennial forms, and these tend to grow in deep swamps, while the annuals are usually found in swamps that periodically dry out and where the soil can be parched for part of the year.[7] As these examples demonstrate, plasticity within a species allows it to vary and establish new life histories, often in relation to different environmental conditions.

Perennials

Except for equatorial plants, most plants on the globe are embedded in a yearly cycle since they have a period during the year when they form flowers, fruits, and seeds. By maintaining roots, stems, and sometimes leaves beyond one growing season, perennial plants become more independent from the annual solar rhythm that is so determinative in the life of annuals. New shoots and leaves in the current season develop out of the buds and germinal tissue that the plant formed in the previous year. In this way herbaceous perennials—most wildflowers and grasses—can live for a few to many years, while woody perennials—vines, shrubs, and trees—live for decades to many hundreds of years. The oldest known individual plants are bristlecone pines of the western

6. Gibeault 1971; Law et al. 1977.

7. Morishima et al. 1984.

United States, which can live to be well over 4,000 years old. Between the short-lived annuals and long-lived trees there are countless types of plants that range in lifespan of the individual plant from two seasons (biennials) to a few years, to many years. Perennial plants—especially trees—become long-term inhabitants of a specific place on Earth, strongly influencing their environment and being influenced by it (see Figure 2).

FIGURE 2: European linden (*Tilia platyphyllos*) with three different growth habits related to where they grow. The bush-like trees on the left grew on the slope of a mixed deciduous forest with a southern exposure in Switzerland. The tall and narrow-crowned trees on the right grew on the opposite, northerly exposed slope of the same valley, also in a mixed deciduous forest. A few kilometers away the freestanding tree grew in a meadow, spreading its large crown in all directions. (Drawings by Mathias Buess; in Bockemühl 1992)

Generally speaking, perennials grow more slowly than annuals, and most perennial wildflowers only begin to flower and produce seeds after a few years. Woody plants develop even more slowly. You can find trees in a temperate forest that are 10 years old and not even three feet high. Moreover, oaks, ashes, maples, and many other trees will often not form flowers and seeds until they are 20 or 30

years old. While slowing down growth and reproductive maturation, trees form the hard and relatively lasting substance of wood. They develop enduring form and substance that becomes the basis for more growth each year. Every year trees expand in girth by adding a ring of wood to trunk and limbs, and grow in length through extending and branching limbs.

In a mature tree, the tips of the twigs form buds during the growing season that will open the next year. These buds contain a germinal stem, leaves, and in some cases flowers. Each year the thousands of buds on a tree unfold and develop a twig with leaves and flowers. In this way the tree, like an annual plant, is embedded in a yearly rhythm. But stems of the "plantlets" that have grown out of the buds do not die away; they become woody and remain rooted in the tree. Year by year the tree thickens its trunk and limbs, laying down new rings of wood, and extends the tips of the branches. Through this growth and branching the tree forms a living foundation for annual growth raised far from the ground—and deep into the soil.

Taking root

While the whole annual plant dies back at the end of the growing season, in herbaceous perennials, the underground stems and roots can continue to grow year to year. In woody perennials, both aboveground stems and the roots below ground continue to grow year to year. In this way perennials develop larger and deeper rooting bodies than annuals. How expansive and deep the roots of a plant grow depend significantly on the soil environment. Figure 3 shows the roots of three Siberian elm trees that are approximately the same age. The root profiles differ starkly from one another. While there is no way to tease out all that influences root growth, it is clear, at least in this case, that the below-ground surface of the water table marks a boundary for the growth of the roots into the depths.

While most of the roots of plants are in the upper meter of soil, roots can grow very deep. Trees and shrubs have the deepest roots, followed by herbaceous perennials.[8] In exceptional cases, roots of trees and shrubs can grow over 20 meters (65 feet) deep and radiate sideways over 20 meters from the trunk. The longest roots have been discovered in bore holes or mines, reaching down more than 60 meters (197 feet).[9]

Roots are in an ongoing process of growth and decay. Ecologist John Weaver, with students and colleagues, studied prairie plants and their growth dynamics in the first half of the 20th century. They investigated root growth in different species of perennial prairie and range grasses.[10] They observed the development of the roots grown from seedlings over three growing seasons. In one species,

8. For interesting comparisons and examples of root depth, see Canadell et al. 1996; Fan et al. 2017; Phillips 1963; Stone and Kalisz 1991.

9. Jennings 1974; Phillips 1963.

10. Weaver and Zink 1946.

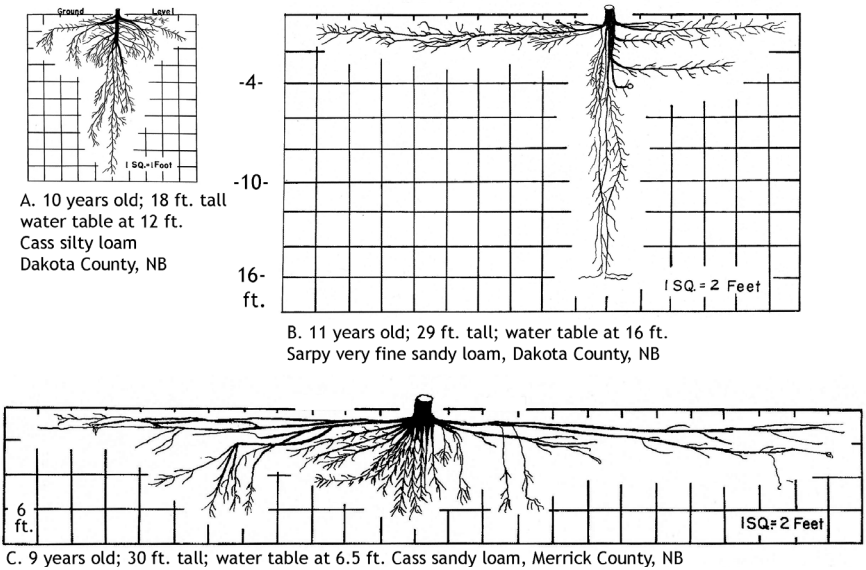

FIGURE 3: Root systems of three Siberian elm (*Ulmus pumila*) trees of similar ages, but growing in different contexts in Nebraska. (Modified after Sprackling and Read 1979)

most of the roots (81 percent) that had formed in the first year were still present at the end of the third growing season. In four others, between only 10 and 45 percent were still present after the third season, so these plants had lost a majority of their first-year roots. But each year they had developed many new roots, so that after three seasons they had grown hundreds to many hundreds of roots. Perennial plants connect more strongly each year with the earth through decay of older roots and formation of new ones. As Goethe put it, "Life is [nature's] most beautiful invention and death her art of creating much life."[11]

Expanding ideas—clonal plants

The concept of annual and perennial plants refers at first to individual plants. We consider this particular wildflower or that particular tree. But it is not necessarily a simple matter to say, "This is an individual plant." Take common milkweed (*Asclepias syriaca*), which grows in stands with long vertical stems that terminate in clusters of flowers.[12] If you dig down into the soil a few inches, you find that the different stems are connected via underground shoots called rhizomes. The stand

11. Goethe 2002, p. 46; translation by author.

12. Holdrege 2010.

that you first think consists of individual plants is actually one branching plant that is connected underground. It is like a shrub that would do all its branching underground and only send the flowering shoots up into light and air. Each year the above-ground shoots die away, but the underground plant develops buds out of which new horizontal and vertical shoots grow. Through underground branching each year, the plant can grow quite large.

Aspen trees tend to grow underground root suckers out of which new trunks grow. In this way large groves of trees develop that, similarly to milkweed, are also individual plants. One of these groves in Utah, called "Pando," spreads over about 43 hectares (about 107 acres).[13] This makes it a very large organism and one that is likely very old. There is no simple way to determine the age of such mega-organisms, which may be many thousands of years old.[14]

Botanists speak of plants that reproduce vegetatively in the way of milkweed or aspen trees as clonal plants. We generally think of plants reproducing via seeds, with the seeds having been formed through pollination. Clonal plants don't need seeds to form new plants, even though virtually all of them can also produce seeds. Clonal plants represent a different form of perenniality. Their existence demands that we expand our idea of plant individuality and plant size; they also present a quandary for determining the age of plants.

Since the connections between underground branches can dissolve or be broken, a clone can separate into plants no longer joined with each other. These separate plants can grow and form their own branching stands. Because they are no longer physically connected, are they now two plants or still one, since they derived from the same mother plant? This is an interesting conundrum. Physically we can consider them as separated entities, but biologically they are connected, since they are of one origin.

To take a more extreme example, a number of species in the plant genus *Kalanchoe* have leaves that grow complete little plants at their margins (see Figure 4). These plantlets fall off the leaves and take root. Each plantlet, in turn, can grow into a plant that creates many more plantlets. In this way, over time, countless plants can derive from one plant. For this reason, one common name for them is "mother of thousands." We grow these plants in pots at The Nature Institute, and often visitors and course participants will take some plantlets with them and grow them at home. When their plants produce plantlets, they may pass them on to others. When children or grandchildren continue to grow mother of thousands, how old are those plants? When does a clonal plant die? As some researchers have remarked, clonal plants are potentially immortal—there is no natural death.

13. DeWoody et al. 2008.

14. Ally et al. 2008; de Witte and Stöcklin 2010.

FIGURE 4: Mother of thousands (*Kalanchoe* sp.). Plantlets grow out of the leaf margins, then drop from the mother plant and can immediately take root in the soil. (Photos by author)

There are even annual and perennial plant species, to which our common dandelion belongs, that can form seeds without pollination.[15] There is no mixing via pollen with another plant, or even with the pollen of the same plant. The seeds develop vegetatively. The seeds are extensions of the mother plant, so all of the mother plant's progeny form a clone—one widely spread organism. Such a species might be an annual from the perspective of its life history—since the mother plant dies away at the end of one growing season—but when the plant lives on through its vegetatively produced seeds, it is in this sense also a perennial.

To summarize: In plants that can reproduce vegetatively, what appears as an individual plant is a snapshot of an unbroken stream of life that connects all the offspring that have arisen from it. The categories of annual and perennial traditionally consider the continuity of life within an individual plant that

15. Hojsgaard and Hörandl 2019; Noyes 2007.

is rooted in one place. The annual, as an individual, is short-lived; the tree is long-lived. These concepts become more fluid and nuanced when we consider vegetative reproduction, which is widespread in flowering plants. From this perspective, some annuals can also be considered perennials, and some perennial clonal herbaceous plants (wildflowers and grasses) may be hundreds of years old.

Plants in community

Plant communities are generally long-lived, perennial entities. While a forest can exist for centuries, the individual plants come and go, and the composition of the forest can evolve with changing environmental conditions. Trees, of course, are the dominant life form in forests, but the forest can also be inhabited by vines, shrubs, herbaceous perennials, and annuals. Many of the spring wildflowers that I observe each year in a local bottomland forest are perennials that mainly spread through rhizomes. There are only a few annual species, but they appear year after year and are integral members of the forest community.

In temperate mixed deciduous forests such as those in middle Europe or eastern North America, the annual cycle of the seasons is determinative for how the life of the community and its organisms unfolds—dormancy in the winter, rapid growth and flowering in the spring to summer, retraction of life processes and leaf loss in the fall. In this way the perennial community is embedded in the annual solar cycle. The interweaving of annuality and perenniality gives life to the community.

Grasslands, which cover wide expanses of continents around the world, consist mainly of perennial grasses and wildflowers. The prairies that covered a large portion of the central United States up through the 19th century developed after the last ice age and existed for 10,000 years. The individual perennial grass and wildflower plants that make up the prairie usually live only a few years to occasionally 40 years.[16]

Desert plant communities are ones often characterized by annuals. For example, the deserts of Palestine consist of about 60 percent annuals.[17] Because flourishing plant life in the desert is so dependent on rainfall, in long rainless periods very little of the plant community appears aboveground. But the seeds are widely spread. Seeds consist of only 10 to 15 percent water (fresh wood, by contrast, can have a water content of 50 percent). Seeds are dry like the desert. But they are also life dormant, sometimes existing for many years until rain falls and they germinate. A desert plant community is one of the most variable of plant communities and owes its existence in part to the capacity of annuals to remain in a quiescent state as seeds for extended periods of time. Paradoxically, annuals contribute in this way to the perenniality of the desert community.

16. Anderson 2006; Lauenroth and Adler 2008.

17. Bazazz and Morse 1991.

Numerous interactions between plants and other plants, animals, fungi, microorganisms, soil, light, warmth, air, and water create the dynamic weaving that is the life of a given plant community. Fungi connect plants via their roots through mycorrhizal networks.[18] Most plants are part of such networks. Through them substances are exchanged between the plants and fungi and, through the fungi, between different plants. For example, in western North America young Douglas fir seedlings receive via mycorrhizae nutrients and water from older Douglas fir trees, allowing the seedlings to grow better. Different species of plants also exchange substances through mycorrhizal networks.[19]

Another form of interaction between plants is through volatile chemicals that they release into the air, such as when they have been damaged by predators.[20] These chemicals can reach plants in the immediate vicinity, and, at least in a good number of those investigated, their neighbors are stimulated to produce protective substances and experience less insect damage.

Plants—especially trees—can have a significant effect on their surroundings by bringing up water from moist deep soil through their roots and releasing it into drier soil closer to the surface.[21] This happens mainly at night, and during the next day this additional water in the soil is available not only to that plant but also to others of the same or different species in the vicinity (Caldwell et al., 1989; Neumann and Cardon, 2012). The reverse can also happen in arid environments: plant roots can bring the moisture they take in near the surface of the soil and move it into deeper dry soil. This increased moisture allows roots to grow deeper.

So while from one perspective a plant may be an individual specimen, as a living being it is activity that weaves together with the life of many others and the larger environment. Every species has its own identity, but this identity is not static. It is thoroughly dynamic, in the sense that the form and substance of a plant are being continually built up, transformed, and broken down, and all this by virtue of the way the plant's activity is embedded in and altering the activities of its environment. Life courses through each plant, but it also courses through a plant community, a biome, and, in the end, the whole Earth.

* * *

Through what I have presented so far, you can gain a sense of the weaving of life on Earth as it shows itself through plants. To come to this understanding,

18. See reviews in Gorzelak et al. 2015 and Tedersoo et al. 2020.

19. Philip et al. 2010; Simard et al.1997.

20. See, for example, Karban et al. 2014; Karban, Yang, and Edwards 2014.

21. Caldwell and Richards 1989; Neumann and Cardon 2012.

we need to grow beyond operating with concepts—such as annual or perennial plant—as categories into which we fit phenomena. Cleanly delineated concepts with precise borders lead us to artificially view nature in terms of separateness—discrete entities interacting.

We can break out of this artificiality when we look to diverse phenomena, as I have done with wild annuals and perennials, and allow our thinking to be loosened and shaped by those phenomena. This kind of participatory or dialogic inquiry is what the scientist and poet Goethe had in mind when he wrote in the early 19th century: "If we want to behold nature in a living way, we must follow her example and become as mobile and malleable as nature herself."[22]

As we intentionally attend to concrete appearances and move through and with the variety nature presents, our thinking can become more lithe and nuanced. We can shed the fixed categories that were helpful to initially gain orientation. Nature then shows herself in gradations. We gain a more fluid understanding of the specificity of the myriad different types of plants (and other creatures), their diverse forms, and their life histories. We see how each organism is intertwined with and supported by other organisms and the larger environmental context, and each organism influences other organisms and that larger context. We see connectedness in the weaving of life.

The qualities of annualness and perennialness lead us to an appreciation of the longevity of life—duration—and that this longevity is only possible because life is also ever-active and responsive in the moment. This is what I want to point to with the phrase "living perenniality."

With annual and perennial plants providing again the focus, I turn now to food crops and agriculture. Here we enter a realm in which the ecology of life becomes highly modified by the interplay of human thought and action with the rest of nature.

22. Goethe 1995, p. 64; translation by author.

CHAPTER 3

Annual and Perennial Food Crops

All grain (cereal) crops in the grass family—rice, wheat, maize, rye, sorghum, millet, barley, and oats—are annuals. Worldwide, just three of these crops—rice, maize, and wheat—contribute two-thirds of food energy.[23] Of course, people eat food from many other crops, and there are many hundreds of other species and varieties of annual crops, including most vegetables. It is a remarkable fact that annuals make up a small percentage of wild plants, while in agriculture annuals dominate and provide the bulk of our food.

Through the interaction of human beings and plants in the process of domestication and breeding, annual crops (including vegetables) have evolved to provide food from the different above-ground parts of the plant—leaves (e.g., lettuce, cabbage, spinach), leaf and flower buds (e.g., Brussels sprouts, broccoli), fruits (e.g., squash, beans) and seeds (e.g., lentils, mustard, sunflowers). In grains, the coat of the seed fuses with fruit tissue to form one unit.

Crops such as potatoes, cassava (manioc), yams, and taro are important staples in South America, Africa, and parts of Asia. They are all perennial plants. The parts of these plants that we eat are not roots, but rather modified underground stems (tubers). They are storage tissues rich in starch. If we didn't harvest the tuber, in the following growing season it would feed the growth of new stems, leaves, and roots, and in the course of the plant's development be used up. You have starch-rich tubers if you harvest them during the first growing season. For this reason, these crops are usually grown as annuals. After the tubers are harvested, the rest of the plant is discarded or used otherwise. Pieces of tubers or stems from the one year's harvest are then planted, and a new plant with tubers develops. Although all these crops can form seeds, and do if they are left to flower, they are propagated vegetatively through the tubers or stem cuttings. So in terms of propagation, what for an annual crop is the seed, in these crops is the tuber or stem cutting.

23. FAO 2020.

A variety of other crops and vegetables that are biennials or perennials are also usually grown as annuals. Carrots, onions, and leeks are biennials and would flower and go to seed in the second season of growth. The parts we eat—the root in the carrot and highly modified leaves in onions and leeks—develop in the first year and are harvested at the end of the season. Tomatoes, eggplants, and peppers (all members of the nightshade family) are perennials. They are frost sensitive and cannot survive the winter in temperate or colder climates. In subtropical or tropical conditions, however, they can be grown as perennials that may live for a few years. Overall, however, most herbaceous perennials are grown as annuals in today's agriculture.

In temperate climates there are only a few herbaceous perennial crops that are actually grown as perennials; you can think of asparagus and rhubarb. Sugar cane, which is a grass, is also a perennial, but usually the stems of the plants are only harvested for two to four years before the whole plant is removed from the soil and new plants (or another crop) are planted.

Many woody perennials—shrubs and trees—have been domesticated. Most of these have been bred to bear edible fruits (e.g., apple, cherry, citrus fruits, banana, mango, olive) and seeds (e.g., sunflower seed, walnut, almond, cacao, coffee). But we can also think of the leaves from tea plants, which are shrubs or small trees. Modern varieties of fruit and nut trees can take anywhere from a few years to over 10 years to mature and bear fruit in temperate climates. Anyone who works with tree crops has to think and plan long term.

Most trees are propagated vegetatively, either by using cuttings or through grafting. For example, the originally cultivated grapefruit trees had fruits with white flesh. Occasionally a given tree will sprout a "sport"—a branch that has fruits with red flesh and no seeds. These branches can be grafted onto the rootstock of a white-fleshed grapefruit sapling, and once the mature tree develops, it will bear red seedless grapefruits. All the red grapefruits of a particular variety stem from the branch of one tree! All "Red Ruby" grapefruits, for example, stem originally from one branch of a tree that was discovered in 1929 growing in McAllen, Texas.[24]

Domestication characteristics

There are a number of characteristics that many domesticated crops share, although not all of them have the overall suite of features that I mention here.[25] The grains and seeds are generally larger in domesticated crops than in related wild plants. They ripen at the same time on the plant, instead of at different times, which is typical of wild plants. A striking difference is that in domesticated plants the grains or pods (in legumes) remain attached to the plants at maturity rather

24. Rouse et al. 2001.

25. Abbo et al. 2014; Larson et al. 2014.

than falling off and scattering. In wild plants, the seeds and grains are released into the environment. Since the seeds or grains in domesticated forms both ripen at the same time and stay connected to the plant at maturity, there is greater ease in harvesting.

Often wild grains and seeds have a period of dormancy. For example, they need a period of time in cold conditions in order to eventually germinate, while many domesticated seeds and grains can germinate after harvesting.

In those perennial food crops grown for their fruits (think of olives, grapes, apples, or bananas), the fruits are larger, fleshier, and less fibrous than their wild relatives and have fewer toxic compounds, while developing a variety of flavors. There is a wide variety of shapes, sizes, and colors. In a similar way, annual vegetable crops develop larger, fleshier, less fibrous, and tastier leaves, stems, or buds (think of lettuce, cabbage, celery, or broccoli).

Through the millennia farmers developed on their small farms distinct varieties of crops. There are thousands of varieties of apples, each with its distinct characteristics. Many traditionally bred crops that were specific to regions and to small-scale farming have disappeared as farming shifted during the 20th century to large-scale, industrial practices. Those varieties of a given crop that are grown commercially today have been bred for uniformity in size, shape, color, and consistency. This makes planting, cultivation, harvesting, and shipping easier—but comes at the cost of crop diversity. In acquiring the domestication characteristics, crops become dependent on human beings for their continued existence. At the same time, humans have become ever more dependent on these crops with which we have co-evolved. We are deeply intertwined with their existence and they with ours.

Sustaining agriculture

The clear gift of annual crops is their short life cycle and the possibility to stagger sowing, which allows multiple harvests during one growing season. This gives farmers a kind of flexibility that they don't have when they plant an orchard of walnut trees. But since all annual crops are propagated by seeds, the seed bed needs to be prepared for each crop cycle. This fact makes annuals labor intensive. When the soil is tilled or plowed, the open soil also invites the germination of weedy annuals.

When in today's industrialized agriculture annuals are grown repeatedly as monocultures in large fields that have been previously plowed and also left bare of plant cover for longer periods in between growing seasons, erosion and the destruction of soil fertility follow in due course. The degradation of soil, along with extensive irrigation and the use of chemical fertilizers and pesticides, causes major environmental problems, as exemplified by the huge monocultures of corn and soybeans in the Midwest of the U.S. Some of the significant unintended

consequences of industrial agriculture include erosion, receding water tables, contamination of well water, fertilizer runoff into streams and rivers that in the end leads to the creation of a dead zone in the Gulf of Mexico, the large amounts of fossil fuel needed to produce fertilizers, and pest resistance to pesticides. These effects are, of course, not problems created by the crops themselves. It is the approach to growing crops that is the source of the problems.

Industrial agriculture has focused largely on increasing yields, which has been achieved by breeding varieties that yield best under the high-input conditions of the industrial agroecosystem. The yield increase has been remarkable. For example, wheat harvests usually ranged from 12 to 16 bushels per acre in the U.S. before the 1940s, when industrial farming began to take hold. Since 2000, yields are usually over 40 bushels per acre.[26] But all this comes at the cost of the above—and other—problems.

Soil degradation and erosion have been issues in agriculture since its beginnings.[27] This is especially true of land with semiarid climates. When forests—which build and maintain soil fertility—are cut down to make space for pastures and crop fields, when domestic animals overgraze pastures, and when repeated planting of annual crops lays bare the soil, conditions are created that deplete the soil and allow for erosion. When people began extending crop fields and grazing from fertile floodplains to hilly, often thinner-soiled upland areas, erosion became an increasingly large issue. Much soil fertility has been lost during the course of the last 10,000 years.

"Erosion eats into our hills like a contagion, and floods bring down the loosened soil upon our valleys like a scourge. Water, soil, animals, and plants—the very fabric of prosperity—react to destroy each other and us."[28] In these words, penned in a 1923 article, Aldo Leopold decried environmental devastation in large areas of the southwestern United States, in most cases at that time due to overgrazing by livestock and clearing of land bordering streams and roads.

It is possible to grow annual crops without depleting the soil and without the devastating environmental effects of high-input industrial agriculture. Historically, traditional farming has utilized a variety of crops, crop rotation, terracing, and other practices to maintain agricultural landscapes in some areas of the globe for thousands of years. For example, in the Colca Valley of Peru, terrace farming has persisted for the last 1,500 years. The soil is one to four feet thicker than the surrounding uncultivated soil and has higher carbon and nitrogen content.[29] This form of agriculture is labor intensive, small scale, adapted to local conditions, and fed through tradition.

26. USDA 2018.

27. Lowdermilk 1953; Hillel 1992; Montgomery 2007 and 2008.

28. Leopold 1923, p. 93.

29. Sandor and Eash 1995; for more examples, see Altieri 1995, McLauchlan 2006.

Today, myriad efforts aim to bring agriculture into greater alignment with the ecology of the planet. They go under a variety of labels, such as permaculture, agroecology, or regenerative, sustainable, ecological, organic, biodynamic, or syntropic agriculture. These different practices work to increase diversity on the farm, so that it becomes more similar to a natural ecosystem. Measures include planting a variety of crops rather than just one. Crop rotation, cover cropping, and the use of compost from manure from on-farm animals and plant materials all help protect and replenish the soil. A variety of studies have shown that organic farming practices can replenish soil organic matter and increase soil stability and the diversity and activity of soil microbes.[30] While the yields in these practices still lag behind those of conventional (high-input) crops, the gap is getting smaller.

While much can be done to make agriculture with annuals more perennial in the sense of becoming sustainable and healthy for the planet and humans in the long term, it is clear that an increase in perennial crops would be highly beneficial.

Woody perennials—trees and shrubs—have been part of agriculture for thousands of years. In the Amazon, forest polycultures that also integrated the planting of maize (corn) existed as far back as 4,500 years ago.[31] These indigenous practices have left their mark on today's rainforest, both in the dark earth soils and in the prevalence of edible plants in forests that otherwise appear "wild."

In the Mediterranean basin, the cultivation of olives, figs, grapes, and date palms extends far into the past.[32] Olive trees are long-lived—the oldest known olive trees today are over 800 years old.[33] Many nut trees are long-lived, and even fruit trees such as apples and pears can live a few hundred years and still bear fruit if they have been properly pruned. In perennial tree crops the problem of erosion is much less than in annuals. With their large and deep root systems trees have significant resilience in terms of accessing water and nutrients from the soil.

Today the tendency in agribusiness-based tree plantations is to plant fast-growing dwarf varieties that bear fruit for decades and not hundreds of years. In large monoculture orchards, which produce most tree fruit and nut crops, widespread use of pesticides and herbicides keeps the area between trees "clean." When they are grown in monocultures, trees are highly susceptible to the spread of pests. Perennial crops lack the advantage of annuals, where you can plant a different crop in the following year to reduce the pressure of specific pests. So just as in industrial agriculture with annuals, the lack of diversity, the high number of inputs (water, pesticides, and fertilizers), and the negative environmental effects

30. Gattinger et al. 2012; Lori et al. 2017; Schrama et al. 2018; Fliessbach et al. 2007.

31. Maezumi et al. 2018.

32. Zohary et al. 2013.

33. Bernabei 2015.

make industrial tree and shrub agriculture unsustainable. As in other areas of agriculture, there are increasing efforts to create integrative polycultures in agroforestry.[34]

Missing from agriculture are perennial staple food crops such as the grains that provide the bulk of food for people today. This fact struck Wes Jackson of The Land Institute in Kansas who, in 1980, wrote about the need for and the promise of perennial grains.[35] Jackson envisioned an agriculture of herbaceous perennials grown in polycultures in which grain and other seed crops mimic the diversity of the prairie. In the last few decades, the movement to breed perennial grains and other plants such as sunflowers has grown into a worldwide effort. And there are first successes with perennial wheatgrass, known as Kerzna®.[36] If perennial grains could be grown in polycultures to increase diversity and resiliency, they would provide food, protect the soil from erosion, and also help build up soil over time.[37]

* * *

In Chapter 5, I will return to the question of the future: How can agriculture and our ways of thinking better foster *living perenniality*—the awareness of the long term, wedded with the ability to integrate thinking and practices into the ecology of the planet?

Before that, in Chapter 4, I look to the past and consider the riddle of the origins of agriculture. The shift from hunting and gathering to farming as a global phenomenon was initiated over 10,000 years ago. It was connected with radical changes in human culture that in turn reshaped the face of the Earth. Think of agrarian societies and the formation of agricultural landscapes. Consider how the development of large cities and substantial population growth are unthinkable without farming. For good reason, the origins and early development of agriculture have been the focus of extensive research. With my focus on annual and perennial plants, I was intrigued by the riddle that perennial grains and major perennial staple food crops were not developed during the long history of agriculture.[38]

I first discuss the evidence that exists about the beginnings of agriculture and build a tentative picture of the context in which agriculture has developed. Then I consider how modern scholars attempt to account for the beginnings of agriculture. We thereby enter a thicket of perspectives that illuminate the difficulties of interpreting the past.

34. Wilson and Lovell 2016; Young 2017.

35. Jackson 1985.

36. See landinstitute.org/our-work/perennial-crops/kernza/.

37. Crews et al. 2018.

38. Cox 2009; Van Tassel et al., 2010; Wagoner and Schaeffer 1990.

CHAPTER 4

On the Origins of Agriculture

While the evolution of humanity is rooted in the evolution of the Earth and life as a whole, the human being in the form of the modern species, *Homo sapiens*, has existed for about 200,000 years. All evidence we have today indicates that for most of this time, humans were hunters and gatherers. They lived in small groups that were largely nomadic, which isn't to say they didn't remain in certain areas for longer periods of time. They crafted stone tools and used fire for warmth and cooking. Cave paintings, sculpted figurines, and burials are found dating back to at least 40,000 to 50,000 years ago. Through these traces we can gain a glimpse into the consciousness of human beings of that time. In the paintings—often in the recesses of totally dark caves—they told stories and depicted not only human and animal forms, but also part-human, part-animal spirit beings. Existence extended beyond what we today would call the sense world, and they brought this larger world of beings to expression in their lives. These "cave people" were not the cartoonish brutes of popular depictions.

There is no evidence that paleolithic humans domesticated animals or plants in the sense of breeding new varieties. But of course they did alter their environments through the selection of the plants they gathered and the animals they hunted. Some at least also probably set fires in the landscapes they lived in, an activity we know from hunting and gathering peoples in historical times. They altered the fabric of the landscape that was their home, and some scholars consider this interweaving an initial form of domestication.[39]

The transition from hunting and gathering to cultivation and domestication of crops and animals occurred in the Near East between around 12,000 and 9,000 years ago.[40] A variety of evidence indicates that in addition to collecting

39. See, for example, Descola 2013; Gamble 2007; Scott 2017.

40. There is a wealth of literature on the beginnings of agriculture. See, for example, Bellwood 2005; Brown et al. 2009; Harlan 1998; Larson et al. 2014; Zeder 2011; Zohary et al. 2013.

and storing wild foods, people began growing wild plants around settlement in the area known as the Fertile Crescent.[41] (The Fertile Crescent extends from today's Israel, Palestine, and western Jordan up through Lebanon and Syria into southeastern Turkey and curves down into Iraq and western Iran to the Persian Gulf.) It had long been thought that large settlements would have been possible only after domesticated crops had been developed and farmed. But this is not the case. There were fairly large settlements and also sanctuaries before plants had been domesticated and farmed.

We must imagine that around these settlements a variety of wild plants grew. The inhabitants collected, planted, harvested, and stored, for example, grains of wild grasses and seeds of wild legumes. The presence of stone mortars and pestles indicates that grains and seeds were also ground into flour. It was these wild plants, with which the people had an intimate connection, that over time transformed into domestic grains and legumes. They became staple crops for the evolving cultures. In the Fertile Crescent these included the cereal grains (which are members of the grass family) einkorn wheat, emmer wheat, and barley; and lentil, pea, and chickpea, which are legumes (pea family).

Significantly, the wild progenitors of these crops—the plants from which they were developed—were all annuals.[42] All the early domesticated plants remained annuals. They were also self-pollinators, which kept the plant populations more uniform. The domestication process, which led to plants distinct from the wild plants and dependent on human intervention for their propagation, extended over several thousand years. It was not an overnight occurrence.[43]

While the Fertile Crescent is the area of earliest crop domestication, domestication was also occurring only somewhat later in Central and South America, East Asia, and Africa. Here are the approximate times (in years before the present) during which domestication characteristics can be identified for just a few of the staple grain crops: maize (corn) in Mexico, 8,700–7,000 years; rice (japonica) in East Asia, 7,500–5,000 years; pearl millet in Africa, 4,500–3,500 years; sorghum in Africa, around 4,000 years.[44] All of these grain crops are annuals.

Long-lived perennial crops—shrubs and trees—were domesticated later than annual grain and seed crops.[45] The earliest tree to be domesticated was probably the olive tree in the Near East around 6,000 years ago. Domestication of fruit trees such as apple, plum, or cherry occurred more recently, starting about 3,000 years ago.

41. Weiss et al. 2006; Zohary et al. 2013.

42. Weiss and Zohary 2011.

43. Larson et al. 2014; Purugganan 2019.

44. Larson et al. 2014; Piperno 2011.

45. Zohary et al. 2013, Chapter 6.

Modern attempts to explain origins

One of the questions that perplex researchers concerned with the beginnings of agriculture is: Why did some hunters and gatherers become farmers? After all, hunting and gathering cultures have thrived into the present day. Why should they, in different parts of the world, have transitioned to a farming lifestyle that in many respects is more labor intensive, demanding, and tenuous? As a !Kung bushman responded to an anthropologist who asked why he didn't farm as his neighbors did, "Why should we plant when there are so many mongongo nuts in the world?"[46]

Archaeologists T. Douglas Price and Ofer Bar-Yosef state the riddle in this way:

> It is completely remarkable that the process of domesticating plants and animals appears to have taken place separately and independently in a number of areas at about the same time. Given the long prehistory of our species, why should the transition to agriculture happen within such a brief period, a few thousand years in a span of more than 6 million years of human existence?[47]

Price and Bar-Yosef were reflecting on a 2009 interdisciplinary symposium attended by 22 researchers—archaeobotanists, archaeozoologists, a geneticist, and a physical anthropologist. (Not present were cultural anthropologists, historians of religion, or philosophers.) They report that the symposium led to much discussion, few answers, many questions—and no consensus even on how to approach the riddle of origins.

Though attendees agreed that the almost simultaneous development of agriculture in so many different places was not simple coincidence, what stood out were uncertainty and questions: Should we invoke climate, environment, population, subsistence intensification, brain capacity, religion, inequality, entrepreneurs? Are there specific conditions? Are there immediate and local causes distinct from global ones? Are the origins of agriculture the results of a "perfect storm" of factors that forced or encouraged human societies to domesticate plants and animals?

There was little agreement on what might constitute a cause in relation to agricultural origins, and one participant even remarked: "Causality is in the eye of the beholder." Price and Bar-Yosef write that "in spite of extraordinary advances in a variety of fields, many detailed at the symposium, we really know very little about the origins of agriculture." What they mean here is that despite the plethora of facts from different disciplines, researchers have not gained a coherent explanation of agricultural origins.

46. Quoted in Harlan 1998, pp. 25–26.

47. Price and Bar-Yosef 2011.

Nonetheless, there have been and continue to be a variety of attempts to "explain" the origins of agriculture. Price and Bar-Yosef name some of the main phenomena that are often claimed to be causal factors: "climate, environment, population, subsistence intensification, brain capacity, religion, inequality, entrepreneurs."

Those researchers who come from the natural sciences tend to emphasize outer factors. Climate change has been invoked repeatedly as a major factor, since at around 9,200 years ago and again, more strongly, at 8,200 years ago within a short period of time the climate in the northern hemisphere became cooler and more arid. Might not these changes, especially in the already semiarid Middle East, have "compelled" people to shift from hunting and gathering to the planting of crops? Anthropologist Melinda Zeder describes the "optimal foraging strategy" as maintaining that "optimizing energetic returns were primary shaping facts in domestication."[48] In this perspective, foragers would have been compelled, in times when their most optimal forage (such as nutritious wild grains) was scarce (perhaps due to increasing aridity) to start to manage those resources and begin domesticating.

There are a number of problems with this idea (and other causal explanations). First, researchers who look in a more fine-grained manner at the two climate events and their relation to cultural changes, such as the transition to farming in specific areas, find that climate and cultural change do not fit together in a way that would suggest a causal connection.[49] Secondly, as Zeder and others point out, it is overly simplistic to think that one factor could account for such a complex process as domestication.[50]

French archaeologist Jacques Cauvin stimulated much discussion and the opening of new avenues of inquiry in his book *The Birth of the Gods and the Origins of Agriculture*.[51] There he emphasized changes in the human mind—not external causes—as a central factor in the development of farming.[52] At the very least, in Zeder's words, research concerning the origins of domestication and agriculture today demands "a broadly transdisciplinary approach that brings together genetics, evolutionary biology, ecology, and anthropology."[53]

However, moving beyond a specific discipline is no easy matter. If you work in a particular field it is difficult to leave behind the conceptual framework that guides your research. Commenting on an interdisciplinary conference about the origins of agriculture, anthropologist Mark Nathan Cohen writes that "we

48. Zeder 2015.

49. Flohr et al. 2015; Maher et al. 2010.

50. Zeder 2015.

51. Cauvin 2000.

52. See also Verhoeven 2011; Watkins 2010.

53. Zeder 2015.

resembled the proverbial blind men, each describing an elephant from the perspective of his or her own incomplete perspective."[54] Cohen himself believes there is an elephant—a "common core of events" that brought about agriculture—but he states that many of the participants "do not agree that the elephant or core understanding exists."

All this shows that there is nothing close to an explanation of the origins of agriculture. There is a wealth of research that brings forth ever more interesting facts. But the desire to "explain" in terms of causal factors is not fulfilled. It may be, in fact, more fruitful to suspend the urge to explain in terms of causal factors, because it is a limited framework and provides an all-too-narrow take on things.

When we imagine that factors, such as drought or growing population, compel a particular action (which would "explain" that action), we forget something very important: responses by people and the initiatives they take are not mechanical reactions. People can respond to something that they perceive as an outer pressure in a variety of ways. There is no way to say in human life that this "cause" will produce this "effect." That is because what is felt to be a cause is dependent on the state of mind of the person. What is stressful and maybe debilitating for one person may be an inspiring challenge for someone else. The causal framework may work fairly well to account for rocks that roll down a hill or the movement of billiard balls, but it certainly does not do justice to the way human beings act and respond.

* * *

The more archaeologists discover, the more material scholars have to build up their pictures of how and why agriculture developed. These pictures are based on different discipline-based thought styles. They are also infused with assumptions about why human beings in those ancient times acted the way they did.

There is clearly a widespread tendency to project a modern manner of thought back into prehistoric times and to imagine those people who developed agriculture as scratching their heads about how to go about farming in the way a modern intellectual would do. As you have already noticed, I am keenly interested in how human consciousness informs our experience of the world. Up until now I have discussed this primarily in relation to plants and agriculture.

When I considered the literature on agricultural origins, the question of human consciousness, which has been in the background of this book so far, came front and center. On the one hand, I was confronted with modern scholarly ways of thinking, and on the other, the question of how the ancients perceived the world became all the more important. Could I get closer to the consciousness

54. Cohen 2009.

of the people who were involved in the transition from hunting and gathering to farming? Did they have the experience of a world "out there" of physical causes that they were responding to? What do archaeology and, later, texts suggest about the way they saw things?

These are the questions that guide what I present in Chapter 5, which is integral to the inquiry into living perenniality. It connects us with what has deep roots—the unbroken current of human consciousness that extends far into the past. It also shows that consciousness is not static, since it has undergone—and continues to undergo—transformation. I want to give a concrete sense of the ways in which human beings experience their relation to the Earth—what they feel to be real and essential—has radically changed. This awareness provides a basis for understanding that a further evolution of the human-earth relation is possible and sorely needed, the issue I address in the book's final chapter.

CHAPTER 5

Evolving Consciousness

When I delved into research about ancient and indigenous cultures, everywhere I looked I found images and stories that are decidedly foreign to the taken-for-granted worldview that imbued my own upbringing and education and that informs the culture I am embedded in. Gods or spirit beings were seen as involved in all of creation, in all change, and in every human action. They were at work in the origins of agriculture.

In the spirit of open-minded inquiry, I want to give due attention to this imagery and these stories, foreign as they may seem. What can they tell us about the way people perceived the world? In this section, I will present a variety of examples and let them speak for themselves. I present them as phenomena we need to take seriously when we are concerned with the beginnings of agriculture. I will consider their significance in the sections that follow.

Göbekli Tepe in the southeastern region of present-day Turkey is a ruin, the oldest part of which stems from the 10th millennium BCE; that is, from over 11,000 years ago (see Figure 5).[55] This is before the first evidence of domesticated grains and during the time in which people were collecting, growing, and storing wild grasses and legumes.

The ruins consist of a number of round enclosures that are sunk into the ground (see photos). There are T-shaped pillars around the margins (Figure 6), and in some of the enclosures the two large T-shaped pillars in the middle are over 16 feet (five meters) high (Figure 7). The pillars were hewn by stone tools from crystalline limestone close by. Whether these spaces had roofs is unknown. There are numerous sculptural depictions of animals as reliefs on pillars, and bones from a variety of species of wild animals have been found. A kind of totem pole of stone was found (Figure 8). The large T-shaped pillars also bear sparse indications of the human form; the head is the rectangular block at the top of the pillar and the torso is the long column of the pillar. They bear long arms and also fingers, and some even possess a belt and loincloth (Figure 7). In the words of Klaus Schmidt, the head of the archaeological group that excavated the ruins,

55. Schmidt 2016.

FIGURE 5: Archaeological excavation of the Neolithic site Göbekli Tepe in Turkey. (Getty Images)

FIGURE 6: Two T-shaped pillars from Göbekli Tepe. Note the depictions of animals. (Wikimedia Commons)

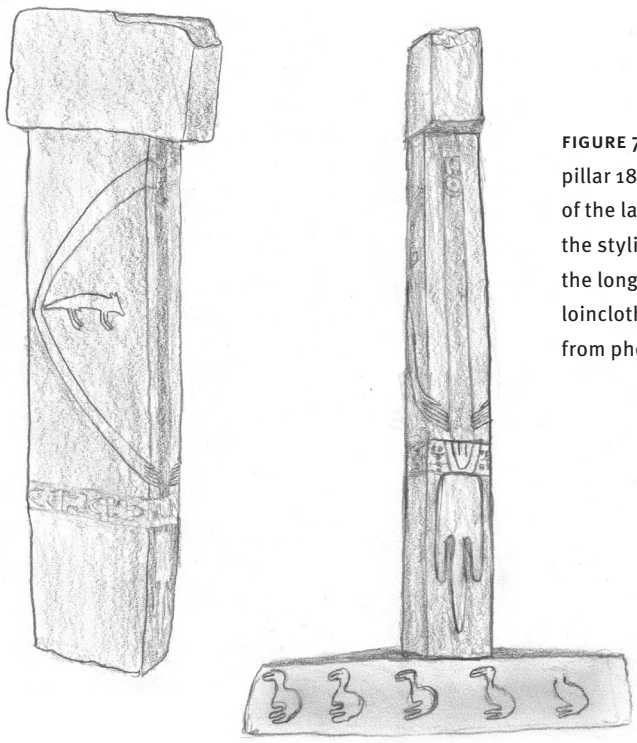

FIGURE 7: Rough sketches of pillar 18 from Göbekli Tepe, one of the large central pillars. Note the stylized humanlike features: the long arms, fingers, belt, and loincloth. (Sketches by author from photos)

FIGURE 8: "Totem pole" from Göbekli Tepe; replica in Sanlıurfa Museum, Turkey. Note the pair of hands above the small human figure at the bottom; they resemble the hands on the large pillars (see Figure 7). (Wikimedia Commons)

the pillars as figures "seem to be impersonal supernatural beings from another world."[56]

Göbekli Tepe is one of numerous sites that show the creative abilities of the Neolithic people. And they show that these people lived in a world populated by spirits. It is likely that Göbekli Tepe was a kind of temple or sanctuary in which initiation rites of some kind were performed.[57]

Written texts that relate to the origins of agriculture stem from a much later time (around 3,000 BCE). Just as the older architecture shows the relation of people to a spirit world, so do all of the earliest texts describe how the spirit world is an integral part of human life. The Earth and all its inhabitants stem from the working of the gods. In a Sumerian myth that relates to the origins of agriculture, Enki (often called the air-god) and Enlil (often called the water-god) bring forth new gods: the goddess Ashnan and the god Lahar; they are siblings. Here is a description from the Sumerian cuneiform tablets (missing text is indicated with an ellipsis):

> At the pure word of Enki and Enlil,
> Lahar and Ashnan descended from the Dulkug.
> For Lahar they set up the sheepfold,
> Plants, herbs, and . . . they present to him;
>
> For Ashnan they establish a house,
> Plow and yoke they present to her.
> Lahar standing in his sheepfold,
> A shepherd increasing the bounty of the sheepfold is he;
> Ashnan standing among the crops,
> A maid kindly and bountiful is she.
>
> Abundance of heaven . . . ,
> Lahar and Ashnan caused to appear,
> In the assembly they brought abundance,
> In the land they brought the breath of life,
> The decrees of the god they direct,
> The contents of the warehouses they multiply,
> The storehouses they fill full.
>
> In the house of the poor, hugging the dust,
> Entering they bring abundance;
> The pair of them, wherever they stand,
> Bring heavy increase into the house;

56. Schmidt 2010, p. 246–7.

57. Schmidt 2010 and 2016.

> The place where they stand they sate, the place where they sit they supply,
> They made good the heart of An and Enlil.[58]

In this story, it was the gods who brought agriculture into existence for humanity. In Egypt, Osiris is "identified with the spirit of the growing crop and the grain god, and he represented vegetation in general. His chief assistant was his wife Isis, who taught men to prepare the grain which her husband had given them, and to make the flower into bread."[59]

The Japanese chronicles called the *Nihongi* (completed in 720 CE) tell the story of the origin of different crops. The moon god Tsukuyomi had killed the goddess Ukemochi. When sent to see the corpse, Ame-kuma-bito, a spirit, discovered the transformed body:

> On the crown of her head there had been produced the ox and the horse; on the top of her forehead there had been produced millet; over her eyebrows there had been produced the silkworm; within her eyes there had been produced panic [grass]; in her belly there had been produced rice; in her genitals there had been produced wheat, large beans and small beans.
>
> Ame-kuma-bito carried all these things and delivered them to Ama-terasu no Oho-kami [sun goddess], who rejoiced, and said:—'These are the things which the race of visible men will eat and live.' So she made the millet, the panic [grass], the wheat, and the beans the seed for the dry fields, and the rice she made the seed for the water-fields. Therefore she appointed a Mura-gimi of Heaven, and forthwith sowed for the first time the rice seed in the narrow fields and in the long fields of Heaven. That autumn, drooping ears bent down, eight span long, and were exceedingly pleasant to look on.[60]

There are numerous creation stories of maize (corn). Here is one told by the Navaho chief Old Man Buffalo Grass in 1928:

> First Man called the people together. He brought forth the white corn which had been formed with him. First Woman brought the yellow corn. They laid the perfect ears side by side; then they asked one person from among the many to come

58. Kramer 2007; myth 53; pp. 78–79.

59. Budge 1973, p. 19.

60. Nihongi 1896.

> and help them. The Turkey stepped forward. They asked him where he had come from, and he said that he had come from the Grey Mountain. He danced back and forth four times, then he shook his feather coat and there dropped from his clothing four kernels of corn, one gray, one blue, one black and one red. The Big Snake came forward. He likewise brought forth four seeds, the pumpkin, the watermelon, the cantaloupe, and the muskmelon. His plants all crawl on the ground. They planted the seeds, and their harvest was great.[61]

The Mayan text *Popol Vuh*, which was compiled in the mid–16th century, describes how the human being was created out of—through the workings of the gods and animals—the substance of maize (corn):

> It was from within the places called Paxil and Cayala that the yellow ears of ripe maize and the white ears of ripe maize came. These were the names of the animals that obtained their food—fox and coyote, parakeet and raven. Four, then, were the animals that revealed to them the yellow ears of maize and the white ears of maize. They came from Paxil and pointed out the path to get there. Thus was found the food that would become the flesh of the newly framed and shaped people. Water was their blood. It became the blood of humanity. The ears of maize entered into their flesh by means of She Who Has Borne Children and He Who Has Begotten Sons. . . . The yellow ears of maize and the white ears of maize were then ground fine with nine grindings by Xmucane. Food entered their flesh, along with water to give them strength. Thus was created the fatness of their arms. . . . Their flesh was merely yellow ears of maize and white ears of maize. Mere food were the legs and arms of humanity, of our first fathers.[62]

All this imagery shows vividly how the gods and spirits were woven into the processes of creation. What we today consider to be the results of human doings were experienced as inspirations or bestowments of the gods.

There are myriad examples of rites and ceremonies in traditional and indigenous agricultural communities around the globe that intend to strengthen the connection to the divine that permeates life. While in many cases ceremonies and celebrations may be a faint reminder of the deep significance they possessed in the past, there are still people for whom our Western mentality appears as

61. Turner 1974, pp. 182–183.

62. *Popol Vuh* 2007, pp. 180–183.

strange as the mythological world of the ancients appears to us. Here are brief descriptions of how members of two different tribes in South America feel themselves embedded in the cosmos.

The Achuar are a tribe in the western Amazon. They are hunters and gatherers, and they also plant gardens:

> The women, who are the mistresses of the gardens to which they devote much of their time, address their cultivated plants as though they are children that need to be guided with a firm hand toward maturity. This mothering relationship is explicitly modeled on the guardianship that Nunkui, the spirit of the gardens, provides for the plants that she herself initially created. Meanwhile, the men, for their part, regard an animal that they hunt as a brother-in-law. . . . For the women, their plants are blood relatives; for the men, animals are relatives by marriage.[63]

The forest around their settlements we would regard as "wild." For the Achuar it is "an immense garden that is carefully cultivated by some spirit."[64]

For the Kogi people of northern Colombia, the Earth is "an immense loom on which the sun weaves the fabric of life."[65] Every aspect of their life is both a reflection and embodiment of divine weaving, of the cosmic loom. The Kogi grow their own cotton (and other crops) and weave all their clothes from the cotton they grow on simple looms that reflect in all its parts the weavings of the universe. Their garden plots are also a kind of loom:

> The woman begins to plant at the southeastern corner of the field and from there proceeds northward to the center line, turning back to the south and so on until she finishes at the middle of the western side-pole. In other words, the woman puts the warp on the loom. Now the man starts at the middle of the western upright post and proceeds to the east, then turns back to the west, winding his way "up" until he finishes the planting at the northeastern corner. His boustrophedon progress symbolizes the putting in of the weft.[66]

63. Descola 2013, pp. 5–6.

64. Descola 2013, pp. 5–6.

65. See Reichel-Dolmatoff 1978.

66. Reichel-Dolmatoff 1978.

Through planting in this way, the Kogi stay in harmony with the Mother Goddess, their creator and the divine weaver. In the Kogi universe the divine is not relegated to a world beyond. It permeates every aspect of their rituals and everyday life. In other words, the "everyday" is also sacred in the sense that activities such as planting crops express and bring to realization the weaving that is the essence of all existence.

Challenge for a science-based worldview

What is someone with a scientifically informed worldview to make of all this imagery and these ways of relating to the world? No modern scientist, given current understanding of organisms, evolution, and breeding, would ever come up with such stories of the origins of crops or human beings. Modern, scientifically based stories about origins involve changes in physical circumstances—whether in the environment or in the human organism itself—from which new developments are surmised to arise. Here are a couple of examples of modern thinkers trying to make sense of ancient consciousness:

> We have here [in Göbekli Tepe] a classic example of cognitive fluidity, the imposition of social intelligence, a way of thinking that had evolved for interacting with other human beings, onto the non-human world. Whatever the social and symbolic role of these animal images, they must have formed part of a remarkably strong ideology that motivated people to create the structures at Göbekli Tepe.[67]

> The people at Çatalhöyük[68] constructed a cosmology (derived in part from "hard-wired" experiences of certain altered states) and reproduced that cosmology in architecture and images. Ritual specialists, appropriating and exploiting the experiences of altered states, asserted themselves by modifying, or elaborating, that cosmology and by manipulating a symbolic vocabulary.[69]

These authors believe that the consciousness of the people they are describing was, in one sense, configured similarly to their own—a mind with ideology, that appropriates, exploits, imposes, and asserts itself upon the non-human

67. Mithen 2007.

68. Çatalhöyük is a Neolithic site in Turkey that flourished around 7,400 to 6,000 years BCE. Ongoing excavations reveal a rich array of sculptures, paintings, and ornaments; see, for example, Hodder 2007.

69. Lewis-Williams and Pearce 2018, p. 148.

world just like theirs does.[70] In other words, they assume that the ancients had the essentially same relation to nature and the same manner of thought as they themselves have. But they don't seem to recognize the paradox inherent in this assumption: if ancient consciousness was essentially the same as ours, then why would these people invoke images and inhabit narratives suggesting realities that to a sober modern scientific thinker seem outrageous, and at least go far beyond what most people today would feel to be real?

With the advent of modern scientific thought, anthropologist Philippe Descola writes, nature "became a domain of objects that were subject to autonomous laws that formed a background against which the arbitrariness of human activities could exert its many-faceted fascination." When one projects this sensibility onto the past—as the authors quoted above do—you imagine that "everywhere and in every age, an unchanging mute and impersonal nature established its grip, a nature that human beings strove to interpret more or less plausibly and from which they endeavored to profit, with varying degrees of success."[71]

From this perspective, it only seems possible to dismiss the earlier way of experiencing as anthropomorphic projection. Philosopher Charles Taylor speaks of "subtraction stories" that are created to account for the modern mind. Such stories depict human beings as freeing themselves from the gods, spirits, and other superstitions held by ancient and indigenous cultures, while at the same time assuming "underlying features of human nature which were there all along." The modern mind was attained, so the story goes, by "human beings having lost, or sloughed off, or liberated themselves from certain earlier, confining horizons, or illusions, or limitations of knowledge."[72]

Dismissal of the ancient (or indigenous) way of being in the world as anthropomorphic assumes there is an impersonal world of things and forces that we stand over and against ("me here; world there"). It assumes that this *is* the configuration of the world and that our relation to it begins with separation. When you project this worldview into ancient or indigenous people, then your conclusion can only be: animism (or whatever other name you want to give it) must be a projection of human subjectivity onto the world, since clearly the world is populated with things and not with sentient beings (except us and maybe animals). While this view may be widespread, it is not the only possible one.

70. I use the term "consciousness" and sometimes the term "mind" in this book as short ways of expressing that people have experiences of themselves and the world. These terms point to that field of experiences and the way of experiencing. I'm not thinking of any kind of a "container," and I'm not trying to develop any particular theory of mind or consciousness. My focus is on lived experience and descriptions of it.

71. Descola 2013, p. xv.

72. Taylor 2007, p. 22.

A world of interacting beings

> When man first began to interpret the nature of things—and this he did when he began to be man—life was to him everywhere, and being the same as being alive. Animism was the widespread expression of this stage. . . . Soul flooded the whole of existence and encountered itself in all things. Bare matter, that is, truly inanimate, dead matter, was yet to be discovered—as indeed its concept, so familiar to us, is anything but obvious. . . .
>
> To early man, standing on his earth arched by the dome of its sky, it could never occur that life might be a side issue in the universe, and not its pervading rule. His panvitalism was a perspective truth which only a change in perspective could eventually displace. Unquestioned and convincing at the beginning stands the experience of the omnipresence of life.[73]

With these words, philosopher Hans Jonas characterizes in broad strokes the sense of the world that people around the globe had before the development of modern science. Based on his extensive research into the history of consciousness, Owen Barfield tries to convey in a concrete way the feeling of a medieval European person—who could have been a farmer—looking out into the world:

> If it is daytime, we see the air filled with light proceeding from a living sun, rather as our own flesh is filled with the blood proceeding from a living heart. If it is night-time, we do not merely see a plain, homogeneous vault pricked with separate points of light, but a regional, qualitative sky, from which first of all the different sections of the great zodiacal belt, and secondly the planets and the moon (each of which is embedded in its own revolving crystal sphere) are raying down their complex influences upon the earth, its metals, its plants, its animals and its men and women, including ourselves. We take it for granted that those invisible spheres are giving forth an inaudible music. . . . Our own health and temperament are joined by invisible threads to these heavenly bodies we are looking at.[74]

73. Jonas 1966, pp. 7–8.

74. Barfield 1965, pp. 76–77.

Human beings felt themselves as microcosms embedded in a macrocosm. All aspects of a person's being were united by invisible connections with the larger world. Barfield summarizes: "Before the scientific revolution the world was more like a garment men wore about them than a stage on which they moved."[75]

The cosmos was populated with beings that were all interconnected. This sensibility was often portrayed in the idea of the great chain of being in which everything has a place and significance.[76] The chain of being, in the words of literary scholar E. M. W. Tillyard, "made vivid the idea of a related universe where no part was superfluous; it enhanced the dignity of all creation, even of the meanest part of it."[77]

It is difficult for us to imagine how the human self was not, in Charles Taylor's words, "buffered" with a clear sense of its boundaries, by virtue of which the "possibility exists of taking a distance from, disengaging from everything outside the mind."[78] Not so to someone living with what Taylor calls a "porous" mind in an enchanted world: When Aphrodite smiles on me, all is going well. "The blooming of the right internal motivation is a gift from her. . . . My being in the highest motivational condition is not just a fact about my inner realm of desires; it is my being the recipient of the gift of the goddess." Taylor asks us to "imagine that this is not a theory, but how we sense things to be; and thus how we seem to experience them. The inside is no longer just inside; it is also outside. That is, emotions which are in the very depths of human life exist in a space which takes us beyond ourselves, which is porous to some outside power, a person-like power."[79]

In a similar way, anthropologist Tim Ingold writes concerning hunter-gatherer cultures, "They do not see themselves as mindful subjects having to contend with an alien world of physical objects; indeed the separation of mind and nature has no place in their thought and practice."[80]

Ancient or indigenous peoples—without the connotation of the extraordinary or supernatural in our sense of a "transcendent world"—speak of gods and spirit beings; they experience plants or bison as "people;" they describe how the gods are at work in all human thoughts, feelings, and actions; they report that plants and animals speak to them in dreams. All of these experiences are taken seriously as experiences, not as some kind of mental creation or fantasy.

We need to take this different way of being in the world seriously when we think about the beginnings of agriculture and its further development

75. Barfield 1965, p. 94.

76. Lovejoy 1976.

77. Tillyard 1959, p. 31.

78. Taylor 2007, p. 38.

79. Taylor 2007, p. 36.

80. Ingold 2011, p. 42.

through the ages. The fabric of experienced reality was radically different from a contemporary science-based worldview. I need to shed my assumptions about how I would have acted and thought were I—untransformed—thrown back 12,000 years. We cannot know that a particular dream or ceremony was the source of inspirations that led people to select a particular plant to cultivate, or to craft a tool in a specific way. Based on everything I have considered here, it only makes sense to imagine that there were such inspirations gained through rituals, rites, or dreams and that they informed the transition from hunter-gatherers to farmers.

It is hard to underestimate the long-term significance of ancient people in different parts of the world connecting with the earth through farming. They felt themselves inspired and guided by sun and moon gods, gods of fertility, and agencies indwelling all that today we call nature. In activities such as tilling the soil and breeding plants and animals, a whole new relation to the earth begins. Rooting in the land is initiated. There is reverence for the earth and her fruits, and reverence expressed in the many ceremonies and celebrations that became part of agricultural societies. Farming created diverse agricultural landscapes, and new forms of human community arose. Over time land was also misused and degraded. All was not rosy. Human consciousness and the relation to the earth continued to evolve.

Transition to modern intellectual consciousness

There is clearly a gulf between human beings who experience themselves in a world of interweaving beings and the modern secular view of a largely impersonal world governed by general laws of nature that we can begin to understand, as if from the outside, with our thinking minds. The unique character of modern intellectual consciousness—its strengths and weaknesses—becomes much clearer when we put it in historical perspective. It developed over the course of millennia and finds clearest expression in modern scientific thought. In what follows, I want to highlight some characteristics of the modern way of seeing and doing things, and its assumptions about the nature of reality. By becoming aware of those assumptions, I can begin to see their limitations and begin a process of moving beyond those limitations. New features of the human-nature relation open up.

Hans Jonas pointed out that, for modern scientific thought, the lifeless—not the living weaving of beings—is the fundamental reality of the universe:

> The tremendously enlarged universe of modern cosmology is conceived as a field of inanimate masses and forces which operate according to the laws of inertia and of quantitative distribution in space. This denuded substratum of all reality could only be arrived at through a progressive expurgation of vital features from the physical record . . . [and] what

> remains is the residue of the reduction toward the properties of mere extension which submit to measurement and hence to mathematics. . . . This means that the lifeless has become the knowable par excellence and is for that reason also considered the true and only foundation of reality.[81]

From the perspective of enchanted or animistic consciousness, the modern scientific take on reality appears as a contraction from the participatory interweaving of beings. This contraction did not take place overnight and it occurred in different ways in different cultures and is also different for each individual

One striking and early example of a transition from a being-embedded consciousness to a centered, more internalized consciousness can be found in ancient Greek tragedies.[82] In Aeschylus' *Eumenides* (first performed in 458 BCE), the Erinyes (Furies) are goddesses that hound Orestes, who has murdered Clytemnestra, his mother (to avenge his father, Agamemnon, who was murdered by Clytemnestra). The main actors in the play are gods (the Erinyes, Athena, and Apollo). The dead soul of Clytemnestra calls the Erinyes, which form the chorus, into action and they torment Orestes about his deed. He believes that Athena had absolved him of guilt, while the Erinyes strive to make him realize his guilt. Both the sense of guilt and absolution come from the gods.

Fifty years later, Euripides's play *Orestes* deals with the same subject. But now all the actors are human beings, except for Zeus, who appears at the end. The Erinyes do not appear on stage; his sister Electra reports at the beginning that they harassed him, causing him to fall "sick of a cruel wasting disease." (Euripides, *Orestes*, first scene). Orestes awakens and enters into conversation with Electra and then Menelaus, Agamemnon's brother. Menelaus asks Orestes what ails him and he replies: "Conscience; I know that I am guilty of an awful crime." It is the only time in the play that Orestes uses the word conscience (*synesis* in Euripides; later in Greek, the word *syneidesis*; in the first century BCE, Cicero translated *syneidesis* into Latin as *conscientia*).[83] Conscience as a kind of inner awareness of personal guilt is expressed for the first time in Greek history. For a moment an inner experience lights up in place of what was otherwise experienced as the tormenting goddesses. As philosopher and historian of consciousness Karl-Martin Dietz puts it, we can see how the "real pictorial perception of the Erinyes (in Aeschylus) becomes an internalization of pictures (in Euripides) and how out of these images the concept [of conscience] arises."[84] Speaking of Euripides more

81. Jonas 1966, p. 10.

82. Dietz 2004, pp. 197–218.

83. Dietz 2004, pp. 216–217.

84. Dietz 2004, pp. 216–217; translation C. Holdrege.

broadly, classical philologist Bruno Snell writes, "In his plays the human being is made to stand apart from the variegated tapestry of divine and earthly forces, and instead becomes himself the point whence actions and achievements take their origin."[85]

Socrates (who died in 399 BCE) was an eminently rational, argumentative thinker. I can imagine him walking around today, challenging people to think more clearly and independently. Yet he was also someone who received knowledge from divine sources. In the *Apology*, Plato's account of Socrates' trial that led to his condemnation and death, Socrates states:

> You have often heard me speak of something related to the gods and to the *daimones*, a voice, which comes to me, and is the thing that Meletus ridicules in the indictment. This thing I have had ever since I was a child: it is a voice which comes to me and always forbids me to do something which I am going to do, but never commands me to do anything.[86]

Socrates acknowledges that the voice (*daimones*) has its own agency, is a being in its own right, and he accepts its working into his consciousness to prevent him from doing things. But it is out of his own felt agency that he must find the impetus to carry out an act. His self is both woven into other beings and has its own agency.

By the 1600s in Western cultures, the contraction to a feeling of self as independent agency goes hand in hand with the growing sense of the boundless expansive potential of intellectual thought and human action. Consciousness becomes increasingly felt as centered-in-me (egocentric) and also expands what it feels to be its own products—a cosmos of intellectual and mathematical thought. Think of people such as Galileo and Newton creating theories about forces shaping the material universe. Over time technologies are created—machines and devices—that embody the power of human thought and transform the world.

Francis Bacon (who died in 1626) was an early proponent of experimental and empirical science, and was an influential thinker who wanted to free knowledge from what he perceived to be the superstitions and speculations of the scholars of the Middle Ages. A few years before his death, Bacon wrote an essay called "New Atlantis." It depicts a kind of utopia in which an advanced culture aims to gain "the knowledge of causes, and secret motions of things" that provided the basis for "the enlarging of the bounds of human empire, to effecting all things possible."[87] Bacon imagines a world with modified plants and animals, with microscopes, telescopes, sound recorders, telephones, amplifiers, airplanes, and

85. Snell 1960, p. 111.

86. Plato, *Apology* 31d.

87. Bacon 1952, p. 210.

submarines. "New Atlantis" is a remarkable vision foreshadowing the ingenuity and power that would allow *Homo faber* (man the maker) to create our modern science- and technology-dominated world.

When I look at agricultural technologies today, I find it hard not to be impressed by the immense creativity they embody. The intelligence poured into crafting a combine; computer-modulated applications of herbicides, pesticides, and fertilizers; or high-yielding, genetically modified crops is mind-boggling. In one sense, industrial agriculture fulfills Bacon's dream. It embodies ideals such as maximal control, efficiency, productivity (yield), and profit. From this vantage point, the fact that ever fewer farmers can produce ever more food in a world with a growing population is proof of its "rightness."

What is the source of such inventions and ideals? Someone may wake up with a "good idea," a novel invention, or a solution to a problem they've been pondering. They may even have received the idea or solution in a dream. But the feeling is: I am the source. An ancient mind would have assumed that some kind of spirit, some kind of intelligence in the world was the source.

Whether a world intelligence or a narrow human-born intelligence, we gain a fuller picture of its nature when we look in two directions. We can consider the thought forms and craftsmanship that flow into ingenious technological achievements. And we can consider the ramifications that technologies and practices have for the larger context of which they are a part. As I mentioned in Chapter 3, while increasing yield (productivity), industrial agriculture uses immense amounts of energy, depletes water resources and soils, pollutes the environment, increases erosion, lowers biodiversity, destroys rural farming culture, and brings most farmers into debt. It has not created the agricultural utopia that Bacon dreamed of. Evidently, the drive to make agriculture an industrial process modeled after the efficiency of factories has effectively ignored the larger context of life. Something is missing when your goal is to make plants and animals more efficient units of production. Something is lacking in a centered consciousness that is bent on giving body to its one-sided ingenuity.

* * *

In this chapter I have taken you on a journey through changing consciousness. This journey reveals how the fabric of experienced reality has transformed. What we take to be real is bound up with our consciousness. This does not mean that reality is "subjective." Rather, there is what we can call a potential in the world to show itself and, depending on the disposition of consciousness, different features of this potential come to appearance. It is easy for us to acknowledge that our senses allow us to perceive specific qualities of things. A rose reveals different

aspects of itself to us through color, taste, texture, or scent. Similarly, the rose can reveal new aspects of itself depending on the disposition of the consciousness attending to it.

In this sense, all phenomena in the world are potentials that at any given moment have the possibility of revealing ever new features if we give them appropriate attention. What we apprehend as reality is a weaving of human awareness with world potential.[88]

The meeting with concrete phenomena and delving into their varied relations can become an opportunity to stretch us beyond habitual ways of thought. And when we develop greater flexibility in thought, paired with open receptivity to the not-yet-known, vital features of the world can come to expression. This dialogic pathway to the living—and some of the considerable obstacles that stand in the way of treading it—is what I discuss in the book's final chapter.

88. For elucidations of this perspective, see Barfield 1965; Bortoft 1996 and 2012; Steiner 2011.

CHAPTER 6

A Pathway to the Living

When Wes Jackson conceived the idea of perennial polycultures in agriculture, he viewed the prairie of the Midwest as a model—an ecosystem with great diversity of perennial plants, high productivity, and deep, fertile soils. When you live in Kansas and have witnessed the destruction of the prairie to make way for unsustainable monocultures of wheat, what could make more sense than to strive to learn from a healthy and resilient ecosystem? He wanted to use "nature as measure" to guide the future of agriculture.[89] Similarly, Sir Albert Howard, one of the founders of what we today call organic agriculture, saw the forest ecosystem as a model for agriculture.[90]

Everywhere today there are calls for farmers—and humans more generally—to learn from the wisdom of nature, rather than imposing on it human-centered ingenuity with all its unintended consequences. Witness the widespread use of terms such as "biocentric" or "ecocentric" to express the desire to take our cues from the world, rather than from our habitual anthropocentric proclivities.

I think it is fair to speak of a growing will to move beyond a human- or ego-centered, control-oriented consciousness to one that wants to learn through dialogue with the natural world.[91] This desire arises in part out of the awareness of the destructive relation to nature that our modern ways of thought and action have generated. And it also reflects a deeper sense that we may not be as smart as we think and have much to learn from the world that supports our very existence.

We are witnessing a turn from self-centered consciousness to an Earth-oriented consciousness. Self-centered consciousness ascribes intelligence to itself and wants its power to radiate out and transform the world. A world-oriented consciousness strives to learn from the intelligence or wisdom (or whatever else we might want to call it) embodied in the whole of life. Out of this learning the

89. Jackson 1985 and 2011.

90. Howard 1940.

91. Talbott 2008.

central question becomes: How can we develop ways of thinking and practices that are more integrated into the larger ecology of life?

It is no simple matter to move beyond all the thought habits that have been built up over the past 500 years of Western culture. How do we picture the "nature" we want to take as a guide for our thinking and action? And since doing always creates change, how can we orchestrate the human-nature relationship so that it is not exploitative?

Beyond mechanism

In the field called biomimicry, researchers aim to learn from nature's structures and processes as models for new technologies.[92] There are many fascinating examples in a variety of fields. Often researchers have an engineering mind that already imagines organic structures in terms of engineering and then proceeds to find "engineering structures" in organisms that they then purport to mimic. Janine Benyus speaks of the cell as "a highly distributed, massively parallel computer [that] is hacking a living for each of us."[93] Such a statement makes you wonder whether she has ever concerned herself with the intricacies of cellular processes and how they transform in relation to the changing needs and activities of an organism. Here is another unbiological depiction, this time from Craig Venter, entrepreneur and the leader of one of the two groups that first sequenced the human genome in 2000:

> The genome can be thought of as the software that encodes the cell's instructions, and the cellular machinery as the hardware that interprets and runs the software. Advances in DNA technology have made it possible for scientists to act as biological "software engineers," programming new biological "operating systems" into cells.[94]

When you express biological phenomena in this way, you are not mimicking cells, you are imagining a cell in terms of your computer-based thought style, and then interpreting what you find in those terms. You are imposing a narrow framework upon life, not attempting to discover life-appropriate ways of conceiving of and expressing life.

This is a widespread issue in the life sciences more generally. Researchers look for mechanisms, and all biology students learn that to explain a given phenomenon you need to find an underlying mechanism. This means discovering how one material happening accounts for another material

92. Benyus 2002.

93. Benyus 2002, p. 187.

94. Gibson & Venter 2014.

happening. All actions and reactions are local and materially based. One can speak, for example, of the mechanism of gene action when the steps between a genetic structure and the synthesis of a given protein can be accounted for. Then the gene is said to "cause," "determine," or "direct" the production of the protein. Note the language of control and power.

The mechanism is a thought framework that informs the conception of experiments and their interpretation. The phenomena are thereby laden with mechanism from the outset and reveal what they can reveal within that framework. But this does not mean that the phenomena don't have other features and facets that escape this particular conceptual net.

In the 1970s, a simple and elegant mechanism of genes and gene action had been formulated, showing how genes determine processes in the organism. Over the past 50 years, the neat gene-centered deterministic view has loosened in the face of a plethora of discoveries showing that genetic structures and processes are much more fluid, dynamic, and contextual than was previously thought.[95] Virtually everyone today has heard about epigenetics—the manifold ways in which organisms can modify gene expression. Nonetheless, the biological community holds onto mechanistic thought forms and language, even though they are woefully inadequate to account for the phenomena and, in fact, skew understanding of them.[96]

We can form the picture of a finely constructed machine in which every part has its role in the smooth functioning of the whole and then go on to imagine an organism in those terms. It's important to consider the simple fact that machines don't exist in nonhuman nature. They are a human creation. Every machine is constructed on the basis of the thoughts of human beings, and the parts are made and brought together according to ideas. A plant (and any other living being) is not constructed—put together—out of preexisting parts by a mind working from the outside and assembling those preexisting parts to configure a whole.

The interweaving of plant and environment (we can't actually separate them) brings forth all the members of the organism—roots, shoots, leaves, flowers, fruits, seeds. These members develop from germinal tissue and remain in continuous dynamic relation with each other as expressions and embodiments of the particular species. We observe the same kind of dynamism at every level of organization—whether organs, tissues, cells, or organelles—and in all physiological and metabolic processes. There is life all the way down.[97]

Mechanism is an inadequate metaphor for life. This does not keep people from treating life as if it were a mechanism—cows as production units, the heart as a pump, or the brain as a computer. Such guiding metaphors and mental

95. See the website www.thethirdwayofevolution.com/ for a wealth of references from a variety of different scholars.

96. See Talbott 2014 and 2015.

97. Talbott 2015.

frameworks allow for partial insights. They also facilitate the overarching goal to manipulate and control.

Mechanism-based manipulations of life both work and don't work. Countless people are thankful today for hip and knee replacements, even though they can know that, unlike living bone tissue, the new structures will not adapt to their lifestyles and will, at some point, need to be replaced. Genetically engineered crops "work" once the plants that do what the engineers intend have been selected from the myriad unsuccessful attempts. And once they "work" there are often unintended effects for the organism and the environment (see The Nature Institute's website nontarget.org).

All this emphasizes how strongly our way of thinking and conceiving of the world becomes embodied in our actions and shapes the world. The central question for me is: How do we discover and do justice to *aliveness* in the world as human beings living in the 21st century? We've practiced mechanism-based thinking for a long time. How do we develop life-based thinking? How do we learn to take *living* nature as measure, as exemplary for our own doings?

Aliveness

I have the sense that most people who speak of ecocentric thinking or taking nature as a model have been touched by the aliveness and wisdom of nature. It might have been the beauty of a sunset or rainbow, the delicate white and pink of an apple blossom, a soaring hawk, or fog lifting on an autumn morning. In such experiences something of the deeper nature of nature resonates in feelings of awe, wonder, and respect. The feeling that nature is rich and wise provides the motivation to learn more from her. There is meaning in the world that I acknowledge and want to pay homage to in my actions.

This sensibility is a kind of echo or a quiet upwelling undercurrent of the felt connectedness with the world that was so strong in ancient and indigenous cultures. As a child of Western education and culture, I have a feeling of separateness. I want to find my way into every greater connection. I don't want to shut down my thinking in the attempt to silence the sense of separateness. I want to transform it. As the meetings with nature give me a felt sense of the aliveness of nature, can aliveness also permeate my thinking relation to the world?

Once I was walking across a field and saw in the distance black balloons in a tree. Strange, I thought. Some remnants of a goth birthday party? I kept walking and suddenly the balloons flew off. They were crows! The concept "balloon" arose without any conscious discernment on my part; and it stuck for a short time. Since I continued to attend to the "balloons" in the distance, I had the opportunity to let my stable worldview be shaken. I was suddenly gripped by fluttering wings, upward flight, and cawing; the world was unsettled and alive. It was an exhilarating experience. I calmed down some when I could say: those are crows.

The black balloons were at first part of the ordered world I was moving through. We take for granted that we move through a world in which things fit together and have coherence. We rarely notice—and that is the gift of such an experience—that this belonging together and coherence has to do with the concepts we have, with the way the world we perceive is also a conceptualized world. To state this a bit differently: all our conscious experience is informed by ideas.

In my experience that day, the black balloons, although somehow "there," also didn't seem quite right. A question arose in my mind: goth birthday party? Questioning is always an unsettling of an ordered world. A question is an opening. When it stimulates me to keep perceiving and to ponder, I become willfully active. As I kept walking, I had my attention with the trees and the balloons. I didn't start thinking about other matters. I was extending myself intentionally and being with the appearances. Then came the moment when the ordered world (black balloons in trees) was shattered. And in the surprising and unexpected event, I experienced an aliveness in the world that I was participating in.

This is not an everyday experience, and is therefore revelatory. It shows how, in one respect, the ordered world in which I live has a certain deadness that is in part due to my own habitual way of conceptualizing. The "black balloons" gave a false sense of order to the scene. I'm not saying we walk through life projecting erroneous concepts in this crass way onto experience. What experiences like this let me realize is that the meadow I'm walking through, the trees I'm looking at, and the crows flying and cawing can be much more vibrant than my habitual reflective concepts of meadow, tree, and crow. It is probably wrong to even call them concepts, if I haven't worked intentionally to gain greater insight into these presences in the world. They are more like labels, designations, or categories that provide stability. The habitual mode also provides the illusion that a stable world of different things is "the real world."

This is a difficult matter to articulate clearly. I'm not saying we construct all our experience and it is therefore "subjective." I could realize, in reflecting on my experience, that the black balloon was a concept that did not fit, while crow did. However, "crow" can also become just a label, rather than an invitation to explore and participate in "crowness" more fully. And if I do that, the aliveness of the world becomes more apparent. I have to change and tap into aliveness in myself to find aliveness in the world. I can't remain in the habitual mode. In this process the me/world boundary of habitual consciousness becomes porous. I sense how I am woven into the world and part of an ongoing weaving.[98]

Such exceptional experiences can stimulate a process of growth, development, and transformation. And just as the development of a plant is a process of plant/environment weaving, so the development of human capacities toward aliveness depends on the growing realization that what, at first, I think of as "the outer

98. To read more about the participatory epistemology that I am describing here, see Bortoft 1996 and 2012; Maier et al. 2008; Steiner 2011.

world" is actually a dynamic participatory relation. The world is not a thing and I am not an onlooker. Any authentic consideration of "holism" or "ecocentrism" needs grounding in the growing (non-fuzzy and matter-of-fact) awareness of world-in-me and I-in-world.

In Chapter 1, I quoted Thoreau. He was wrestling with what I will call in this context "Thoreau's enlivening paradox": He pointed out that to get close to a natural object, you have to "conceive of it with a total apprehension" and "for the thousandth time approach it as something totally strange. If you would make acquaintance with the ferns you must forget your botany."[99] In taking his daily walks, which he called "sauntering," he was striving to be open to discover new and fresh qualities in nature and himself. But he also recognized that "we cannot see anything until we are possessed with the idea of it, and then we can hardly see anything else."[100] I need concepts to perceive anything, and yet I must forget my botany to get to know ferns? This seems at first like an impossible situation. By looking at experience from these two sides we can keep a healthy tension in the process of knowing. The tension infuses wakeful aliveness into the drama of knowing.[101] It keeps us on our toes (an act that involves continuously achieving balance).

If I mainly learn to categorize ferns—what distinguishes them, say, from mosses and flowering plants—then a meeting with an unknown plant can be merely a matter of determining whether I actually have before me a fern. My already existing conceptual framework provides the container into which something can fit or not fit. I felt this lack of drama in a college botany course.

It is a different matter when I observe a plant carefully that others tell me is called a fern and I begin to form an idea of its characteristics, where it grows, its neighbors, and so on. Then I go to other plants and see in what ways they are similar and different from the previous fern. By continually attending to the new, I'm not concerned with fitting what's new into a box, but with growth of experience and my concepts. "Fern" provides focus to my studies and becomes an open invitation to discover more. It becomes more meaningful, a realm of varied expressions in which each new instance can enrich and maybe also challenge what I have learned so far. As I form a more and more differentiated, living idea of fernness, every new encounter with a fern can be revelatory.

If you substitute "fern" with any other concept or field of experience, you can see how it is possible in manifold realms of experience and inquiry to cultivate aliveness in our relation to the world. Aliveness or vitality in the drama of knowing shows itself in a number of ways. It allows me to let go of static categories and to stay in flux. It gives me the ability to be active in perception, to be sensitive to the colors, forms, the particular situation and its relations. I mingle with the

99. Cited in Walls 1999, p. 91.

100. Cited in Walls 1999, p. 84.

101. I borrow the expression "drama of knowledge" from Steiner 1987.

phenomena and let them be my guide. I attend to how in the meeting with the phenomena my understanding is growing and transforming. Whether I am engaging with a plant, another person, the organization I work in, or a concept, something can come to life in me. My aliveness is a precondition for the aliveness in the world to show itself, and the aliveness I meet can then become my teacher about life. It is a reciprocal, potentizing relation.[102]

The "test" for whether I am on a pathway of aliveness is if I see that my understanding is continually growing and morphing, and whether my experiences of new phenomena are increasingly vibrant and vital. It is not enough to say we need to think outside the box. We can think outside the box and still just be making new boxes.

Living perenniality

The grove of 800-year-old oak trees in Switzerland that I visited once has been a lasting presence in a landscape that has experienced the ebb and flow of much change. The trees too have transformed. Each year, living in an annual rhythm, they bring forth new roots, branches, leaves, flowers, and acorns; they form new buds and lose their leaves in the fall. Underground they weave with fungi and other plants; bacteria and fungi break down their discarded leaves and, together with myriad small animals, create a humus-rich soil that also supports the life of trees and other plants. While oak leaves feed the decomposers, acorns provide food for various animals. In a mast year, when they produce an overabundance of acorns, teeming animal life thrives, and this, in turn, brings new dynamics into the relations among other species. The trees respond to the changing conditions of light, air, and moisture in the moment and over longer periods of changing climate. The trees are lasting and they are embedded; they are responsive and they are active. They are exemplars of living perenniality.

The long-lived oaks are enduring but not static. The annual ring of wood that each tree grew in its trunk in 1546 is still there. But it would not be there if the tree as a whole were not, day in and day out, living in receptive and active weaving with the changing world. The width of the ring and the quality of the wood reflect its relation to the larger ecosphere.

What is long lasting and alive is also responsive in the moment. What is long lasting in the sense of solidity, but not aliveness, will be broken down over time and disappear. What endures and is in touch with its context will transform. You don't have living perenniality in nature without continuity and without ongoing transformation.

Dynamic and healthy ecosystems are usually inhabited by a great variety of plant growth forms, from the short-lived to the long-lived. They are all active contributors to the long-term, vital coherence and transformation within a forest, prairie, or lake. Short-lived parts of creatures, such as root tips and root hairs or

102. I deal with this topic at length in Holdrege 2013.

the hyphae of fungi, and creatures with short life cycles—spanning months in annual plants, weeks or days in nematode worms, to less than an hour in actively dividing bacteria—are all essential in nature's life processes.

Human life is dependent on this living perenniality in the rest of nature. Nature is not a separate "other," outside of me. I am woven into it as an organism and could not exist without it. And yet, in consciousness, I can be essentially oblivious to it. Nothing external can compel me to strive to learn from, honor, and act in relation to the wisdom at work in the world. It is a choice I can make—a choice that does not arise for trees, fungi, and squirrels.

Humanity has—whether we like it or not—a unique place on Earth. Over two hundred years ago J. G. Herder wrote that the human being is the first creature to be "set free" in creation. Clearly, I am not free to live without ground under my feet or the oxygen that plants create. "Set free" points to a state of consciousness—my ability to ponder, choose, strive for a better future, or ignore what's going on around me. Humans can, in Herder's words, "look to far horizons" and also "see much darkly and false. We forget our steps, only to be reminded when stumbling on what a narrow basis the whole head- and heart-edifice of our concepts and judgments rests."[103]

To take a perennial view as a human being is to attend to the long term. We consider—in the present—the past, and we look to the future. Grounding for living perenniality in a human context lies in the growing insight into the currents of life that are at work in the present. We can learn from the life of nature—nature as measure—and we can consider how human thought and action have influenced and will influence the course of evolution. Humanity has strongly disrupted processes on the Earth. Much of this has to do with egocentric minds that think short term. And also with the drive to do the doable, which manifests in profit-seeking economics and immense developments in technology.

In his novel *The Caine Mutiny*, Herman Wouk describes a main character as "too clever to be wise."[104] This is one conundrum of our situation today. In cleverness left to its own devices, a person can be caught up in a web of ideas—a "cool idea" comes and he wants to try it out. He follows that idea, helped by a cadre of smart people, and develops a product. While the product, considered in isolation, may be ingenious, the larger context that it will in fact influence and change is usually given little consideration—except to the extent that it serves the limited goals of the creators. It is left to others to pay attention to and deal with all the unintended consequences. You can see this in technology, in laws that serve egotism, or in political and economic structures that reinforce the life-inhibiting status quo.

As human beings we are enmeshed in forms that stem from the past; we are active in the present, and we consider the future. Future is a "not yet" that is at

103. Herder 1982, pp. 64–65; translation by author.

104. Wouk 1951, p. 468.

work in our concerns, hopes, and ideas in the now. How can we further a healthy evolution of the planet so that diverse life on Earth—including human life—can thrive? This question embodies a striving beyond what is given today.

How the future should look is not written in the stars. While there is no script, there is much that we can learn from living perenniality in the natural world. When we work to gain a deeper understanding of its qualities, we are not only learning new facts. The participation in how life is at work on Earth can enliven our perceptions, help our thinking become more dynamic, and let our doing become sensitive to the contexts in which we are working. We become more rooted in the life of the planet. The wisdom in the world provides guidance.

The study of living perenniality in nature will not tell us what to do. It does provide fertile soil for intuitions and inspirations that have the potential to be in touch with what the Earth and humanity need. While we can decry so much that is out of sync in what we do, there are also, all around the globe, people who generate seed ideas, such as the idea of perennial polycultures or the farm as an individualized ecosystem. Such ideas can lead to new creations on the planet, born of human intentions that strive for integration into the large context of life.

When we plant seed ideas, their growth and transformation in the web of life need tending. This includes ongoing attention to process. Are we able and willing to continue to guide their development with a sensitivity to the context they are in and that they are transforming? Do we stay flexible and open to further change? Do we realize that organizational forms also need to be imbued with life and not become rigid structures? Do we continue to learn—and remain aware of our ignorance? These are the kinds of questions that can foster living perenniality in human striving.

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