4
ORGANISMS
Respect for Life

A more inclusive ethics asks about appropriate respect toward all living things, not only the wildlife and farm animals, but now the butterflies and the sequoia trees. Otherwise, most of the biological world has yet to be taken into account: lower animals, insects, microbes, plants. If one really seeks a biologically based ethic, a sentient animal welfare ethic still leaves most of the world valueless. We already started to worry about this in the last chapter. The sentient animals form only a minuscule fraction of the living organisms on Earth. Over 96% of species are invertebrates or plants. A deeper respect for life must value more directly all living things and the generative processes that sustain life at all its levels, from the genetic to the global.

To get the big picture, look at a cartoon of life on Earth, where each group is sized according to the number of described species (see Figure 4.1). Find the tiny elephant (representing all mammals) near the gigantic beetle (representing insects). Compare the tiny elephant with the trees (representing plants) or the eight-legged arthropod (crustaceans, spiders, mites). And remember that humans, among the mammals, would hardly amount to the minuscule tail on the tiny elephant. But this is a cartoon with truth in it—putting mammals, putting humans in their place. Get the picture. Get an ethic for all of life. Perhaps

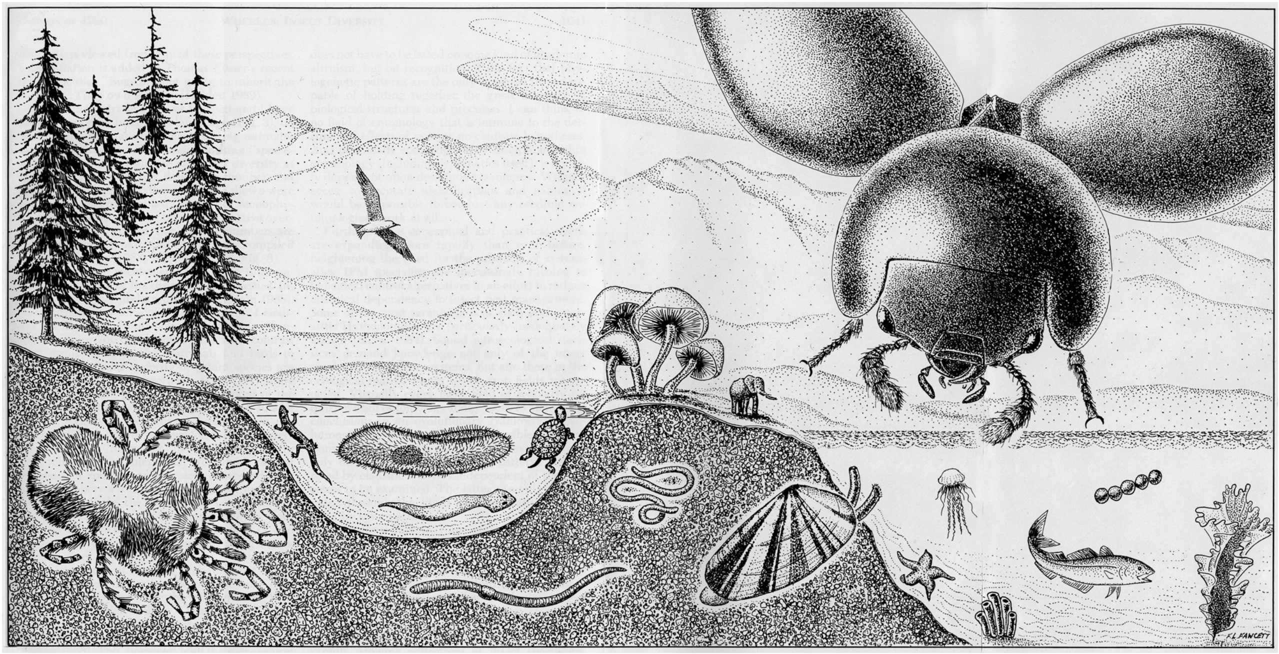

FIGURE 4.1 The buggy planet (Wheeler, 1990)

man is the only deliberative measurer of things, but man does not have to make himself the only measure he uses. Nor do we just measure sentient animals. Life is a better measure.

1. The Buggy Planet: The Little Things that Run the World

We need a little perspective. Looking around the landscape humans have a search image for large animals. We put ourselves out front. We think that we run the world, and, in Chapter 2, we looked at some of that evidence—the Anthropocene Epoch, with human-dominated landscapes widespread on Earth. But if we are trying to understand the landscape, we need to be much more inclusive, from plants to creepy crawlies. If we are marine, we need to appreciate the whales and dolphins, but just as much the coral reefs. Some 43,000 vertebrate species have been described by zoologists, of which a tenth, 4,000, are mammals. Over 990,000 species of invertebrates have been described, but, since invertebrates are less studied in detail, all the systematists believe that there are there are many more—so many more that we are unsure whether this means 3 million or 30 million. If you count numbers of individuals, a couple acres of Amazon rainforest may have a few dozen birds and mammals, but well over a billion invertebrates: insects, spiders, termites, other arthropods, nematodes. Coral reefs are built out of the bodies of coelenerates (brainless organisms that sweep food into their mouth with tentacles, such as hydras, jellyfish, sea anemones). The most abundant animals of the open sea are copepods, tiny crustaceans forming part of the plankton. In terms of living body mass, over ninety percent of living mass is invertebrates. These are "the little things that run the world" (Wilson, 1987).

These "lower organisms" can do without us, but we "higher humans" cannot do without them. Invertebrates have been around a ten times as long as mammals. They are in the food webs, of course; all the big animals eat little animals, or eat what eats little animals, or eat plants or eat what eats plants. These little things do the brunt of the recycling; those that feast on dead wood may depend on even more tiny organisms in their gut for digestion. Fungi also break down wood and other biomass, permitting recycling. Insects recycle dung. Insects pollinate many plants, including our food sources—so much so that, where these pollination process are degraded, agribusiness has to create a commercial pollination industry, breeding billions of bees.

We also get a comprehensive account if we turn to the Bible. The apex of the creation is man and woman, made of mud, made in the image of God, incarnate and set in their garden earth. Humans prove to be the great challenge to God, the contentious creature, but the world is habitat not only for humans but for the myriads of creatures—from "great sea monsters" to "birds," "beasts," and "creeping things"—which, repeatedly, God finds "good," bidding them to "be fruitful and multiply and fill" the waters, the earth, the skies (Genesis 1.20–22).

God enjoys biodiversity. That includes the creepy things, and here we might recall the biologist J.B.S. Haldane's famous remark, when asked by theologians what he had learned about the Creator from studying creation in biology, that God had "an inordinate fondness for beetles" (quoted in Hutchinson, 1959).

Haldane's remark is cute, but not profound, the anthropocentrists (including many theologians) will reply. Yes, there are myriads of beetles, but often beetle species are not that different from one another—a few spots or bristles here or there. Humans differentiate within their *Homo sapiens* species (Einstein and Mother Teresa); beetles of a species do nothing of that kind, and even related species hardly differ. The personal differences between Susan and Sally, both members of *Homo sapiens*, are much more exciting.

There are more microbes in Susan's body, Sally's body than there are persons on Earth. We kill millions of yeast cells every time we bake bread. But none of this has any ethical importance. An ant is only about a millionth the size of a human, and even less important. Lewis Thomas, an astute biologist, concludes: "A solitary ant, afield, cannot be considered to have much of anything on his mind; indeed, with only a few neurons strung together by fibers, he can't be imagined to have a mind at all, much less a thought. He is more like a ganglion on legs" (1975, p. 12). All the plants and the vast number of these simple organisms don't have a mind at all. So, dealing with them is no moral matter.

2. Plants: Nothing Matters! Never Mind?

Maybe the problem is that we have let ourselves get imprisoned in our own felt experiences. We might have blinders on, psychological and philosophical blinders that leave us unable to detect anything but experientially based valuers and their felt values. Over-instructed in philosophy, we are under-instructed in biology, unable to accept a biologically-based value account, that is otherwise staring us in the face. Organisms post a defended, semipermeable boundary between themselves and the outside world; they assimilate environmental materials to their own needs. They can be healthy or diseased. Some accounts claim that the minimal form of autonomy necessary and sufficient for characterizing biological life is what is termed *autopoiesis*, literally self-making. Some defense of a "self" (a somatic, bodily self, not a sentient, psychological self) is thus required.

Let's focus on plants, to make sure we are not biased by our preference for minimal neural experience. Considering plants makes clear the differences between a life ethic and an animal rights ethic. A plant is not an experiencing subject, but neither is it an inanimate object, like a stone. Nor is it a geomorphological process, like a river. Plants are quite alive. They resist dying. Plants, like all other organisms, are self-actualizing. Plants are unified entities of the botanical though not of the zoological kind; that is, they are not unitary organisms with highly integrated centered neural control, but they are modular organisms, with a meristem that can repeatedly and indefinitely produce new vegetative modules, additional stem nodes and leaves when there is available space and resources, as well as new reproductive modules, fruits and seeds.

Plants repair injuries and move water, nutrients, and photosynthate from cell to cell; they store sugars; they make tannin and other toxins and regulate their levels in defense against grazers, they make nectars and emit pheromones to influence the behavior of pollinating insects and the responses of other plants, they emit allelopathic agents to suppress invaders, they make thorns, trap insects. They can reject genetically incompatible grafts. A plant is a spontaneous, self-maintaining system, sustaining and reproducing itself, executing its program, making a way through the world, checking against performance by means of responsive capacities with which to measure success.

Something more than merely physical causes, even when less than sentient experience, is operating within every organism. There is *information* superintending the causes; without it the organism would collapse into a sand heap. The information is used to preserve the plant identity. This information is recorded in the genes, and such information, unlike matter and energy, can be created and destroyed. That is what worries environmentalists about extinction, for example. In such information lies the secret of life.

Plants do not have ends-in-view, and in that familiar sense they do not have goals. Yet the plant grows, reproduces, repairs its wounds, and resists death, maintaining a botanical identity. All this, from one perspective, is just biochemistry—the whir and buzz of organic molecules, enzymes, proteins—as humans are, too, from one perspective. But from an equally valid—and objective—perspective, the morphology and metabolism that the organism projects is a valued state. *Vital* is a more ample word now than *biological*. We could even argue that the genetic set is a *normative set*; it distinguishes between what *is* and what *ought to be*—not of course in any moral or conscious sense—but in the sense that the organism is an axiological system. The genome is a set of conservation molecules. A life is spontaneously defended for what it is itself.

For classical ethicists, all this seems odd. Plants are not valuers with preferences that can be satisfied or frustrated. It seems curious to say that wildflowers have rights, or moral standing, or need our sympathy, or that we should consider their point of view. We would not say that the needless destruction of a plant species was cruel, but we might say that it was callous. We would not be concerned about what the plants did feel, but about what the destroyers did not feel. We would not be valuing sensitivity in plants, but censuring insensitivity in persons.

These biologically-centered ethicists are now claiming, however, that environmental ethics is not merely an affair of psychology, but of biology. The concentric circles keep expanding. Every organism has a *good-of-its-kind*; it defends its own kind as a *good kind*. True, virtuous persons ought not to be callous. But that does not end the question; we at once ask what are the properties in plants to which a virtuous person should be sensitive. Judgments of disgust are derived from an admiration for something of value in the organisms.

An objector can say, "The plants don't care, so why should I?" But plants do care—using botanical standards, the only form of caring available to them. The plant life per se is defended—an intrinsic value. Though things do not matter *to* trees, a great deal matters *for* them. We ask, What's the matter *with* that tree? If it is lacking sunshine and soil nutrients, we arrange for these, and the tree goes to work and recovers its health. Such organisms do "take account" of themselves; and we should take account of them.

The tree is benefiting from the water and fertilizer; and *benefit* is—everywhere else we encounter it—a value word. Biologists regularly speak of the "selective value" or "adaptive value" of genetic variations. Plant activities have "survival value," such as the seeds they disperse or the thorns they make. Natural selection picks out whatever traits an organism has that are valuable to it, relative to its survival. When natural selection has been at work gathering these traits into an organism, that organism is able to value on the basis of those traits. It is a valuing organism, even if the organism is not a sentient valuer, much less a conscious evaluator. And those traits, though picked out by natural section, are innate in the organism; that is, stored in its genes. It is difficult to dissociate the idea of value from natural selection.

Any sentigenic, psychogenic, vertebragenic, or anthropogenic theory of value has got to argue away all such natural selection as not dealing with "real" value at all, but mere function. Those arguments are, in the end, more likely to be stipulations than real arguments. If you stipulate that valuing must be felt valuing, that there must be somebody there, some subject of a life, then plants are not able to value, and that is so by your definition. But what we wish to examine is whether that definition, faced with the facts of biology, is plausible. Perhaps the sentientist definition covers correctly but narrowly certain kinds of higher animal valuing, namely that done by sentient animals, and omits all the rest. To say that the plant has a good of its own seems the plain fact of the matter.

Let's look over the shoulders of some scientists and their discoveries. Studies of dragonflies in the Carboniferous show that their wings "are proving to be spectacular examples of microengineering" giving them "the agile, versatile flight necessary to catch prey in flight." They are "adapted for high-performance flight" (Wootton et al., 1998, p. 749). "To execute these aerobatic maneuvers, the insects come equipped with highly engineered wings that automatically change their flight shape in response to airflow, putting the designers of the latest jet fighters to shame" (Vogel, 1998, p. 598).

Dragonflies have to change their wing shape in flight without benefit of muscles (as in birds and bats), so they use a flexible aerofoil with veins that enable the wing surface to twist in direct response to aerodynamic loading, when suddenly changing directions or shifting from upstroke to downstroke.

A hind-wing base mechanism is especially impressive in the way it mixes flexibility and rigidity. "The 'smart' wing-base mechanism is best interpreted as an elegant means of maintaining downstroke efficiency in the presence of these adaptations to improve upstroke usefulness" (Wootton et al., 1998, p. 751). The flexible wings did "matter" to the Carboniferous dragonflies.

The social behavior of honeybees is, in a way, rather stereotyped. But biologists who study bees also find that such behavior is also labile in different environments, evidenced by their waggle and other dances conveying information to other bees about the location of food or suitable nest sites. The bees integrate multiple sources of environmental information in "deciding" the appropriate behavior in dynamically changing circumstances. Thomas D. Seeley, neurobiologist and world authority on communication in honeybees, describes the bee as "a sophisticated decision maker, one capable of integrating numerous pieces of information (both current perceptions and stored representations) as she chooses the general type and specific form of signal that is appropriate for a particular situation" (2003, p. 22; 2010; see also Hölldobler and Wilson, 2009). Critics may insist that, impressive though this is, it is nonreflective. Still bees seem rather smart at what they do.

Botanists report studies in what they call "a plant's dilemma." Plants need to photosynthesize to gain energy from the sun, which requires access to carbon dioxide in the atmosphere. They also need to conserve water, vital to their metabolism, and access to atmosphere evaporates water. This forces a tradeoff in leaves between too much and too little exposure to atmosphere. The problem is solved by stomata on the undersides of leaves, which can open and close letting in or shutting out the air. "The stomatal aperture is controlled by osmotic adjustment in the surrounding cells. In a sophisticated regulatory mechanism, light, the carbon dioxide required for photosynthesis, and the water status of the plant are integrated to regulate stomatal aperture for optimization of the plant's growth and performance" (Grill and Ziegler, 1998, p. 252). The details of such "plant strategies" vary in different species, but are quite complex, integrating multiple environmental and metabolic variables—water availability, drought, heat, cold, sunlight, water stress, and energy needs in the plant—for sophisticated solutions to the plant's dilemma (Craine, 2009).

Even the cyanobacteria, blue-green algae, which are relatively primitive single-celled organisms, can track day and night with molecular clocks built with a genetic oscillator rather similar to those in more advanced organisms. Discovering this, Marcia Barinaga says, "Keeping track of day-night cycles is apparently so essential, perhaps because it helps organisms prepare for the special physiological needs they will have at various times during the daily cycle, that clocks seem to have arisen multiple times, recreating the same design each time" (Barinaga, 1998, p. 1429).

One has to use language with care; we should guard against overly cognitive language. But scientists do have to describe what is going on. Why is the organism not valuing what it knows how to do—keep a molecular clock or make resources of food it gathers at night? Not consciously, but we do not want to presume that there is only conscious value or valuing. That is what we are debating, not assuming. And what we are claiming is that life is organized vitality, which may or may not have an experiential psychology. A value-er is an entity able to feel value? Yes, and more. A value-er is an entity able to defend value. On the second meaning, plants too defend their lives. In an objective gestalt some value is already present in nonsentient organisms, normative evaluative systems, prior to the emergence of further dimensions of value with sentience. There is no feeling in the organism, but it does not follow that humans cannot or ought not to develop, as Barbara McClintock put it, "a feeling for the organism" (Keller, 1983).

There is praise for those dragonfly wings in the Carboniferous, coming from the scientists who study them. What is a philosopher to say? "Well, those are interesting wings to the scientists who study them, but they were of no value to the dragonflies." That seems implausible. Perhaps one can go part-way and say: "Well, those wings did have value to the individual dragonflies who owned them. Instrumentally, the dragonflies found them useful. But a dragonfly is incapable of intrinsically valuing anything. Much less do these wings represent anything of value to the species line. Similar engineering features persist, Wootton and his associates (1998) add, in present-day dragonflies, living 320 million years later than the fossil dragonflies they studied in Argentina. That does sound like something that has been useful for quite a long time. Could that be of value to the species line?

The repeated discovery of molecular clocks in those cyanobacteria is important in fulfilling the organisms' "needs," and that seems pretty much fact of the matter. After that, do we want to insist that nevertheless this has no "value" to these organisms or their species lines, who have several times discovered how these internal clocks, similarly "designed," increase their adapted fit?

In Yosemite National Park, there are giant sequoia trees, some of the largest trees on Earth. In 1881 a tunnel was cut through one of them, named the Wawona Tree, large enough to drive a horse-and-buggy through, and later automobiles. The tree was world famous, a highlight of trips West for nearly a century. Impressed by the tree, amused tourists (including, once, this author) took photos of themselves driving their cars through a tree. In 1969, with a heavy snow load, the tree blew over in a winter storm, perhaps weakened by the tunnel cut, although it had stood for many winters. Soon people asked the Park Service to cut another "drive-through sequoia," but the rangers refused. A new ethic found it inappropriate to mutilate a giant sequoia for amusement.

There are two ways to interpret this refusal. One is that driving an automobile through a tree is just tacky, not the sort of thing becoming to park visitors—maybe they could amuse themselves in Disneyland. But the deeper ethic is that a sequoia has age, size, persistence resisting fire, insects, disease, an integrity, a good of its own, intrinsic value. A tunnel fails to respect this intrinsic good. Of course, the two perspectives can combine—human virtue respecting plant good of its own—but philosophical analysis will recognize differences. The Wawona Tree, often visited in summer, was seldom visited in winter; deep snows made it a challenge to get there. When the seasonal humans left, no longer virtuously respecting the giant, the sequoia good of its own remained, all four seasons, continuing across millennia, whether or not tacky tourists or, before them, native Americans (probably more respectful) were in the woods.

You may be thinking: Well, okay, no more-drive-through sequoias, but we use trees all the time, some redwoods included. True, but we still need to consider whether the use is justified, and whether we overuse them. Some years back, campers would cut boughs from trees to make a springy mattress for the night; they had been taught to do this in their Boy Scout handbook. But no responsible backpacker would do this today. Trees are not to be used trivially.

Americans consume about a half a million trees each week to have their Sunday paper. Newspapers are a good thing, up to a point; but, since the Sunday paper is mostly ads and much of it is only glanced at, one might argue that Americans having their Sunday papers does not warrant sacrificing half a million trees a week. The sellers might, for example, impose a return tax so that half the papers are recycled, and that would save a quarter of a million trees a week.

At Christmas time, a National Christmas tree is put up on the White House lawn. Once a year, American foresters go to some national forest, find a fine spruce tree, or other conifer, in the prime of its life, cut it down, ship it far across the country on a railroad flatcar, put it up on a lawn in downtown Washington, and place lights on it. There is a ceremony, the president wishes Americans "Merry Christmas," photographers take pictures, which are printed in those newspapers. The cut tree stands ten days, withering, and is then tossed. Can this be justified?

Or is this teaching the wrong thing about trees? Why not locate such a tree in a national forest, a different tree each year. Then light it up where it grows, let the president go there, with photographers traipsing along. Ten days later, take the lights off and put up a sign that this was the national Christmas tree in that year. A decade or later, touring the country, daddy can take little Jimmie on a hike to see the national Christmas tree the year Jimmie was born. Maybe Jimmie grows up, gets to be a dad, and takes little Suzie to see another Christmas tree. Dad, Jimmie, Susie all get exercise and a greater appreciation for what trees are in themselves—added on to whatever is the holiday significance of the tree.

Where plant species are endangered, we may save the plants, even if this kills animals—thousands of animals to save a few plants. San Clemente Island is far enough off the coast of California for endemic species to have evolved in the isolation there; some species of plants and animals are found there and nowhere else on Earth. The island also has a population of feral goats, introduced by the Spanish in the 1500s as a source of meat for sailors. After the passage of the Endangered Species Act, botanists resurveyed the island and found some additional populations of endangered plants. But goats do not much care whether they are eating endangered species. They had probably already eradicated several never-known species. So, the U.S. Fish and Wildlife Service and the U.S. Navy, which owns the island, planned to shoot thousands of feral goats to save three endangered plant species, *Malacothamnus clementinus*, *Castilleja grisea*, *Delphinium kinkiense*, of which the surviving individuals numbered only a few dozens.

Some goats were shot. Then the Fund for Animals took the case to court to stop the shooting, and the court allowed the Fund to live trap and relocate what animals they could. Relocated animals survive poorly, however; most die within six months. Trapping was difficult; the goats reproduced about as fast as trapped. So, the shooting continued during the 1980s. The remaining goats were wary and in inaccessible canyons, which required their being shot by helicopter. Altogether about 29,000 live goats were removed from the island and 15,000 shot. At the end, there were only six feral goats on the island, five females and one billy, called a Judas goat, because, radio-collared, he was used to lure the females to where they could be shot. These last were killed in 1991 (Keegan, Coblentz, and Winchell, 1994; and personal communication, Jan Larson and Clark Winchell, Natural Resources Office, Naval Air Station, North Island, San Diego, California).

Despite the Fund's objections, the Park Service killed hundreds of rabbits on Santa Barbara Island to protect a few plants of *Dudleya traskiae*, once thought extinct and curiously called the Santa Barbara Live-Forever. This island endemic was once common. But New Zealand red rabbits were introduced about 1900, fed on it, and by 1970 no *Dudleya* could be found. With the discovery in 1975 of five plants, a decision was made to eradicate the rabbits (Mohlenbrock, 1983, pp. 180–182).

Does protecting endangered plant species justify causing animal suffering and death? Does the fact that the animals were brought in from South America make a difference? An ethic based on animal rights will say, "No", but a more broadly based environmental ethic will prefer plant species, especially species in their ecosystems, over sentient animals that are introduced misfits. We might say that, one on one, a goat does have more intrinsic value than a plant. So, if the trade off were merely a thousand goats for a hundred plants, oblivious to instrumental, ecosystem, and species considerations, the goats would override the plants. But the picture is more complex. Out of place from their original ecosystems, goats are degrading the ecosystems in which they presently exist, producing extinctions of plant species that are otherwise well adapted to those ecosystems. The prevailing ethic here found that the well-being of plant species outweighed the welfare of the goats.

The question, notice, is not: Does subjective life count more than objective life? Rather: Does only subjective life count? To say that the threshold of our moral sensitivity is just the same as the threshold of felt sensitivity is to say that moral concern is directed only toward inwardness; its scope does not include outwardness, except relationally. That is, in a sense, to make morality *subjective*, to attach it to subjects and deny it to objects. Only subjects—indeed on Earth only human subjects—can be moral *agents*. But who are their moral *patients*?

3. Genetic Value: Smart (Cybernetic) Genes

All these organisms are found in species lines. There is historical evolutionary and ongoing genetic creativity that makes life possible. Contemporary geneticists are insisting that thinking of this process as being entirely "blind" misperceives it. Genes have substantial solution-generating capacities. Though not deliberated in the conscious sense, the process is cognitive, or cybernetic. A genome has an array of sophisticated enzymes to cut, splice, digest, rearrange, mutate, reiterate, edit, correct, translocate, invert, and truncate particular gene sequences. There is much redundancy (multiple and variant copies of a gene in multigene families) that shields the species from accidental loss of a beneficial gene and provides flexibility on which these enzymes can work.

John H. Campbell, a molecular geneticist, writes, "Cells are richly provided with special enzymes to tamper with DNA structure," enzymes that biologists are extracting and using for genetic engineering. But this "engineering" is already going on in spontaneous nature:

> Gene-processing enzymes also engineer comparable changes in genes in vivo.… We have discovered enzymes and enzyme pathways for almost every conceivable change in the structure of genes. The scope for self-engineering of multigene families seems to be limited only by the ingenuity of control systems for regulating these pathways.
>
> (1983, pp. 408–409)

These pathways may have "governors" that are "extraordinarily sophisticated." "Self-governed genes are 'smart' machines in the current vernacular sense. Smart genes suggests smart cells and smart evolution" (Campbell, 1983, pp. 410, 414).

In a study of whether species as historical lines can be considered "intelligent," Jonathan Schull concludes:

> Plant and animal species are information-processing entities of such complexity, integration, and adaptive competence that it may be scientifically fruitful to consider them intelligent.… Plant and animal species process information via multiple nested levels of variation and selection

> in a manner that is surprisingly similar to what must go on in intelligent animals. As biological entities, and as processors of information, plant and animal species are no less complicated than, say, monkeys. Their adaptive achievements (the brilliant design and exquisite production of biological organisms) are no less impressive, and certainly rival those of the animal and electronic systems to which the term "intelligence" is routinely (and perhaps validly) applied today.
>
> (1990, p. 63)

The result, according to David S. Thaler (1994), is "the evolution of genetic intelligence."

Leslie E. Orgel, summarizing the origin of life on Earth, says "Life emerged only after self-reproducing molecules appeared.... Such molecules yielded a biology based on ribonucleic acids. The RNA system then invented proteins. As the RNA system evolved, proteins became the main workers in cells, and DNA became the prime repository of genetic information." "The emergence of catalytic RNA was a crucial early step" (1994, p. 4). If there was "a crucial early step," that certainly sounds like something of value was at stake.

Not only does such problem solving take place early on, and continuously thereafter, but the genes, over the millennia, get better at it. Past achievements are recapitulated in the present, with variations, and these results get tested today and then folded into the future. Christopher Wills concludes, "There is an accumulated wisdom of the genes that actually makes them better at evolving (and sometimes makes them better at not evolving) than were the genes of our distant ancestors.... This wisdom consists both of the ways that genes have become organized in the course of evolution and the ways in which the factors that change the genes have actually become better at their task" (1989, pp. 6–8).

Donald J. Cram, accepting the Nobel prize for his work deciphering how complex and unique biological molecules recognize each other and interlock, concludes: "Few scientists acquainted with the chemistry of biological systems at the molecular level can avoid being inspired. Evolution has produced chemical compounds that are exquisitely organized to accomplish the most complicated and delicate of tasks." Organic chemists can hardly "dream of designing and synthesizing" such "marvels" (1988, p. 760).

Reporting "Molecular Strategies in Evolution," geneticists have found so many examples of "how the genome readies itself for evolution" that they are making a "paradigm shift." Abandoning the idea that genetic mutation is entirely blind and random, and that genetic errors are suppressed to minimize change, geneticists are impressed with the innovative, creative capacities in the genome. These "new findings are persuading them that the most successful genomes may be those that have evolved to be able to change quickly and substantially if necessary" (Pennisi, 1998, p. 1131).

Genes do this by using transposons, gene segments, mobile elements that they can use rapidly to alter DNA and the resulting protein structures and metabolisms in time of stress. "Chance favors the prepared genome," says Lynn Caporale, a biotechnology geneticist. James Shapiro, a bacterial geneticist at the University of Chicago, comments: "The capability of cells has gone far beyond what we had imagined." "Cells engineer their own genomes" (quoted in Pennisi, 1998, p. 1134). Shapiro continues: "Thus, just as the genome has come to be seen as a highly sophisticated information storage system, its evolution has become a matter of highly sophisticated information processing" (2002, p. 10; see also Shapiro, 2005).

The process of genes unzipping and transcribing their sequences is, so to speak, "headed" somewhere. A genetic sequence has a potential for being an ancestor in an indefinitely long line of descendant genotype/phenotype re-incarnations. The gene does not contain simply descriptive information "about" but prescriptive "for." The gene will be a gene "for" a trait because there has been natural selection "for" what it does contributing to adaptive fit. The preposition "for" saturates both natural selection and genetics. Genes act directed toward a future, under construction. Wherever it shows up in genetics, there is a "telos" lurking in that "for." Ernst Mayr coined the term "teleonomic" for biological functions, contrasted with simple causation in physics and chemistry; also contrasted with "teleological," which, he thought, had objectionable overtones of conscious intent. What genes have is a "telos," an "end." Magmas crystallizing into rocks, and rivers flowing downhill have results, but no such "end."

Rather than wishing to filter out the intentional elements in biology, some theoretical biologists and philosophers have, interestingly, begun using the term "intentional" as descriptive of biological information in genes. John Maynard Smith insists: "In biology, the use of informational terms implies intentionality" (2000, p. 177). That word may have too much of a "deliberative" component for most users, but what is intended by "intentional" is this directed process, going back to the Latin: *intendo*, with the sense of "stretch toward," or "aim at." Genes have both descriptive and prescriptive "aboutness"; they do stretch toward what they are about.

Intentional or semantic information is for the purpose of ("about") producing a functional unit that does not yet exist. It is *teleosemantic*. Where there is information being transmitted, there arises the possibility of mistakes, of error. The DNA, which "intends" to make a certain amino acid sequence that will later fold into a protein segment, can be misread. If the reading frame gets shifted off the "correct" triplet sequence, then the "wrong" amino acids get specified and the assembling fails. There is "mismatch." Often there is machinery for "error-correction." None of these ideas make any sense in chemistry or physics, geology or meteorology. Atoms, crystals, rocks, weather fronts do not "intend" anything and therefore cannot "err."

A mere "cause" is pushy but not forward looking. A developing crystal has the form, shape, location it has because of preceding factors. A genetic code is a "code for" something. The code is set for "control" of the upcoming molecules that it will participate in forming. If we use the word "control" with crystal formation (the size of the crystals is controlled by the temperature at formation), this "control" refers to the past. By contrast, genetic "control" faces forward. There is proactive "intention" about the future.

Perhaps the central metaphor in genetic theory is "information." Nevertheless, many philosophers of biology have reservations about the concept of "information" as applied to genes (Sterelny and Griffiths, 1999, p. 105). A common complaint is that the term is "only" "analogical." Molecules can't literally "know" any "code." What could "information" mean in a molecule? A deeper problem is that the term is difficult to make operational. Darwin famously introduced the metaphor of natural "selection" and made it powerfully descriptive of what is going on in evolutionary history. "Selection" is first something we experience in ordinary life, including the activity of breeders, and by extended meaning evolutionary processes "select" the fittest. Biologists can filter out the intentional element; the remainder does describe differential survival processes. Population geneticists have found ways to operationalize, to quantify, selective pressures. Can geneticists do the same thing for "information," "coding," "reading"?

Humans first know the meaning of the word "information" in our own experience. To speak of "information" in DNA is, at least initially, metaphorical. Are we to say the same of terms such as "translation"? The term "translate" usually means to move from one language system to another; the DNA is a symbol system, but the resulting protein molecule is not another symbol system, so perhaps "transcription" is a less metaphorical term? "Synonym" is a term first learned in human language, then applied to differing codons that result in the same amino acid. It will be difficult to strip out all the terms that start as metaphors from ordinary life: "adapt," "function," "correct," "mistake," "start," "stop," "develop," "regulate," "change," "evolve."

Genes make "copies" of their DNA chains. That word too, one can insist is metaphorical, but it does not follow that "copy" is not an authentically descriptive term. Various words, such as "replicate," "regenerate," "reproduce," "activate," "inhibit, "start," "stop," "cut," "splice," "error," "correct," enable scientists to recognize qualitative, substantive similarities, with insight into how processes work, using comparisons between familiar and unfamiliar systems. So also with "information." Strip all this dimension out of genetics, and you will not understand what is going on. Strip talk of "value" entirely out of genetics, and you are left mumbling.

To put this genetic activity—genotypes, with know-how, producing phenotypes adapted for survival—in the language of conservation biology, a plant is already engaged in the biological conservation of its identity and kind, long before conservation biologists come on the scene. What conservation biologists ought to do is respect plants for what they are in themselves—projects in conservation biology. That aligns human ethics with objective biology. The point of such thinking about plant information, about genetic information is that we should value life. Life matters, not just mind.

4. Invasive Exotics: Plants Way Out of Place

Widespread on our landscapes, rural and wild, there are exotic plants (Kudzu, see Chapter 1), also birds (starlings) and other animals (zebra mussels). Exotics are non-native species living on landscapes where they did not come to be present by natural selection, either having evolved there or moving there on their own. Nearly all of them are brought by humans, intentionally or unintentionally. Of the 150,000 plant species growing on the American landscapes, 7,000 are alien and about 10% of these are considered invasive, that is, aggressively crowding out native species. True, 90% are more or less inconspicuous, perhaps we could say that they are more or less naturalized. But the 10% are trouble-makers. Billions of dollars are spent each year to destroy the invasive non-native organisms and prevent their spread (Mooney et al., 2005; Cox, 1999; McKnight, 1993). What do advocates of environmental ethics say about these introduced exotics? There are differing points of view (Eser, 1998).

Although most find that exotics are bad, some have said that, if we welcome natural abundance, we should also welcome unnatural abundance. The root meaning of "exotic" is "from the outside." "Exotic" is an interesting word, with alternative meanings. On the one hand, a common meaning is: "intriguing," "charming," "beautiful" because unfamiliar. When one visits botanical gardens, one searches out the exotics. If one leaves the garden and finds novel flowers growing across the countryside, why not welcome the increase in biodiversity?

Really, it is a mistake to call them unnatural, since, once they have gotten into place, they do their own thing naturally, now on their own. If the original locals cannot compete with them, that's the way natural selection works. The preference for original natives is an unjustified bias. Forget about the foreign origins, enjoy these plants now. Humans too are quite exotic, non-native, and invasive. On every continent except Africa, humans are foreigners out of place; and everywhere, Africa included, they have long since transformed the native vegetation with what they brought along (corn and cows). So, if some plants and animals tag along with the human migrations, they too are "ours," no more misplaced than we are (Burdick, 2005). Isn't human ethics supposed to be inclusive of foreigners? Why cannot environmental ethics be inclusive of non-natives?

Mark Sagoff (2005), a well-known environmental philosopher, has defended exotics. Conservation biologists and other environmentalists confront serious obstacles when they seek to exclude or remove introduced plants and other non-native species, on grounds that they threaten the natural environment. Whether most of these non-natives harm the environment is debatable; apparently some 90% do not. Nor can ecologists predict how specific introduced species will behave, so they must target all non-native species as potentially harmful, an impossibly large task. Further, introduced organisms generally and sometimes significantly add to species richness in ecosystems. There is little evidence that non-native plants have caused any extinctions of natives, except in a few small island-like environments. Honeybees are not native to the New World, but they are fully naturalized and quite useful (Schlaepfer, Sax, and Olden, 2011).

Daniel Simberloff (2005), a well-known ecologist, vigorously replied to Sagoff on both empirical and philosophical grounds. Major ecosystem-wide impacts of non-native species, including extinctions of both island and continental species, have been scientifically demonstrated, the kinds of impacts that are judged by the public to be harmful (as with Japanese brome-grass, which degrades range). Further, biologists have recently developed methods that greatly aid prediction of which introduced species will harm the environment. Although introduced species may increase local biodiversity in certain instances, this does not result in any desired changes in ecosystem function. In most localities, exotics decrease biodiversity. More importantly, globally homogenized faunas and floras tends to continental biodiversity decrease (McKinney, 2002; Hepinstall, 2008; Cronk and Fuller, 1995).

Exotics are sometimes "escapes" from plants first deliberately planted (Japanese honeysuckle, multiflora rose. More often these are weedy species (dandelions, Russian thistle). Purple loosestrife invades a pond. Such exotics often displace native vegetation. Such invasives in their new locations are not adapted fits, having evolved on other landscapes and been transported to their new locations anomalously. These plants and animals have not entered these ecosystems by any of the lawlike natural processes that, in the wild, govern community structure. Exotics do not contribute to what Aldo Leopold called the "integrity, stability, and beauty of the biotic community" (1968, pp. 224–225). Charles Elton recognized this, half a century ago: "We are living in a period of the world's history when the mingling of thousands of kinds of organisms from different parts of the world is setting up terrific dislocations in nature" (1958, p. 18). These exotics are "weeds," misplaced on landscapes.

Invasive plant species often flourish because they land on disturbed sites, similar to those from which they came, but with more resources (such as fertilizer and water). They have a life-history strategy of making many seeds rather than protecting themselves for long-lives; they are released from their natural enemies (which are left back where they came from), meanwhile, the natives still have their natural enemies to compete with. These factors compound to make invasives especially disruptive to natural systems (Blumenthal, 2005).

Exotic seeds have often been carried by jet planes to different continents. Once hemmed in by oceans, these plants play hopscotch because of human travel. These exotics are spillovers from civilization. They are like the foreign viruses that land in New York or Los Angeles and upset human health in cities, except that, instead, these upset the health of the land. Humans disturb enormous amounts of soil and make it easy for them. Exotics are waifs of culture.

One might expect, however, that exotics might make inroads where land is tilled, but that they will fail in wild ecosystems, since they are not good adapted fits. And that is often so. The invasives often linger around culture, on the roadsides, in the fence rows. One does not find them deep in the wildlands—at least not at first. But there is disturbed soil in nature as well as in culture, and these plants can gradually invade the native places. Say if you like that they did so competitively; it is equally true that they did so by assistance of ship (in the ballast), plane (dirt on passenger's shoes), and plow (turning the soil, destroying natives).

Plants do move around on their own. They invade new areas, as when climates change; and one can, if one wishes, speak of naturally invasive species (Botkin, 2001). In prehistoric times, with melting ice, species moved north perhaps 200 to 1,000 meters per year, as revealed by fossil pollen analysis. Spruce invaded what previously was tundra. Today, introduced exotic species, once they arrive, move fifty times that fast, typically 50 kilometers a year (Whitlock and Millspaugh, 2001). Most of these introductions crossed oceans by boat or by air, thousands of times faster than any natural plant movements. Most are rapidly propagating species that arrived in North America within the last two centuries.

Invasion by exotics is an ongoing global event. Look forward a century. Michael Soulé says:

> In 2100, entire biotas will have been assembled from (1) remnant and reintroduced natives, (2) partly or completely engineered species, and (3) introduced (exotic) species. The term *natural* will disappear from our working vocabulary. The term is already meaningless in most parts of the world because anthropogenic [activities] have been changing the physical and biological environment for centuries, if not millennia.
>
> (1989, p. 301)

That forces us to ask whether we want an entirely managed nature, where humans engineer and assemble the biotas, or disassemble them by ignorance and accident: a landscape where nature has come to an end. Did we not say, in Chapter 2, we now live in the Anthropocene Epoch, with human-dominated landscapes widespread on Earth? Whatever wild nature was present in the Americas before the native Americans arrived 15,000 years ago, even if it could be known, was Pleistocene nature. Climates have since changed; and nature today, had it been left on its own, might be vastly different from any Pleistocene nature. So, the quest for pristine natural landscapes, museum pieces out of the past, is a hopeless quest—so another argument goes. All we have, or have ever had, is a dynamically changing nature occupied by humans. Humans are the creatures who rule on their landscapes, and, in that sense, we have rebuilt, or, by pristine criteria, contaminated every landscape we observe.

Still, perhaps there can remain on wild and rural landscapes some remnants of what was once native. But now a new protest arises. This is backward looking, because such museum-piece landscapes are vanishing. Bits and pieces of our landscape can be preserved, and there, looking backward, we can be nostalgic about a past that we really no longer have. National parks are grand, but quaint: corners of a continental landscape mostly managed for multiple use, these parks being intentionally managed to create an illusion of wild nature.

Environmentalists do want to respect continuity with the past, but they are not that comfortable with thinking of conservation as preserving museum-pieces. They prefer to think of dynamic ongoing landscapes, and they do not find weedy ecosystems, filled with invasives, to provide that continuity past, present, and ongoing into the future. Yes, respect life, but respect life in place, not life misplaced. Environmental ethics is about individuals, but individuals included in appropriate places. That is a more genuinely inclusive ethic; not an inclusive smorgasbord of species. We must respect ecosystems (as we see in the next chapter); we have to consider niches and adapted fits.

We can take "weed" as a metaphor for the whole story. In gardens, a weed is a plant out of place. Now-invasive plants once and elsewhere did have a niche, an adapted fit in places where they evolved. But scattered all over myriads of landscapes, they are weedy. One does not want a weedy landscape. Initially this means a landscape where fields and pastures are full of weeds that we dislike. Later it means a landscape where wild nature has been invaded with exotics. One does not want a garden with weeds. One does not want a home landscape with weeds. One does not want a national park, a natural park, with weeds. On a larger scale, garden Earth, with tens of thousands of species misplaced and far from home, becomes a weedy planet, with less biological richness and less ecological integrity.

5. Respect for Life: Biocentrism

Biocentrism is a worldview claiming respect for all living organisms. Biocentrism is sometimes used as a general synonym for any naturalistic or non-anthropocentric ethics. More specifically, biocentrism refers to an ethics of respect for life, now with the focus on any and all living beings—plants, microbes, lower animals—not just an ethic centered on humans (anthropocentrism), nor one directed only to the higher animals, who can suffer pains and pleasures. The question is not, "Can it suffer?" but "Is it alive?"

This view has philosophical precedents. Albert Schweitzer was a famous advocate of such an ethics, for which he was awarded the 1953 Nobel Peace Prize. "A man is truly ethical only when he obeys the compulsion to help all life which he is able to assist, and shrinks from injuring anything that lives.... Life as such is sacred to him. He tears no leaf from a tree, plucks no flower, and takes care to crush no insect," not at least unnecessarily, or without appropriate justification (Schweitzer, 1949, p. 310). Schweitzer's ethic was deeply grounded in his Christian faith. There are parallels in many religions, for example the non-injury ethic (*ahimsa*) of Buddhism or Jainism. In the book of Genesis (as we recalled at the beginning of this chapter), God commands the earth to bring forth vegetation, plants, trees, and swarms of living creatures and finds them to be very good (Genesis 1).

In more recent philosophical analysis, biocentrism is set forth with rigorous argument by Paul Taylor: "The relevant characteristic for having the status of a moral patient is not the capacity for pleasure or suffering but the fact that the being has a good of its own which can be furthered or damaged by moral agents" (1981a, p. 314). Taylor develops this at length in his *Respect for Nature* (1986). Humans are non-privileged members of the Earth's community of life. We have an evolutionary kinship and common origin with other species. Humans are absolutely dependent on other forms of life, but they do not depend on us. Each species of life, exemplified in its member organisms, has its own excellences. Plants can photosynthesize, as animals cannot; and all animals, humans included, depend on this photosynthesis.

A bristlecone pine tree, surviving for several thousand years, makes human life seem quite transient. Earth was teeming with life long before humans arrived, entering a world where others had resided for hundreds of millions of years. Nor are humans the only or final evolutionary goal. The community of life continues to be interdependent. All organisms are teleological centers of life (plants seek light and water, defending their lives), as we found above, looking at genetics. They have a welfare, a good of their own.

More controversially, Taylor called for "biocentric egalitarianism." The belief in human superiority is an unjustified bias; we should be species impartial and egalitarian. Biocentrism "regards all living things as possessing inherent worth—the same inherent worth" (Taylor, 1981b, p. 217). Humans do mathematics better than monkeys; monkeys climb trees better than humans. Sequoia trees do what they do quite well. Ants do what they do quite well. These other species are equally good at doing what is appropriate for them to do. We should respect them all. "The killing of a wildflower, then, when taken in and of itself, is just as much a wrong, other-things-being-equal, as the killing of a human" (Taylor, 1983 p. 242).

Critics have replied that this is incredible. Although sequoia trees, wildflowers, and ants do their thing quite well, this overlooks the richness of experience which is present at differing levels in differing species. That differential richness of experience also produces in moral agents differential responsibilities.

Perhaps all living organisms are equally to be considered, for what they are, but this does not imply equal moral significance for them all. Thinking of humans on their landscapes, we found ways in which humans are a part of nature, but also found humans radically different from any other species, unique in their dignity (see Chapter 2).

James Sterba is a biocentrist who attempts reconciliation between anthropocentrism and biocentrism (1995, 2001). Biocentrism may seem to claim that there is no sound reason for thinking that any species is special or superior, including humans, with the apparent implication that there are no good grounds for treating either individuals of different species, or living things collectively, differently. So it seems that human interests count for no more than the interests of any other living thing or system. But, according to Sterba, this implication need not follow.

It is morally permissible to act preferring human interests on self-defense grounds (as Taylor also sometimes argues). This includes showing preference for human interests for the sake of preservation of human basic needs. Sacrificing nature is justified when this gets people feed, clothed, sheltered. Sterba formulates this as "a principle of human preservation" (2001, p. 34). "Actions that are necessary for meeting one's basic needs or the basic needs of other human beings are permissible even when they require aggressing against the basic needs of individual animals and plants or even of whole species or ecosystems" (Sterba, 1995, p. 196).

Even though this shows a preference for humans, Sterba thinks that this is not a problem because it is the way all species behave; they all show preference to their own species. But the good obtained must be proportionate to the harm caused. There will be tension here whether a human is becoming too "aggressive" about "necessary" and "basic" needs. At this point, Sterba's critics reply that one can expect (and fear) that "necessary" and "basic" will prove elastic enough that various advocates can shrink and stretch them to their liking. Do humans satisfy legitimate basic needs when, showing preference for their own species, they continue to increase their population and displace other species?

Lawrence Johnson defends the idea that all living organisms are to be respected morally because they have "interests," not just those with considered preferences, but all those that have vital, biological interests, something "at stake" (Johnson, 1991, 2011). Robin Attfield argues that "all individual animals and plants have interests. For all have … a direction of growth, and all can flourish after their natural kind," and so trees, for example, can count morally, though their significance in practice is frequently rather small (1981, pp. 40–41). In practice, of course, though the life of one tree or grass plant may not count much, since such organisms are very numerous, in the aggregate they may count a great deal.

Kenneth Goodpaster argues for a "'life principle' of moral considerability." Every living organism is self-sustaining in its organized defending of its living state against the disorganization that would otherwise proceed through entropy, or the natural tendencies for things to rot and decay.

> The typifying mark of a living system … appears to be its persistent state of low entropy [high organization], sustained by metabolic processes for accumulating energy, and maintained in equilibrium with its environment by homeostatic feed back processes.… The core of moral concern lies in respect for self-sustaining organization and integration in the face of pressures toward high entropy [disorganization].
>
> (Goodpaster, 1978, p. 323)

Biocentrists hope to defend an *objective* morality, one with a focus on objective life. Animal welfare ethics holds a hedonist theory of value, as though pain is nature's only disvalue and pleasure its only value. In a biocentric ethic, pains and pleasures will be part of a larger picture, derivative from and instrumental to further values at the ecosystemic level, where nature evolves a flourishing community in some indifference to the pains and pleasures of individuals, even though pain and pleasure in the higher forms is a major evolutionary achievement.

Humans must and ought to use plants in many ways, for food, for timber, for cellulose—as the "basic needs" justification allows. Still, biocentrists argue forcefully that there are occasions when humans encounter plants—sequoia trees, or the rare Chapman's rhododendron—in ways that require the organisms to be taken into account for what they are in themselves. Given their adapted fitness in their ecosystems, there is at least a presumption that these are good kinds, right where they are, and therefore that it is right for humans to let them be, to let them evolve. That leaves plants, along with all kinds of living things, and their species, and the processes that support them all in place. Humans should use this life with respect, restraint, and gratitude.

6. Respect for Life: Naturalizing Values/Virtues

Indeed humans can and ought to respect life, and when they do this they locate intrinsic value in nature. But what account should we give of this? Such locating seems to be some sort of human activity, some relation taken up by persons who become concerned for what these living things are in themselves. But is this *discovering* values already there? Or is it *placing* such value there—choosing (virtuously?) to value some non-human life intrinsically, rather than instrumentally?

By the placing account, values in nature are always "anthropocentric," or at least "anthropogenic" (generated by humans). Bryan G. Norton concludes: "Moralists among environmental ethicists have erred in looking for a value in living things that is *independent* of human valuing. They have therefore forgotten a most elementary point about valuing anything. Valuing always occurs from the viewpoint of a conscious valuer.… Only the humans are valuing agents" (1991, p. 251). Anthony Giddens, a distinguished social theorist, following Robert Goodin, a philosopher, agrees: "Objects in nature can only have value through us—when we speak of value there is inescapably a human element involved, since there must be someone to hold these values" (2009, p. 54).

Humans have, says Ernest Partridge, "the Midas touch," recalling the mythical Midas gifted with the capacity to turn to gold whatever he touched (1998, p. 86). Humans bring value into the world when they point at something and choose to value it. We humans carry the lamp that lights up value, although we require the fuel that nature provides. Actual value is an event in our consciousness, though natural items while still in the dark of value have potential intrinsic value.

Life is worth valuing, but there is a value ignition when humans arrive—something like the way wood is always flammable, but not on fire until actually burning. Or, to change the metaphor, something like the way the light comes on in the refrigerator when we open the door; before that everything is in the dark. Intrinsic value in the realized sense emerges relationally with the appearance of the human-generator. The *attributes* under consideration are objectively there before humans come, but the *attribution* of value is subjective. The object causally affects the subject, who is excited by the incoming data and translates this as value, after which the object, such as a sequoia tree appears as having value, rather like it appears to have green color. Some speak of a "dispositional" account of intrinsic value.

J. Baird Callicott defends such a view. All intrinsic value is "grounded in human feelings" but is "projected" onto the natural object that "excites" the value. "Intrinsic value ultimately depends upon human valuers." "Value depends upon human sentiments" (1984, p. 305). We humans can and ought to *place* such value on natural things, at times, but there is no value already *in place* before we come. Intrinsic value is our construct, interactively with nature, but not something discovered which was there before we came. "There can be no value apart from an evaluator,… all value is as it were in the eye of the beholder [and],… therefore, is humanly dependent" (Callicott, 1980, p. 325). Such value is "anthropogenic." (Callicott, 1992, p. 132).

This, Callicott says, is a "truncated" sense of value where "'intrinsic value' retains only half its traditional meaning. An intrinsically valuable thing on this reading is valuable *for* its own sake, *for* itself, but is not valuable *in* itself, i.e. completely independently of any consciousness" (Callicott, 1986, pp. 142–143). Some critics complain that the term *intrinsic*, even when truncated, is misleading. What is meant is better specified by the term *extrinsic*, the *ex* indicating the external, anthropogenic ignition of the value, which is not *in*, *intrinsic*, internal to the nonsentient organism, even though this value, once generated, is apparently conferred on the organism.

Another way of respecting life intrinsically comes from those who advocate environmental virtue ethics (James, 2006; Sandler, 2007; Sandler and Cafaro, 2005; Cafaro, 2010). An admirable trait in many persons is their capacity to appreciate things outside themselves. An interest in natural history ennobles persons. It stretches them out into bigger persons. Humans must inevitably be consumers of nature; but they can and ought sometimes be more: admirers of nature. That redounds to their excellence. One condition of human flourishing is that humans enjoy natural things in as much diversity as possible—and enjoy them, at times, because such creatures flourish in themselves.

The Americans, the British, the Australians, or any people should be ashamed if they destroy the biodiversity on their landscape; they will be more excellent people if they conserve this biodiversity, all creatures great and small. Humans of decent character will refrain from needless destruction of all kinds, including destruction of even unimportant species. We can always gain excellence of character from acts of conservation. We have a duty to our higher selves to respect life. There is generated a human virtue, actualizing a uniquely human capacity and possibility for excellence, when a person respects a wild animal's life for what that life is in itself, a different and yet related form of life. "In an environmental virtue ethics, human excellence and nature's excellence are necessarily entwined" (Cafaro, 2002, p. 43). To be truly virtuous one must respect values in nature for their own sake, and this is inevitably tributary to human flourishing.

By Robert L. Chapman's account: "Virtue ethics is more interested in character development, and while we can attribute intrinsic value to the 'integrity, stability and beauty' (harmony) of the biotic community, it remains a human activity that will be evaluated from a human-in-nature perspective.... You cannot properly value one without the other.... Cooperation exemplified by virtuous actions preserves a place for human participation and ultimately a placed-based identity befitting human development" (2002, p. 136). If we want a healthy society, then we need to preserve nature so that we still have something natural with which to have such encounters.

Critics of environmental virtue ethics still worry whether the focus is in the right place. If this excellence really comes from appreciating otherness, then such human virtue is tributary to value in other forms of life. Excellence is intrinsically a good state for the self, but there are various intrinsic goods that the self desires and pursues in its relation to others that are not self-states of the person who is desiring and pursuing. An enriched humanity results, with values in biodiversity and values in persons compounded—but only if the loci of value are not confounded. Otherwise the focus of the ethic is misplaced. These species have been around for millions of years. Yes. And why save them? It makes *me* a better person. My quality of life is entwined with theirs. But that confuses the by-product with the located focus of value. The wild other does not become valuable if and when it results in something valuable for me. It is valuable for what it is, whether I am around or not, and recognizing that value does valuable things to me. Such an ethic is best called a value-based ethic, not a virtue-based ethic.

Still, the environmental virtue ethicists are right to remind us that we need to cultivate our human excellences, if we are to succeed in protecting life. We need benevolence and compassion toward other animals. We need respect for other life forms. We need gratitude for their presence on landscapes along with ourselves. We need humility to accept a limited share of Earth's resources—rather than trying to exploit as much as possible. We need wisdom—a capstone human virtue (the "sophia" found in "philo-sophy," "the love of wisdom")—if we are to know who we are, where we are, and what we ought to do.

The *discovered-in-place* account finds *autonomous intrinsic value* in nature, already there and recognized when humans arrive (Rolston, 1983; 1994; Agar 1997, 2001; Lee, 1996; Naess, 1989; McShane, 2007). Less formally, but perhaps more plainly: organisms have a good of their own. This account may not object to humans placing intrinsic value on natural things—Americans may choose the bald eagle as a national symbol and place a special value on these eagles in result. But a truncated sense of intrinsic value is not good enough. Organisms have value for themselves and on their own.

In fact, biology is value-laden. Biologists talk about values all the time. "An ability to ascribe value to events in the world, a product of evolutionary selective processes, is evident across phylogeny. Value in this sense refers to an organism's facility to sense whether events in its environment are more or less desirable" (Dolan, 2002, p. 1191). Remember those aerobatic dragonflies with their high-performance flight back in Carboniferous times, or the plants solving their photosynthetic/water dilemma with complex stomata. Adaptive value, survival value, is the basic matrix of the governing Darwinian theory. An organism is the loci of values defended; life is otherwise unthinkable.

As we found when looking at "smart genes," this defense of value is coded into the behavior programmed by DNA; but, in organisms with the capacity to acquire information during their lifetimes, it may also involve learned behavior. "Evolution has endowed certain organisms with several means to sense the adaptive value of their behavior" and these "value systems themselves can be modified and extended by experience." So both "innate and acquired value" are involved (Friston et al., 1991, pp. 229, 238).

Organisms gain and maintain internal order against the disordering tendencies of external nature. They keep recomposing themselves, while inanimate things run down, erode, and decompose. Organisms pump out disorder. Life is a local counter-current to entropy, an energetic fight uphill in a world that overall moves thermodynamically downhill (recalling Erwin Schrödinger in *What Is Life?*). An organism is thus a spontaneous cybernetic system, self-maintaining, sustaining and reproducing itself on the basis of information about how to make a way through the world. There is some internal representation that is symbolically mediated in the coded "program" and metabolism executing this goal, a checking against performance in the world, using some sentient, perceptive, or other responsive capacities by which to compare match and mismatch. On the basis of information received, the cybernetic system can reckon with vicissitudes, opportunities, and adversities that the world presents. In the "dynamics of emergent processes," says Brian Goodwin, a biologist, "organisms cease to be mere survival machines and assume intrinsic value, having worth in and of themselves" (1994, p. xvi).

The tree is value-able ("able-to-value") itself. If we cannot say this, then we will have to ask, as an open question, "Well, the tree has a good of its own, but is there anything of value to it?" "This tree was injured when the elk rubbed its velvet off its antlers, and the tannin secreted there is killing the invading bacteria. But is this valuable to the tree?" Botanists say that the tree is irritable in the biological sense; it responds with the repair of injury. Such capacities can be "vital." These are observations of value in nature with just as much certainty as they are biological facts; that is what they are: facts about value relationships in nature.

Values are like color, the humanists say. Both arise in interaction. Trees are no more valuable than they are green on their own. This account seems plausible, if one is asking about certain kinds of values, such as the fall colors we enjoy. But consider rather the information that makes photosynthesis possible. Photosynthesis is rather more objective than greenness. What is good for a tree (nitrogen, carbon dioxide, water) is observer-independent. But is not the good of the tree (whether it is injured or healthy) equally observer-independent? The tree's coping based on DNA coding is quite objective.

The sequoia tree has, after all, been there two thousand years, whether or not any green-experiencing humans were around. *Sequoia sempervirens*, the species line, has been around several million years, with each of its individual sequoia trees defending a good of their kind. Why is the tree not defending its own life just as much fact of the matter as its use of nitrogen and photosynthesis to do so? Organisms have their own standards, fit into their niche though they must. They promote their own realization, at the same time that they track an environment. In that sense, as soon as one knows what a sequoia tree is, one knows what a good sequoia is. One knows the biological identity that is sought and conserved.

One must not be confused here by comparing such organisms with human beings, who have career choices, as nonhumans do not. Jack the Ripper was a good murderer in the sense that he was clever and was never caught, but being a murderer is reprehensible. Jack had a good of his own; as a normative system he sought to kill. But his career choice, his norm, was morally wrong. Among moral agents one has to ask not merely whether x is a normative system, but to judge the norm. But organisms, sentient or not, are amoral normative systems, there are no career choices, and there are no cases where an organism seeks a good of its own that is morally reprehensible. Neither wolves nor nettles are bad because they defend their kinds of good. In organisms, the distinction between having a good of its kind and being a good kind vanishes, so far as any faulting of the organism is concerned.

Yes, but biology is not enough, the philosopher-critics will reply. True, plants seek life and avoid death and this comprises a good of their own, biologically. But we need some further reason why this is a good thing, really, philosophically. John O'Neill puts it this way:

> That Y is a good of X does not entail that Y should be realised unless we have a prior reason for believing that X is the sort of thing whose good ought to be promoted. While there is not a logical gap between facts and values, in that some value statements are factual, there is a logical gap between facts and oughts. "Y is a good" does not entail "Y ought to be realized."
>
> (1992, p. 132)

Robin Attfield wonders: "Even if trees have needs and a good of their own, they may still have no value of their own" (1981, p. 35).

Now the idea is that some natural things might have a good of their own and still not be good—such as germs (*Plasdmodium* causing malaria), weeds, greenflies, mosquitoes, skunks, rattlesnakes, weasels. They do not have stand-alone good, real value, though they may have a good for themselves. True, each has a *good-of-its-kind*, but that does not make it a *good kind*. They might be bad in relation. In relation to whom? In relation to some valuer who knows better what real value is. Agreed, nonhumans are not to be judged for their moral goodness. But still we might find that some organism, during the course of pressing its normative expression, upset the ecosystem or caused widespread disease; we find that it is a bad organism. In this sense *Choristoneura fumiferana*, the spruce budworm that is ravaging northeastern boreal forests, or *Plasmodium vivax*, the malaria parasite, might be judged bad kinds, though each has a good of its kind. They are bad kinds instrumentally in the roles they play.

Remember though, that an organism cannot be a good kind without situated environmental fitness. With rare exceptions, organisms are well adapted to the niches they fill. By natural selection their ecosystemic roles must mesh with the kind of goods to which they are genetically programmed. An ecosystem is a perpetual contest of goods in dialectic and exchange (as we develop in the next chapter), and it is difficult to say that any organism is a bad kind in this instrumental sense either. The misfits are extinct, or soon will be. In spontaneous nature any species that preys upon, parasitizes, competes with, or crowds another will be a bad kind from the narrow perspective of its victim or competitor. But if we enlarge that perspective it typically becomes difficult to say that any species is a bad kind overall in the ecosystem.

Such an "enemy" may even be good for the "victimized" species, though harmful to individual members of it, as when predation keeps the deer herd healthy, and drives the species toward increased fleetness over evolutionary time. Beyond this, the "bad kinds" typically play useful roles in population control, in symbiotic relationships, or in providing opportunities for other species. Cape May warblers, usually, rare, thrive during budworm outbreaks; other birds that eat the worms can nest twice in a season when normally they would be hard-pressed to complete one nesting.

Still, one might find examples of organisms with a situated environmental fitness that seem bad arrangements. In the communities that evolve, there is constant struggle. There are upsets. There are false starts, trials and errors, but there is much fitting together of smart genes discovering positive value. The life adventure on Earth requires some wandering around, exploring paths that fail, or at least lose out to others who explore better paths. There are deformed organisms in nature, bad organisms of their kind, and even monstrosities: things that have no natural kind, unfitted for any habitat. Such individuals are immediately eliminated, although in the course of experimental mutation they are required, if life is to continue. So even mutants and monsters play their roles in the trial and error by which the evolutionary ecosystem tracks changing environments and achieves new life forms.

True value, real goodness, must be relational—so we are told. But these relations are seldom judgments about bad arrangements in ecosystems. Philosophers usually do not have enough empirical knowledge to make such judgments. In relation to whom? The common answer is "in relation to humans"-who dislike weeds, skunks, and weasels in the chicken coop, though not weasels (ermine) as coats on their backs. A better, because more objective and less selfish answer, is "in relation to life in all its rich natural history."

Where we find living things valuing their lives, have we reason to count this morally? The question is essentially: Ought we to respect this ongoing life? Is a philosopher still going to insist: Well, all this inventiveness, strategy, remarkable efficiency, wisdom of the genes, exquisite organization to accomplish delicate tasks, all these marvels to the contrary, there is nothing of value here? True, these cell biologists have been finding something "wonderful" in genome strategies, but philosophers are wise about the use of language and know that this is only "wonderful" when cell biologists get there to wonder about those dragonflies, beetles, cyanobacteria, corals, sequoia trees. Or at least nothing was "astounding" until a human being came around to be astounded. We do not think that the genomes have a sense of wonder or are astounded. Still, the biological achievements are there long before we get let in on them. Facing up to these facts, which are quite as certain as that we humans are valuers in the world, it can seem "astounding" arrogance to say that, in our ignorance of these events, before we arrived there was nothing of value there.

Traditionalist philosophers insist there is not—no real independent value in the leaf stomata, genome evolution, dragonfly wings, or bacterial clocks. These wised-up philosophers will insist that environmentalists who find value out there in plants and insects, certainly those who find it in genetic information, have not yet faced up their epistemological naivete. They persist in ontological realism, unaware of how contemporary analytic or postmodern philosophy has made any scientific knowing of any objective nature out there impossible, much less any realism about natural values. Scientists are exporting their human experiences and overlaying nature with them when they set up these frameworks of understanding. Though unsophisticated biologists have used "value" regarding plants, careful analysis will put that kind of "value" in scare quotes. This so-called value is not a value, really, not one of interest to philosophers. because it is not a value with interest in itself. Even if we found such interest-taking value, as we do in the higher animals, we humans would still have to evaluate any such animal values before we knew whether any "real" value were present.

The biologists may say that whatever survives is "better" adapted than what it has replaced. But this, philosophers will reply, is only a biological sense of "better." There is nothing moral about it. In wild nature, organisms are not moral agents at all. The new survival tricks may be meaner and more cruel than before, causing other individuals in that same species to lose out, or other species to go extinct. Even though an organism evolves to have a situated environmental fitness, not all such situations are good arrangements; some can be clumsy or bad. Some might even be evil. Nature is "red in tooth and claw," and the last thing philosophers want to do is to imitate nature.

Philosophers know *better* what is really "*better.*" But when we press these philosophers to specify what is this overall-filtering-super-value that legitimates or de-legitimates the diverse survival-goods of their own in these myriads of species on Earth, the philosophers start to stutter. Challenged to name the good ones (elk, impala, sequoia trees, baobab trees) and name the bad ones (those rattlesnakes and greenflies), and maybe some in-between ones (wolves and weasels), the answers look mostly like anthropocentric biases. Philosophers may say that the overall good is pleasure, or utility (whose utility?), or what is right, or some Platonic ideal (perfect deer?), or what keeps the community flourishing, or what humans find wonderful, or something like that. The deeper problem is that, despite the excellence of our increasingly scientific accounts in biology, nature has been mapped philosophically as a moral blank space, as value-free in and of itself. But in doing this, we make a fallacy of mislocated value, a humanistic mistake taking value to lie exclusively in the satisfaction of our human preferences.

Can we not say that in general that the evolution and ongoing continuing of life on Earth is a good thing? Generally perhaps yes, the reply comes; but this is not enough to let us conclude in any particular case that the achievement of a some particular organism's goals is a good thing. We celebrate life collectively, value it as a whole, but particularly we are picky about what we find of value—leave out those mosquitoes and rattlesnakes. We cannot always back down from universals to particulars. Life as a whole is good, but nothing follows about specific lives.

Or maybe we need to think of it both as a whole (collectively) and as particular species (distributively). "Ought mosquitoes and rattlesnakes to exist?" is a distributive increment, one small part, in the global collective question, "Ought life on Earth to exist?" If the answer to the particular question is not always the same as the answer to the collective question, we can still say, at least, since life on Earth is an aggregate of many species, that the two are sufficiently related that the burden of proof lies with those who wish deliberately to disvalue some species and simultaneously to care overall for life on Earth. The whole idea of the value of biodiversity, as biologists say, or "plenitude of being," as philosophers used to say, presumes that life collectively is a good thing and ought to be respected. If you say, "Biodiversity of life is good, but mosquitoes are bad," it's up to you to explain why.

No. No! The skeptical philosophers will say: Have you never heard of the naturalistic fallacy? Life *is*. One *ought* to respect it. If philosophers have ever settled on anything, they unanimously forbid moving from what *is* the case (a description of biological facts) to what *ought to be* (a prescription of duty). Any who do so commit the naturalistic fallacy. Philosophers may not know much biology, but they do know logic. If x has a good of its own, then x is good. If x is good, then you ought to protect it. One counterexample will defeat such premises, and the counterexamples are legion—those germs, weeds, skunks, greenflies, weasels (Nolt, 2006, 2009).

Well, even if there are some counterexamples, surely we regularly use this form of argument: Sally has a good of her own. Sally is good. One ought to respect Sally. Humans have a good of their own. Humans are good. You ought to protect human life. We may argue for an instrumental good; Sally is a good cook. We need our neighbors—as store clerks and friends. But we just as often argue that there is some good inherent in the these others. Those who disagree with such argument, and harm Sally, or murder other humans, will soon find themselves in jail. Why not be more inclusive, and extend such consideration to nonhumans—at least often if not always? Does that not seem logical, as well as biological? Even the virtue ethicists claimed that humans realize an excellence otherwise unachievable when they value others for what they are in themselves. Presumptively, if spontaneous natural lives are of value in themselves, and if humans encounter and jeopardize such value, it would seem that humans ought not to destroy values in nature, not at least without overriding justification producing greater value.

No, the reply may come, this is an unjustified extrapolation, from humans who are complex rational, self-conscious, emotional agents to those beetles or sequoia trees who have no such capacities. True, they have a life that they defend, call it a good of their own, but the kind of life that they have, their kind of good, lays no moral on us humans—as is proved by the germs and greenflies counterexamples. Yes, environmental ethicists insist, a comprehensive ethic is quite rational; the humans-as-better-valuers ethic is not so much rational as myopic. Environmental ethics calls humans to a genuine self-transcendence, to a larger respect for life on Earth.

This may not be the best possible world, but Earth is the only one we know that has produced any life at all, and the life it has produced is, on the whole, a good thing. These claims about good kinds do not say that organisms are perfect kinds, nor that there can be no better ones, only that natural kinds are good kinds until proven otherwise. At least the burden of proof is on a human evaluator to say why any natural kind is a bad kind and ought not to call forth admiring respect.

Humans are not so much lighting up value in a merely potentially valuable world, as they are psychologically joining ongoing planetary natural history in which there is value wherever there is positive creativity. While such creativity can be present in subjects with their interests and preferences, it can also be present objectively in living organisms with their lives defended, and in species that defend an identity over time, and generate the storied achievements of natural history. The valuing human subject in an otherwise valueless world is an insufficient premise for the experienced conclusions of those deep into biology. Nature has added up all this defending of individuals into wonderful life on the planet. What's going on is life persisting in the midst of its perpetual perishing. Humans ought to respect such life.

References

Agar, Nicholas. 1997. "Biocentrism and the Concept of Life," *Ethics* 108:147–168.

———. 2001. *Life's Intrinsic Value: Science, Ethics, and Nature*. New York: Columbia University Press.

Attfield, Robin. 1981. "The Good of Trees," *Journal of Value Inquiry* 15:35–54.

Barinaga, Marcia. 1998. "New Timepiece Has a Familiar Ring," *Science* 281(4 September): 1429–1431.

Blumenthal, Dana. 2005. "Interrelated Causes of Plant Invasion," *Science* 310:243–244.

Botkin, Daniel. B. 2001. "The Naturalness of Biological Invasions," *Western North American Naturalist* 61:261–266.

Burdick, Alan. 2005. "The Truth about Invasive Species," *Discover* 25(no. 5, May):35–41.

Cafaro, Philip. 2002. "Thoreau's Environmental Ethics in *Walden*," *The Concord Saunterer*, 10(2002):17–63.

Cafaro, Philip, ed. 2010. *Environmental Virtue Ethics*, theme issue of *Journal of Agricultural and Environmental Ethics* 23(nos. 1-2):1–206.

Callicott, J. Baird. 1980. "Animal Liberation: A Triangular Affair," *Environmental Ethics* 2:311–338.

———. 1984. "Non-anthropocentric Value Theory and Environmental Ethics," *American Philosophical Quarterly* 21:299–309.

———. 1986. "On the Intrinsic Value of Nonhuman Species." Pages 138–172 in Bryan G. Norton, ed., *The Preservation of Species*. Princeton, NJ: Princeton University Press.

———. 1992. "Rolston on Intrinsic Value: A Deconstruction," *Environmental Ethics* 14:129–143.

Campbell, John H. 1983. "Evolving Concepts of Multigene Families," *Isozymes: Current Topics in Biological and Medical Research*, *Volume 10: Genetics and Evolution*, 401–417.

Chapman, Robert L. 2002. "The Goat-stag and the Sphinx: The *Place* of the Virtues in Environmental Ethics," *Environmental Values* 11:129–144.

Cox, George W. 1999. *Alien Species in North America and Hawaii: Impacts on Natural Ecosystems*. Washington, D.C.: Island Press.

Craine, Joseph M. 2009. *Resource Strategies of Wild Plants*. Princeton, NJ: Princeton University Press.

Cram, Donald J. 1988. "The Design of Molecular Hosts, Guests, and Their Complexes," *Science* 240:760–767.

Cronk, Quentin C. B., and Janice L. Fuller. 1995. *Plant Invaders: The Threat to Natural Ecosystems*. London: Chapman and Hall.

Dolan, R. J. 2002. "Emotion, Cognition, and Behavior," *Science* 298:1191–1194.

Elton, Charles S. 1958. *The Ecology of Invasions by Animals and Plants*. London: Metheun and Co.

Eser, Uta. 1998. "Assessment of Plant Invasions: Theoretical and Philosophical Fundamentals." Pages 95–107 in Uwe Starfinger, K. Edwards, I. Kowarik, and M. Williamson, eds., *Plant Invasions: Ecological Mechanisms and Human Responses*. Leiden, The Netherlands: Backhuys.

Friston, K. J., G. Tonoi, G. N. Reeke Jr., et al. 1991. "Value-Dependent Selection in the Brain: Simulation in a Synthetic Neural Model," *Neuroscience* 59:229–243.

Giddens, Anthony. 2009. *The Politics of Global Climate Change*. Cambridge, UK: Polity Press.

Goodpaster, Kenneth E. 1978. "On Being Morally Considerable," *Journal of Philosophy* 75:308–325.

Goodwin, Brian. 1994. *How the Leopard Changed Its Spots: The Evolution of Complexity*. Princeton, NJ: Princeton University Press.

Grill, Erwin, and Ziegler, Hubert. 1998. "A Plant's Dilemma," *Science* 282 (9 October):252–254.

Hepinstall, Jeffrey A., Marina Alberti, and John M. Marzluff. 2008. "Predicting Land Cover Change and Avian Community Responses in Rapidly Urbanizing Environments," *Landscape Ecology* 23:1257–1276.

Hölldobler, Bert, and Edward O. Wilson, 2009. *The Superorganism: The Beauty, Elegance, and Strangeness of Insect Societies*. New York: W. W. Norton.

Hutchinson, G. Evelyn. 1959. "Homage to Santa Rosalia, or Why Are There so Many Kinds of Animals." *American Naturalist* 93:145–159.

James, Simon P. 2006. "Human Virtues and Natural Values," *Environmental Ethics* 28:339–353.

Johnson, Lawrence E. 1991. *A Morally Deep World*. Cambridge, UK: Cambridge University Press.

———. 2011. *A Life-Centered Approach to Bioethics: Biocentric Ethics*. Cambridge, UK: Cambridge University Press.

Keegan, Dawn R., Bruce E. Coblentz, and Clark S. Winchell. 1994. "Feral Goat Eradication on San Clemente Island, California," *Wildlife Society Bulletin* 22 (no. 1):56–61.

Keller, Evelyn Fox. 1983. *A Feeling for the Organism: The Life and Work of Barbara McClintock*. New York: W. W. Freeman.

Lee, Keekok, 1996. "The Source and Locus of Intrinsic Value: A Reexamination," *Environmental Ethics* 18:297–309.

Leopold, Aldo. 1968. *A Sand County Almanac*. New York: Oxford University Press.

Maynard Smith, John. 2000. "The Concept of Information in Biology," *Philosophy of Science* 67:177.

McKinney, Michael L. 2002. "Urbanization, Biodiversity, and Conservation," *BioScience* 52: 883–890.

McKnight, Bill N., ed.. 1993. *Biological Pollution: The Control and Impact of Invasive Exotic Species*. Indianapolis: Indiana Academy of Science.

McShane, Katie. 2007. "Why Environmental Ethics Shouldn't Give Up on Intrinsic Value," *Environmental Ethics* 29:43–61.

Mohlenbrock, Robert H. 1983. *Where Have All the Wildflowers Gone?* New York: Macmillan.

Mooney, Harold A., Richard N. Mack, Jeffrey A. McNeeley, et al., eds. 2005. *Invasive Alien Species: A New Synthesis*. Washington: Island Press.

Naess, Arne. 1989. *Ecology, Community and Lifestyle: Outline of an Ecosophy*. Cambridge, UK: Cambridge University Press.

Nolt, John. 2006. "The Move from *Good* to *Ought* in Environmental Ethics," *Environmental Ethics* 28:355–374.

———. 2009. "The Move from *Is* to *Good* in Environmental Ethics," *Environmental Ethics* 31:135–154.

Norton, Bryan G. 1991. *Toward Unity Among Environmentalists*. New York: Oxford University Press.

O'Neill, John. 1992. "The Varieties of Intrinsic Value," *The Monist* 75:119–137.

Orgel, Leslie E. 1994. "The Origin of Life on the Earth," *Scientific American* 271(no. 4, October):4, 76–83.

Partridge, Ernest. 1998. "Values in Nature: Is Anybody There?" Pages 81–88 in Louis J. Pojman, ed., *Environmental Ethics: Readings in Theory and Application*, 2nd ed. Belmont, CA: Wadsworth.

Pennisi, Elizabeth. 1998. "How the Genome Readies Itself for Evolution," *Science* 281(21 August):1131–1134.

Rolston, Holmes, III. 1983. "Values Gone Wild," *Inquiry* 26:181–207.

———. 1994. "Value in Nature and the Nature of Value." Pages 13–30 in Robin Attfield and Andrew Belsey, eds., *Philosophy and the Natural Environment*. Cambridge, UK: Cambridge University Press.

———. 2001. "Naturalizing Values: Organisms and Species." Pages 76–86 in Louis P. Pojman, ed., *Environmental Ethics: Readings in Theory and Application*, 3rd ed. Belmont, CA: Wadsworth.

Sagoff, Mark. 2005. "Do Non-Native Species Threaten The Natural Environment?" *Journal of Agricultural and Environmental Ethics* 18:215–236.

Sandler, Ronald S. 2007. *Character and Environment: A Virtue-Oriented Approach to Environmental Ethics*. New York: Columbia University Press

Sandler, Ronald, and Phillip Cafaro, eds. 2005. *Environmental Virtue Ethics* Lanham, MD: Rowman and Littlefield.

Schlaepfer, M. A., D. F. Sax, and J. D. Olden. 2011. "The Potential Conservation Value of Non-Native Species," *Conservation Biology,* no. doi: 10.1111/j.1523-1739.2010.01646.x

Schrödinger, Erwin. 1944. *What Is Life?* Cambridge, UK: Cambridge University Press.

Schull, Jonathan. 1990. "Are Species Intelligent?" *Behavioral and Brain Sciences* 13:63–75.

Schweitzer, Albert. 1949. *The Philosophy of Civilization*. New York: Macmillan.

Seeley, Thomas D. 2003. "What Studies of Communication Have Revealed about the Minds of Worker Honey Bees." Pages 21–33 in Tomonori Kikuchi, Noriko Azuma, and Seigo Higashi, eds., *Genes, Behaviors and Evolution of Social Insects*. Sapporo, Japan: Hokkaido University Press.

———. 2010. *Honeybee Democracy*. Princeton, NJ: Princeton University Press.

Shapiro, James A. 2002. "Genome System Architecture and Natural Genetic Engineering." Pages 1–14 in Laura F. Landweber and Erik Winfree, eds., *Evolution as Computation*. New York: Springer-Verlag.

———. 2005. "A 21st Century View of Evolution: Genome System Architecture, Repetitive DNA, and Natural Genetic Engineering," *Gene* 345(2005):91–100).

Simberloff, Daniel. 2005. "Non-native Species *Do* Threaten the Natural Environment!," *Journal of Agricultural and Environmental Ethics* 18(2005):595–607.

Soulé, Michael E. 1989. "Conservation Biology in the Twenty-first Century: Summary and Outlook." Pages 297–303 in David Western and Mary Pearl, eds., *Conservation for the Twenty-first Century*. New York: Oxford University Press.

Sterba, James. 1995. "From Biocentric Individualism to Biocentric Pluralism," *Environmental Ethics* 17:191–207.

———. 2001. *Three Challenges to Ethics: Environmentalism, Feminism, and Multiculturalism*. New York: Oxford University Press.

Sterelny, Kim, and Paul E. Griffiths. 1999. *Sex and Death: An Introduction to Philosophy of Biology.* Chicago: University of Chicago Press.

Taylor, Paul. 1981a. "Frankena on Environmental Ethics," *Monist* 64:313–324.

———. 1981b. “The Ethics of Respect for Nature,” *Environmental Ethics* 3:197–218.

———. 1983. “In Defense of Biocentrism,” *Environmental Ethics* 5:237–243.

———. 1986. *Respect for Nature: A Theory of Environmental Ethics*. Princeton, NJ: Princeton University Press.

Thaler, David S. 1994. “The Evolution of Genetic Intelligence,” *Science* 264:224–225.

Thomas, Lewis. 1975. *The Lives of a Cell*. New York: Bantam Books.

Vogel, Gretchen. 1998. “Insect Wings Point to Early Sophistication,” *Science* 282(23 October):599–601.

Wheeler, Quentin D. 1990. “Insect Diversity and Cladistic Constraints,” *Annals of the Entomological Society of America* 83:1031–1047.

Whitlock, Cathy, and Sarah H. Millspaugh. 2001. “A Paleoecologic Perspective on Past Plant Invasions in Yellowstone,” *Western North American Naturalist* 61:316–327.

Wills, Christopher. 1989. *The Wisdom of the Genes: New Pathways in Evolution*. New York: Basic Books.

Wilson, Edward O. 1987. “The Little Things that Run the World (The Importance and Conservation of Invertebrates),” *Conservation Biology* 1(4):344–346.

Wootton, R. J., J. Kuikalová, D. J. S. Newman, and J. Muzón. 1998. “Smart Engineering in the Mid-Carboniferous: How Well Could Palaeozoic Dragonflies Fly?” *Science* 282(23 October):749–751.