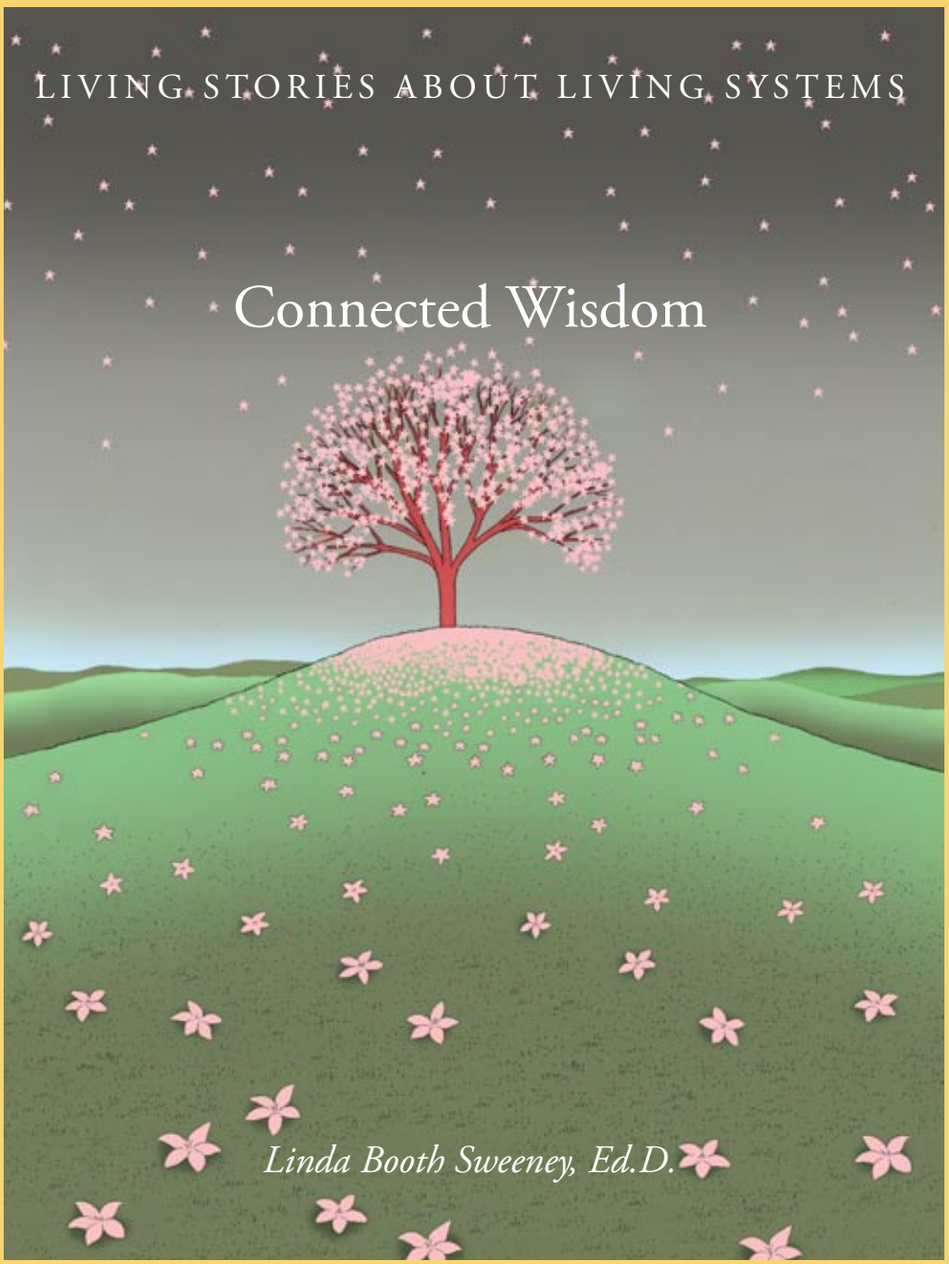
APPENDIX C

BOOK NOTES



APPENDIX C

BOOK NOTES

INTRODUCTION

PAGE 5: **For one precious moment, Jack experienced a subtle but powerful shift in understanding.** When "systems" becomes the context for decision-making, we are more likely to see multiple causes, effects and unintended impacts, a perspective we need to navigate interdependent financial systems, create healthy communities and understand issues of global impact such as climate change. As anthropologist Joseph Campbell once observed, "People who don't have a concept of the whole, can do very unfortunate things …" (*A Joseph Campbell Companion: Reflections on the Art of Living,* selected and edited by Diane K. Osbon, [New York: Harper Collins, 1991]).

PAGE 6: **Margaret Read MacDonald** is a folklorist, a children's librarian, and the author of more than 45 books on folklore and storytelling. To learn more about Margaret Read MacDonaldís work, see: www.margaretreadmacdonald.com.

CHAPTER 1: INTERDEPENDENCE

PAGE 8: **They've warned of the *problems* of unintended consequences, when a solution to one problem actually leads to a bigger problem, which leads to a growing spiral of solutions and problems.** Many people who study systems thinking tell this old joke from China to quickly convey the principle of interdependence:

> A ferry boat was once crossing a river. Suddenly the boat struck a rock, and water relentlessly poured into the cabin. The passengers were frightened out of their wits. Only one man sat calmly as if nothing had happened and even laughed at the way the others were so alarmed. "Don't worry! It's not our problem," the man said. "It doesn't matter if it's leaking, because it's not our boat."

It is easy to fall into the trap of seeing ourselves, like the man on the ferry boat, as disconnected from the boat we're in. Turn on the faucet and water comes out. Get rid of your garbage by putting it in a trash can. But there really is no "away," because the garbage just goes somewhere else. This sense of disconnectedness is a fragile illusion. As we develop an awareness of ourselves as part of a web of interdependencies and interrelationships, we see that we influence our environment as much as it influences us. We stop looking "out there" for causes of troubling behavior, and begin to look inward, to our own actions and goals, which may be influencing the systems around us.

CHAPTER 2: SYSTEMS INTEGRITY

PAGE 15: **We tinker with elements in the natural world and expect it to continue working all the same.** Recognizing the hidden integrity of living systems, Aldo Leopold, American

conservationist and author, argued for "intelligent tinkering":

> The last word in ignorance is the man who says of an animal or plant: "What good is it?" If the land mechanism as a whole is good, then every part is good, whether we understand it or not. If the biota, in the course of aeons, has built something we like but do not understand, then who but a fool would discard seemingly useless parts? To keep every cog and wheel is the first precaution of intelligent tinkering.

To Leopold, harmony with the land came from viewing the land as one organism, as a system with integrity:

> Harmony with land is like harmony with a friend; you cannot cherish his right hand and chop off his left. That is to say, you cannot love game and hate predators; you cannot conserve the waters and waste the ranges; you cannot build the forest and mine the farm. The land is one organism.

(Aldo Leopold, *A Sand County Almanac* [New York: Oxford University Press, 1949])

PAGE 15: **In the 1920s, for instance, ranchers, angered that wolves were attacking some of their sheep and cattle, called for all wolves to be removed from Yellowstone National Park in the western United States.** For more on the impact of returning wolves to Yellowstone, see: *Decade of the Wolf: Returning the Wild to Yellowstone,* by Douglas W. Smith and Gary Ferguson (Guilford, CT: Lyons Press, 2005).

PAGE 16: **Over the next 70 years, wildlife biologists and park rangers watched as the integrity, or the "wholeness," of the Yellowstone ecosystem fell apart.** Ecology is the study of ecosystems. The word *ecology* comes from the Greek *oikos* for "house" and *logos* for "knowledge." When we study ecology, we are building our knowledge of nature's house.

PAGE 19: **When the parts of the house finally realize that "none is important without the other…"** The theme of systems integrity was also explored by Aesop, the humble Greek slave turned storyteller. In a lesser-known Aesop fable, "Belly and The Other Members" (*Aesop's Fables* [New York: Grosset & Dunlap, 1963] p. 43). Aesop tells a tale of the parts of the body and what happens when they don't get along.

> It is said that in olden times, the parts of the human body did not get along as well as they do now. On one occasion, the other body parts began to be critical of the belly for being lazy while they had to spend all their time working to support the wants and needs of the belly. The parts of the body went so far as to decide to cut off the belly's supplies for the future. The hands were no longer to carry food to the mouth, nor the mouth to receive, nor the teeth to chew it.
>
> But, lo and behold, it was only a short time after they had agreed upon this course of starving the belly into obedience when they all began, one by one, to fail and flop and

> the whole body to waste away. In the end, the parts of the body became convinced that the belly also, cumbersome and useless as it seemed, had an important function of its own, and that they could no more exist without it than it could do without them.
>
> Moral: As in the body, so in the community, each member in his place must work for the common good.

CHAPTER 3: BIODIVERSITY

PAGE 21: **When the population of several species of vultures from India and South Asia plummeted, scientists discovered that they were being killed by a drug commonly given to cattle.** For more on this situation, see the article by Peter Kareiva and Michelle Marvier, "Conservation for the People," *Scientific American*, [October 2007].

CHAPTER 4: COOPERATION AND PARTNERSHIP

PAGE 30: **Fritjof Capra.** I am indebted to physicist and systems theorist Fritjof Capra for our many conversations about living systems in general, and about nature's tendency toward cooperation and partnership in particular. "Partnership," Capra has written, "the tendency to associate, establish links, live inside one another, and cooperate, is one of the hallmarks of life." (Fritjof Capra, *The Web of Life: A New Scientific Understanding of Living Systems* [New York: Anchor Books, 1996], p. 301]).

PAGE 34: **Cooperation and Partnership.** There are many tales that promote the virtues of cooperation for young readers. *The Tale of the Little Red Hen*, for instance, is a story of what happens to those who fail to cooperate. In this traditional tale, the Little Red Hen grows the wheat, harvests it, grinds it into flour, and bakes the break without any help from the Pig, the Duck, or the Cat. In the end, she enjoys the whole loaf of bread, all by herself.

CHAPTER 5: RIGHTNESS OF SIZE

PAGE 35: **Gregory Bateson.** For the full version of Bateson's tale of the Polyploid Horse, see Bateson's *Mind and Nature: A Necessary Unity* (New York: E.P. Dutton, 1979), pp. 55-56.

CHAPTER 6: THE COMMONS

Page 41: **The Commons.** Thinking about our shared natural resources goes back well over a millennium and a half. Emperor Justinian, ruler of the Byzantine Empire, declared

in 535 CE: “By the law of nature these things are common to mankind—the air, running water, the sea, and consequently the shore of the sea.” (The Medieval Sourcebook, The Institutes, 535 CE).

Page 41: **Aristotle.** The line from Aristotle is quoted by William Ophuls from Ernest Barker’s *The Politics of Aristotle* (New York: Oxford, 1952). I’ve found Ophuls’ *Ecology and the Politics of Scarcity: Prologue to a Political Theory of the Steady State* (San Francisco: W.H. Freeman, 1977) to be an invaluable resource in my own self-study about the ecology, economics, and politics surrounding our common, natural resources.

CHAPTER 7: LIVING CYCLES

PAGE 46: **While we may not think much about natural cycles, we often disrupt them.** We may not pay much attention to cycles, especially if they’re longer than 24 hours. Some cycles may be short, for instance the 12-day life cycle of a mosquito. Others are long, such as that of a rock, unfolding over tens of thousands of years. When we don’t understand cycles, sometimes our solutions become the problem. If lightening strikes in a forest, should the fire be put out immediately? Not always. By allowing cyclical forest fires to burn, fires can act as a natural means of pruning, burning down dense evergreen trees and allowing seedlings to sprout from the rich soil made by the fire’s ashes. Occasional fires can also take care of the build up of fallen dead branches, leaves and dry needles – before it becomes fuel for an unnaturally large and devastating fire.

PAGE 46: **When we pave streets and parking lots, we interrupt the water cycle by lessening the amount of water absorbed into the soil and increasing the amount of water diverted into storm sewers.** More pavement on our streets also means less water is taken up by plants and trees, which through evaporation help to cool the area around them. So, more pavement means less natural cooling.

CHAPTER 8: WASTE = FOOD

PAGE 52: **Waste = Food.** The American businessman Ray Anderson, whose company makes floor coverings, was one of the first corporate leaders to transition from a human way of using what Anderson calls “take → make → waste” to nature’s more circular way of moving materials or “waste = food.” See Anderson’s book Mid-course Correction: *Toward a Sustainable Enterprise—The Interface Model* (White River Junction, VT: Chelsea Green, 1999). The phrase “Waste Equals Food” was originally coined by William McDonough, American architect and designer. For more on the principle of “waste equals food” see Chapter 4 of *Cradle to Cradle: Remaking the Way We Make Things,* by William McDonough and Michael Braungart, (New York: North Point Press, 2002).

PAGE 52: **As American natural science writer Janine Benyus puts it: “All waste is food, and everybody winds up reincarnated inside somebody else.”** This is one of the key lessons of systems ecology, writes Benyus. (Janine Benyus, *Biomimicry: Innovation Inspired by Nature* [New York: Harper Collins, 1997] p. 255).

PAGE 53: **If we imitate living systems, waste from one system can become “food” for another.** Some companies are now forming “ecological clusters” so that the waste of one company can become food of another. The clusters around Colombian coffee farms are a good example. As Fritjof Capra explains: “When the coffee beans are harvested, the remains of the coffee plant are used to grow shiitake mushrooms (a high-priced delicacy); the remains of the mushrooms (rich in protein) feed earthworms, cattle, and pigs; earthworms feed chickens; cattle and pig manure produce biogas and sludge; the sludge fertilizes the coffee farm and surrounding vegetable gardens, while the energy from the biogas is used in the process of mushroom farming.” (Fritjof Capra, *The Hidden Connections: Integrating the Biological, Cognitive and Social Dimensions of Life into a Science of Sustainability.* [New York: Doubleday, 2002], p.236) For more examples of ecological clusters (also known as Industrial Ecology), see the book *World Changing: A User’s Guide to the 21st Century*, edited by Alex Steffen (New York: Abrams: 2006, pp. 111-113) and the Zero Emissions Research and Initiatives (ZERI), www.zeri.org. ZERI, founded by sustainability educator Gunter Pauli, is a network of 3,000 scientists focusing on creative solutions for pressing problems—and the redesign of production and consumption into clusters of industries.

CHAPTER 9: BALANCING FEEDBACK

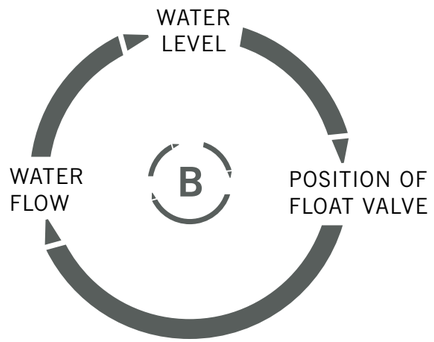
PAGE 61: **By shaking your muscles, shivering warms your body back up to its normal 37°C (98.6°F).** In the 1930’s, American physiologist Walter Cannon coined the term *homeostasis* to describe the process by which chemical and/or temperature balance is maintained in the body. (Walter B. Cannon, *The Wisdom of the Body* [New York: W.W. Norton & Co.], 1939)

PAGE 61: **Balancing feedback works to keep living systems in a state of dynamic balance through an endless series of self-correcting changes.** Examples of dynamic balancing, also called negative or self-regulating feedback, are all around us. Business writers refer to the “rollercoaster economy” as a way to remind readers that, during good times they need to prepare for the inevitable downturn.

Dynamic balance has long been understood by many cultures around the world. An un-

derstanding of dynamic balance was demonstrated through early mechanical innovations, including the thermostat control device invented by the 17th century Dutch inventor Cornelius Drebbel. We also see this same type of self-correcting process in float valves, which emerged in the 1740s. A float valve is a simple self-regulating mechanism that senses a discrepancy in the water level and then corrects it. On a farm a float valve might be used to keep a pond from overflowing or from drying up. Here's how it works: A long, thin board or stick is placed over a dam. A piece of wood is attached to one end of the stick. The wood floats in the water. At the other end, the stick is fastened to a valve or gate. When the pond is low, the wood pulls the end of the board down. This in turn pulls the other end up, opening the gate and allowing the water to flow in. When the water level goes back down again (either through use or through evaporation), the process starts all over again.

Below is a causal loop diagram of the float valve's self-correcting feedback structure:



Float valves have made their way into many machines, including in steam boilers (the float valve controls the water level), in carburetors on car engines (it regulates the amount of gas supplied), and, most universally, in flush toilets (again, it controls the water level).

During the 1940s and 1950s, engineers, sociologists, biologists, psychologists, and anthropologists began to focus on the role that feedback plays in processes of communication and control. Led by the work of scientists such as English psychiatrist W. Ross Ashby and American mathematician Norbert Wiener, the field of cybernetics emerged. System dynamicist George Richardson's book *Feedback Thought in Social Science and Systems Theory* (Philadelphia: University of Pennsylvania Press, 1991) remains one of the most thorough works on the presence of feedback structures in social systems.

PAGE 62: **Gluskabe.** I am grateful to Joseph Bruchac, Abenaki Indian author and storyteller, for permission to adapt his telling of this Gluskabe story. According to Joseph, the first written version of this story was recorded by Frank Speck in the Penobscot language. To learn more about Joseph Bruchac's work, see: www.josephbruchac.com.

CHAPTER 10: REINFORCING FEEDBACK

PAGE 67: **Reinforcing feedback.** Once we understand reinforcing feedback, we see and hear examples of reinforcing patterns all around us. An executive might use the phrase vicious cycle to describe the reinforcing feedback that occurs when price cuts eventually lead to a loss of market share, as customers come to question a product's quality. Reinforcing feedback is responsible for the rise and fall of many businesses, for example, the Internet-based businesses that boomed and faded in late 1990s and early 2000s. As described by American journalist Michael Kinsley: "Whenever the price people will pay today depends on the belief that other people will pay even more tomorrow, you've got a bubble. It takes only a slight letdown in those expectations to send the whole delightful, self-feeding process into reverse." (Michael Kinsley, "Your House is Worth Less? Good" Time, [September 3, 2007]: 26).

PAGE 67: **A biologist might use a different term, such as *cascading,* to describe events that trigger other events in an ever-growing spiral…** For a wonderfully clear explanation of reinforcing feedback, or cascading, inside the cell, see Mahlon Hoagland's book *The Way Life Works* ([New York: Random House, 1995], pp. 158-159).

PAGE 68: **Whether reinforcing feedback consists of an engine of growth or decay, we can work with it and even change the hidden forces that cause it.** Whirlpools—powerful, reinforcing, circular currents of water—are created when opposing currents meet. Long ago, when I worked for Outward Bound, an outdoor experiential education organization, I received the following advice from a white-water rafting instructor, just before we pushed our boat into raging level-five rapids: "If you fall out, don't let go of your oar. If you find yourself in an underwater whirlpool, don't panic. Stick your oar out. The force will break you out of the whirlpool. Then swim as fast as you can to the surface." When we find ourselves in such reinforcing dynamics, whether natural, such as whirlpools, or social or psychological, what is our oar? To Hercules, we might say Pallas was that oar. How do we break a link in a closed loop of cause and effect? What action can we take or what perspective can we change to help us break out of a closed reinforcing loop?

CHAPTER 11: NONLINEARITY

PAGE 72: **Traffic jams, weather patterns, and epidemics are additional examples of nonlinearities.** In debates and discussions about global warming, we often hear the term nonlinear to describe dangerous and abrupt climate changes. A basic understanding of these nonlinearities is essential. The goal, according to many climatologists and scientists, and adeptly summarized here by journalist to Mark Hertsgaard, "is to stop global warming

before it crosses tipping points and attains unstoppable momentum… For example, should the Greenland ice sheet melt, white ice - which reflects sunlight back into space - would be replaced by dark water, which absorbs sunlight and drives further warming." (Mark Hertsgaard, "While Washington Slept," *Vanity Fair*, May 2006: 200)

PAGE 73: **Addressing small crimes (such as broken windows and graffiti) can set off nonlinear change.** The broken windows example is drawn from Malcolm Gladwell's book, *The Tipping Point: How Little Things Can Make a Big Difference* (Boston: Little, Brown & Co., 2000).

CHAPTER 12: EARTH TIME

PAGE 79: **Whether we wait a few weeks for carrot tufts or two years for bamboo shoots, we can think of the time required for this growth as the pace of the biological world, or the biosphere.** Understanding Earth time also means stretching our time horizons. Often it means extending our perspective of "the present" to look beyond the next day or two. As American sociologist Elise Boulding observes: "The futures-creating individual must learn to live in an extended present. The present as defined by the year, the decade, or even the quarter century is too small of an adequate grasp of significant social processes." (Elise Boulding, "Education for Inventing the Future," in *Alternatives to Growth I: A Search for Sustainable Futures,* edited by Dennis L. Meadows [Cambridge, MA: Ballinger Publishing Co., 1977], p. 304). Rather, Boulding urges that we extend our sense of the present to include 50 to 200 years into the future and 50 to 200 years into the past. This extended sense of the present is particularly appropriate for living systems because many living systems, both natural and social, don't generate a full cycle of behavior over short time intervals. You won't understand the seasonal cycle of your garden, for instance, if you observe it for only a day or two.

PAGE 80: **As humans are pulled into the pace of the technosphere, we can become disconnected from the pace of the biosphere.** If the biosphere operates at the pace of nature's cycles, the technosphere operates at the pace of industrial cycles.

PAGE 80: **Joanna Macy.** The quote from Joanna Macy is drawn from her book, *Coming Back to Life: Practices to Reconnect Our Lives, Our World,* co-authored with Molly Young Brown ([Stony Creek, CT: New Society Publishers, 1998], pages 136-137). To learn more about Joanna Macy and her work, see: www.joannamacy.net.

PAGE 84: Another relevant folktale here is the story of *The Ant and the Grasshopper,* among the better known of Aesop's fables. This story points to the importance of early action without waiting until one is forced to do something, by which time it is often too late.

APPENDIX A: MORE PRINCIPLES OF LIVING SYSTEMS

PAGE 85: **After conversations with many scientists and practitioners, I selected 12 principles of living systems to highlight in this book.** These are a number of comprehensive lists that describe key characteristics of living systems. Here are a few places you may want to look:

The Center for Ecoliteracy (CEL,www.ecoliteracy.org, is a non-profit educational organization in Berkeley, California that was founded by Fritjof Capra, Peter Buckley, and Zenobia Barlow. CEL works with educators and students around issues of sustainable living by fostering understanding of the natural world through direct experience (for example, a school garden). See CEL's "principle of ecology" list at the following web site: www.edibleschoolyard.org

Biomimicry is a scientific discipline that generates innovations inspired by nature. Biomimicry practitioners study nature and then imitate its best designs and processes to solve human problems. Studying a gecko's feet to make more sustainable adhesives is a good example. For a list of biomimicry principles, see: www.biomimicry.net

Hoagland's *The Way Life Works* includes a wonderful list unifying themes in biology.

Paul Hawken, Amory Lovins, and Hunter Lovins describe four principles of natural capitalism in their book, *Natural Capitalism: Creating the Next Industrial Revolution* (Boston: Little, Brown & Co., 1999).

The four principles are:

1. Increase the productivity of resource use.
2. Shift to biologically inspired production models (see biomimicry above).
3. Move from products to services to create a solutions-based business model.
4. Reinvest in natural capital.

For more information, see www.natcap.org.

Dr. Karl-Henrik Robèrt founded *det Naturliga Steget*, or the Natural Step, a nationwide sustainability program in Sweden that is moving that nation from linear to cyclical processes across all disciplines, including industry, healthcare, and education. The growth of the Natural Step to a dozen countries worldwide has resulted in widespread aware-

ness of four principles of sustainable societies:

1. **Substances from the Earth's crust must not systematically increase in nature.** This means we cannot take resources such as fossil fuels and minerals out of the Earth faster than they are able to be replenished.

2. **Substances produced by society must not systematically increase in nature.** We cannot produce materials at a faster rate than they can be broken down and returned to the Earth.

3. **The physical basis for the productivity and diversity of nature must not be systematically deteriorated.** This means we cannot harvest more from nature than can be reproduced in activities such as forestry, agriculture, fishing, and community planning.

4. **Just and efficient use of energy and other resources.** This means our basic human needs must be met with the most resource-efficient methods possible.

(Karl-Henrik Robèrt, *The Natural Step: Seeding a Quiet Revolution* [Gabriola Island, B.C.: New Society Publishers, 2002). More information about the Natural Step can be found at www.naturalstep.com.)

PAGE 86-87: **Self-Generation, or Autopoesis.** I am grateful to Peter Senge, founder of the Society for Organizational Learning, and social scientist Dennis Sandow for their many clarifying conversations on the topics of autopoesis, cognition, and learning.

PAGE 87: **The First and Second Laws of Thermodynamics.** Many thanks to Joe Laur of Greenopolis and Hilary Bradbury-Huang, director of the University of Southern California's Sustainable Business Research. Both have helped me to explore the link between thermodynamics and sustainability.

PAGE 88: **The Parts-Whole Connection, or The Seed Principle.** The Seed Principle is a concept that is most eloquently explained in the book *Presence: Human Purpose and the Field of the Future.* The authors Betty Sue Flowers, Peter Senge, Joseph Joworski, and Otto Scharmer, illustrate the Seed Principle with a seed and a tree:

> It's common to say that trees come from seeds. But how could a tiny seed create a huge tree? Seeds do not contain the resources needed to grow a tree. These must come from the medium or environment within which the tree grows. But the seed does provide something that is crucial: a place where the whole of the tree starts to form. As resources such as water and nutrients are drawn in, the seed organizes the process that generates growth. In a sense, the seed is a gateway through which the future possibility of the living tree emerges. (Betty Sue Flowers, Peter Senge, Joseph Joworski, and Otto Scharmer, Presence: Human Purpose and the Field of the Future [Cambridge, MA: SoL, 2004], p. 2)

PAGE 88: **The cell and the acorn may seem like parts, but in fact they are both places, as Henri Bortoft, German physicist and philosopher of science, put it, "for presencing the whole."** Bortoft's quotation is from a "Conversation with Henri Bortoft: Imagination Becomes an Organ of Perception," in an interview conducted by C. Otto Scharmer, (London, July 14, 1999; available at www.dialogonleadership.org, as cited in the introduction to the book *Presence: Human Purpose and the Field of the Future.*

PAGE 88: **Carrying Capacity.** Although the term *carrying capacity* may be new to this century, the concept is ancient, as we see in this old Chinese proverb: "A crowded chicken farm produces fewer eggs." The gist of this proverb is that a farm has a certain carrying capacity—if there are too many chickens (or people), the farm (or any limited resource) is less efficient.

PAGE 89: **Flux.** Great thanks to Dr. Christine Kelly for sharing many relevant examples of flux in social systems.

PAGE 89: **Exponential, or Runaway, Growth.** In the 3rd century BCE, Chinese philosopher Han Fei-Tzu used this story to raise awareness of the exponential nature of population: "People at present think that five sons are not too many and each son has five sons also, and before the death of the grandfather there are already 25 descendants." Han Fei-Tzu describes a behavior that can be tricky to understand: The larger the quantity (for example, number of seeds, amount of money in a bank account, number of children in a family), the greater the *rate* of growth of that quantity. As a consequence of this reinforcing process, the greater the *quantity* will be in the future.

PAGE 90: **Stocks and Flows.** John Sterman, professor of system dynamics at Massachusetts Institute of Technology, has written extensively about the unique qualities and counter-intuitive behavior of stocks and flows. For more on stocks and flows, see Sterman's book *Business Dynamics: Systems Thinking and Modeling for a Complex World* (Boston: Irwin/McGraw-Hill, 2000).

PAGE 90: **An amount of something—trees, fish, people, goods, money—is a stock. The rate at which a stock changes, going up or down, is its flow.** We can see an excellent example of stock-and-flow thinking in this 1999 letter to the editor of *The Chemical Engineer*, by A. Lodge. Here Lodge compares the complexities of global climate policy to the filling up and draining of a bathtub:

> The article…gives a fascinating insight into the way international politics struggles with complex technical issues. I was inspired to set up an experiment to test some of the ideas, and hit upon the analogy of using my bath instead of the Earth and taking the water as carbon dioxide. I jammed the plug firmly, and turned one tap to full. I observed

that the bath was filling with water. I turned the flow down to 80%—a massive 20% reduction—only to discover that it was still filling but slightly more slowly. At this point, I was joined by my neighbour, an American. He pointed out that reducing the flow by 20% was out of the question; we haggled for a bit before agreeing on a reduction to 94.8%. We thought the 5.2% reduction had a nice ring to it. Oddly, the bath was still filling up with water at almost the same rate that it had been initially. My friend then gave me a five pound note to turn the tap down by another 20%. I did so. He then turned on the other tap to exactly counter the 20% saving. I complained, only to be told that he had "bought my credits," whatever that means. He then rushed out, returning with a bucket which he put under the second tap. I was so impressed that I did not notice for a moment that the bath was still filling up and that the bucket would soon overflow. We decided we had experimented enough for one day and went off to the pub. We were on our third pint when we remembered that the experiment was still running.

Using the bathtub as a metaphor, Lodge explains that as a society, we continue to inject carbon dioxide (CO_2) into the atmosphere (the rate at which water is flowing into the bath tub) at about twice the rate it is being drained out. Therefore, to stabilize the concentration of CO_2, emissions must be cut substantially, even at rates below those agreed to in the Kyoto Protocol.

MORE APPRECIATION

Space constraints in the book did not allow me to thank all of those who have helped make this book what it is. I am grateful to be surrounded by an amazing circle of colleagues and friends—Joanna Macy, Jaimie Cloud, Sheila Heen, Elaine Johnson, Drew Jones, Joe Lauer, Jonathan Rowe, Hilary Bradbury-Huang, Stephanie Ryan, Dennis Sandow, Steve Roderick, Teresa Ruelas, Sarita Chawla, Joseph Bruchac, Vanessa Timmer, Louise Cadwell and Christine Kelly—all of whom greatly enhanced this book through their careful readings and commentary. Thank you all!