method that had a distinctively pragmatist flavor and that for him the method of experience was the ultimate arbiter of both scientific truth and right action. Before going further, however, it is important to provide a more systematic explanation of what I mean by the term *adaptive management.*

3.2 What Is Adaptive Management?

I am arguing that Aldo Leopold, in the first half of the twentieth century, anticipated the core ideas of an increasingly popular approach to environmental management that today is called adaptive management. I have emphasized the importance of recognizing that a theory of environmental *management* must be a theory of *action.* The actions can be motivated only by social values, and all actions, including scientific study, are suffused with values. No system for managing the environment can be understood in purely physical terms. Understanding the physical systems involved is of course important: our theory of environmental action must embody an analysis of the physical mechanisms of environmental degradation. For convenience, we can refer to this component of our broader subject as the act of building a "model" of physical impacts of humans on natural systems—the habitats—that support human societies as their physical context. Since we seek a system of active *management,* our scientific models must be understood as embedded in a larger process of social discourse and political institutions. Management necessarily involves us in goal-directed activity; and our theory of management must therefore include a means of identifying, justifying, and/or legitimating goals by reference to some social value. Adaptive management, as understood here, is an approach to understanding, justifying, and implementing policies that affect the environment. This approach is worthy of being called adaptive by virtue of its intellectual pedigree and its increasingly important function in the life of human societies.

Although different advocates of adaptive management emphasize different aspects of the approach, I will here define adaptive management as management according to three key tenets.

1. Experimentalism. Adaptive managers emphasize experimentalism, taking actions capable of reducing uncertainty in the future.
2. Multiscalar analysis. Adaptive managers understand, model, and monitor natural systems on multiple scales of space and time.
3. Place sensitivity. Adaptive managers adopt local places, understood as humanly occupied geographic places, as the perspective from which multiscalar management orients.

The first and defining characteristic of adaptive management is experimentalism. The method used by adaptive managers, following Leopold, is a commitment to constantly use our experience to reduce uncertainty and also to adjust our goals and commitments. Experimentalism implies that we should take nothing for granted and that we should wherever possible replace assumptions with beliefs based on experimentation or careful observation. Taking nothing for granted means also that the goals and objectives set for policy, as well as physical models, are open to amendment. The very goal of sustainable living is a moving, changing target, to be defined as part of a process and refined as more experience pours in.[3]

Leopold was also the first to articulate the need to understand environmental problems as unfolding on multiple scales of time and space. Measurements, aggregations, and judgments, Leopold learned, must be considered tentative; but tentativeness is just what we would expect, given Hadley's historical caution that the Darwinian approach to identifying truth with permanence would lead us to look at some practices as permanent simply because we have examined their impacts within too short a frame of time. This warning was the operative concept, eventually, in Leopold's famous dictum "think like a mountain," a maxim that will become increasingly important as our analysis continues. According to this advice, we must pay attention to effects not only as they play out on individual and immediate scales but also on the scales of decades and generations. One important aspect of this second characteristic, then, is a commitment to open systems, to understanding nature and the environment as a complex and multiscalar interaction of parts. Since the parts change at different rates, multiscalar understanding introduces the possibility of emergent qualities, qualities of larger wholes that cannot be understood as the sum of actions of parts. The adoption of the multiscalar management model, treated as a method of systems analysis, provides the advantages of a more holistic viewpoint without the ontological commitments of organicism. It allows us to interpret impacts that emerge on different scales in terms of a single, integrated model and thus allows, at least in principle, a set of postulates for organizing space-time relations and perhaps even principles for integrating models over multiple levels. The second characteristic of adaptive management thus amounts to a commitment to build the formal apparatus necessary to follow the systematic consequences of our acts as they play out on different scales of the system.

The third characteristic of adaptive management is localism, a commitment to examine each problem in its particular context and to pay attention to differences that matter in a "place."[4] Darwinian adaptation is always local—one organism either survives or perishes in particular situations, and when

Darwin's principle is applied to societies, the relevant question is not whether the society has THE TRUTH (for all times and places) but rather whether the society has developed practices and institutions that are responsive to, and sustainable in, their local environment. Environmental management as community adaptation to a "place" is thus locally based. This is not to say, of course, that larger regional and global systems never impact local systems—but rather to say that the survival of the community takes place against the backdrop of changing systems on many scales, as these are viewed from the perspective of the local community. These complex, interlocking dynamics must be understood from a specific, local place, from a given perspective within a multiscalar system.

I have chosen to interpret the local aspect of adaptive management as signifying a local perspective not just in the physical sense but also in the social sense, involving a participatory component. Localism, as understood here, includes the idea of a community of people capable and willing to participate in decisions that affect their lives in their local context. This may be thought by some to go beyond the key ideas of adaptive management. For example, when my friend the philosopher and conservationist Peter Brown read an earlier version of this manuscript, he argued that I had unjustifiably conflated adaptive management with the idea of public participation in management practices. Using his own woodlot, which he manages for sustainable forestry, as a case study, he said: "I manage my land adaptively, discussing options with a forester from the local extension service—and we try various experiments, keeping track of results; but I don't consult the public in any way—adaptive management is scientific management, and has nothing conceptually to do with participatory governance." Especially if we apply the term to private woodlands such as Peter's, public process is hardly relevant. In this book, however, my goal is to examine environmental public policy and, at the community level, adaptive management. At that level, I believe public involvement is essential so I see his point. If one defines adaptive management narrowly as adaptive management that employs the scientific method to reduce uncertainty and guide management decisions, then the method of governance is simply irrelevant. Given that definition, I'd have to agree; but I have, despite Peter's excellent point, decided to define adaptive management more broadly to include also the goal-setting process that determines the direction of management inquiry.

I build this aspect into my definition by emphasizing the local nature of environmental values and by seeing localism as not just a geographic point but a "place," which is best thought of as a negotiation between the land and a human culture. In this sense the localism aspect of adaptive management—once it is supplemented in part 2 of this book with a pragmatist approach to

values—entails an unavoidable interaction between adaptive managers, members of the public, politicians, and resource users.[5] Put simply, I understand the scientific aspect of adaptive management to be applicable to goal-setting and to social learning about community values as well as about physical processes, so defining a functional adaptive management system for a *public management process* (unlike Peter Brown's private use of adaptive management) requires also that the management be politically feasible and capable of reflecting community-based ("place-based") values. This decision, to use a broad, value-laden conception of adaptive management and hence to relate adaptive management to politics, is reinforced in chapter 4, where it is shown that many environmental problems reflect competition among multiple goods and that problem formulation requires iterative treatment of both science and values. Such iterative treatment requires some kind of political structure; and if the structure is to be supported by the public, the public must be involved and take ownership of the process.

On my understanding of the three principles of adaptive management, then, each principle has a goals-and-values aspect as well as a physical modeling aspect. Each of the principles has important implications for environmental values and valuation. Experimentalism as an attitude and a method—pragmatism—applies equally to factual and to evaluative claims. So a consistent application of the first principle requires an experimentalist approach to human values as well as to science. The second principle also has a normative aspect: the use of multiscalar physical models to describe impacts of humans on natural systems opens the door to a multiscalar analysis of environmental values. Might environmental values unfold on multiple scales? The place-based approach also has normative implications because it involves emphasizing local perspectives and locally articulated values, at least as a starting point. Adaptive management is thus committed to a place-based, contextual approach to evaluation as well as to modeling, and this stance disrespects "one-size-fits-all" solutions and implies favoring locally grounded values whenever possible. So adaptive management as presented in this book represents a philosophy of management; the same philosophy that governs the search for scientific understanding also governs the search for better management solutions and guides revisions of values and evaluations when observation and experience indicate the need for such revisions. Adaptive management is as much a search for the right thing to do as it is a search for the truth. Adaptive management, like medicine, is a normative science.

So far, this all may sound very pedestrian; adaptive management may seem like little more than common sense. There is, however, a payoff. Given this rather sparse set of assumptions and hypothetical premises, it is possible to provide a simple and elegant definition of *sustainability,* or rather what

might better be called a definitional schema for sustainability definitions. Because of the place-based emphasis of adaptive management and the recognition of pervasive uncertainty, there is only so much that one can say about what is sustainable at the very general level of a universal definition. Speaking at this level of general theory, sustainability is best thought of as a cluster of variables; local communities can fill in the blanks, so to speak, to form a set of criteria and goals that reflect their needs and values. Although I recognize the importance of local details in particular determinations of sustainability, the three core characteristics of adaptive management go a long way toward specifying a schematic definition of sustainability. A schematic definition makes evident the *structure* and *internal relationships* that are essential to more specific, locally applicable definitions of sustainable policies.

First notice that the latter two principles of adaptive management can be represented in a very simple model of individual actors in a world encountered as a collection of resources. Each actor is treated as a chooser who acts upon observing her or his environment, which we can, in turn, represent as a mixture of opportunities and constraints; some of the chooser's choices result in survival; the chooser lives to choose again and has offspring who will also choose in the face of similar but changing environmental conditions. Choices of other opportunities lead to death with no offspring. This is the basic structure of an evolution-through-selection model that interprets the environment of a chooser as a mixture of opportunities and constraints; it contextualizes the "game" of adaptation and survival and can be represented as in figure 3.1.
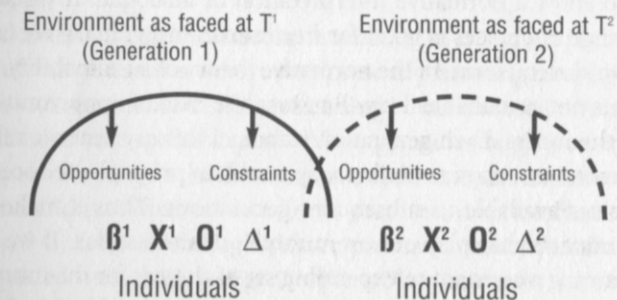
This relationship is simply an expression of the relationship implicit in the second and third principles of adaptive management: the chooser is located at a space-time point within an environmental system, observing and acting from that perspective within the system. The actions of individuals, taken individually and collectively, moreover can be understood as experiments on two different scales. Survival of the individual depends, in the short run, on very local conditions of stability; but that local stability represents also a negotiation with slower-changing background conditions. The actions, once undertaken, will result in either survival or termination of the individual or the population over varying periods of time. Community-level success, in other words, requires success on two levels: at least some individuals from each generation must be sufficiently adapted to the environment to survive and reproduce, *and* for the population to survive over many generations, the collective actions of the population must be appropriate for (adaptive to?) its environment. Since humans are necessarily social animals (because of the long period of helpless infancy of individuals), individual survival depends also on reasonable levels of stability in the "ecological background," the stage on which individuals act. This environment normally changes much more slowly than

A. At a Given Time

The Environment

Opportunities   Constraints

ß X O Δ
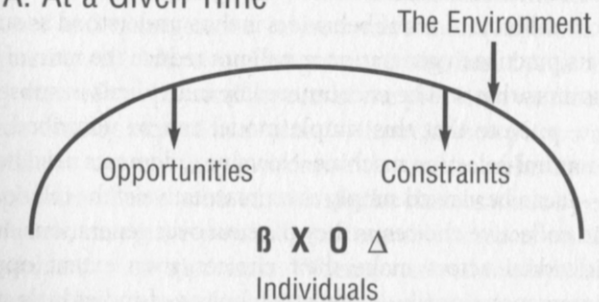
Individuals

Individuals face their environment as a complex mix of opportunities and constraints as they adapt to their environment at any given time

B. The Cross-Scale Dynamic across Time

Environment as faced at T^1 Environment as faced at T^2
(Generation 1)   (Generation 2)

Opportunities   Constraints   Opportunities   Constraints

$ß^1$ X^1 O^1 $Δ^1$ $ß^2$ X^2 O^2 $Δ^2$

Individuals   Individuals

Choices made by members of an earlier generation can change the mix of opportunities and constraints faced by subsequent generations, limiting the latter's choices in their attempt to adapt

Figure 3.1 A simple hierarchical model

individual behaviors, permitting adaptation, over generations, to stable aspects of the environment. This simple model, if given a temporal expression, represents the relationship between individuals who live in an earlier generation and those who live later, as represented in figure 3.1B.

From this simple framework, a schematic definition of sustainability emerges: Individuals in earlier generations alter their environment, using up some resources, leaving others. If all individuals in the earlier generations overconsume, and if they do not create new opportunities, then they will have

changed the environment that subsequent generations encounter, making survival more difficult. A set of behaviors is thus understood as sustainable if and only if its practice in generation m will not reduce the ratio of opportunities to constraints that will be encountered by individuals in subsequent generations n, o, p. Note that this simple model can be described, in its bare bones, as a natural-selection machine. No value judgments need be implied in the model—it can be viewed simply as representative of the relationship of individual and collective choices as they play out over generations. In each generation, individual actors make their choices *given* extant opportunities; looked at intergenerationally, aggregated choices of individuals may change the ratio of opportunities and constraints faced in subsequent generations.

Although the model has a "flat," schematic character, it could also be given a richer, normative-moral interpretation, as is surely hinted at by use of the terms *opportunities* and *constraints*. If we stipulate that the actors are human individuals, then the simple model provides a representation of intergenerational impacts of decisions regarding resources; our little model can thus be enriched to allow a normative interpretation or analogue. If we accept that having a range of choices is good for free human individuals, we can see the structure, in skeletal form, of the normative theory of sustainability. An action or a policy is not sustainable if it will reduce the ratio of opportunities to constraints in the future. Each generation stands in this asymmetric relationship to subsequent ones: choices made today could, in principle, reduce the range of free choices available to subsequent generations. Thus it makes sense to recognize impacts that play out on multiple, distinct scales. If we can agree that maintaining a constant or expanding set of choices for the future is good, and that imposing crushing constraints on future people is bad, our little model has the potential to represent, and relate to each other, the short- and long-term impacts of choices *and* to allow either a physical, descriptive interpretation or a normative one. This schematic definition, understood within the general model of adaptive management, captures two of our most important basic intuitions about sustainability: that sustainability refers to a relationship between generations existing at different times—a relationship having to do with the physical existence of important resources—and that this relationship has an important normative dimension. As my argument unfolds, it will become obvious that I believe any adequate conception of sustainability, one adequate to serve as a key term in public deliberation about what to do, will be explicitly normative. It is nonetheless interesting that this schematic definition can be viewed as flat, and descriptive of a Darwinian process, *or* as a richly normative expression of a community's values.

Thus we can tentatively put adaptive management—complete with a

schematic definition of sustainability—forward as a useful model for environmental science and management. Its normative-moral aspect is the subject part 2 (chapters 5–9). Adaptive management is also based on a broad, multidisciplinary view of the physical aspects of the problems we face: it suggests that each community, located in a "place"—from its viewpoint within a complex, multiscalar system (its environment)—must make choices. These choices, especially when combined with similar choices made by others in the same generation, may have physically measurable impacts on the range of choices available to their successors. When conceived in physical terms, the model tracks the long-term adaptability of a population to a particular physical place, from the temporal viewpoint of a given generation. This schematic definition, in turn, directs attention to those impacts that are likely to affect the choice set available to future generations, linking the physical model to the realm of values associated with free choices. Given this dual nature of the schematic model, the multiscalar model can represent the possibility of intergenerational harm, so it begins to shape our notion of intergenerational responsibilities.

It is of course an empirical question whether at any given point in history, activities of one generation were, or are presently, harming future generations. Historians can reasonably disagree regarding when humans, through increasing populations and technological ability, gained enough power to significantly impact the range of actions and possibilities open to those who live in future generations. Wherever one draws that line, it certainly seems that we have passed it. Indeed, through slower processes ancient civilizations certainly degraded their land over generations; Plato discusses the deforestation and soil erosion that left the Attic peninsula largely barren. Today, expanded technological prowess, as well as growing human populations, enables individuals and societies to more rapidly, irreversibly, and pervasively change the context in which future generations will encounter their environment, and it seems certain that some of our choices today will change the set of choices available to future people in many ways. Among these are changes in the ecology of a "place," which is experienced by locals as a mixture of opportunities and constraints. Changes may be for the better, developing new options while holding others open. It is also at least possible that changes initiated today may impose serious hardships on future people by limiting the range of choices available to them. Leopold, immediately after acknowledging that change is natural and that not all change is bad, made this point eloquently in 1939: "Evolutionary changes, however, are usually slow and local. Man's invention of tools has enabled him to make changes of unprecedented violence, rapidity, and scope."[6] The adaptive management model becomes pertinent,

then, in situations in which human populations have the technological and personal power to transform the opportunities of the present into constraints on future choices; it is thus the appropriate model for adaptive managers today and should become more apt as human impacts increase with population and growing consumption. Our physical model permits a moral interpretation by exhibiting the structure of intergenerational harms; threats to the future are represented as losses of significant options or opportunities. It therefore becomes important that we understand how to determine which options are significant in a place, a task that is central to the remainder of this book.

We now have a schematic model of what is at stake; but in order for people in earlier generations to have obligations to later ones, they must be able to foresee to some degree the possible impacts of their actions. Actions of an earlier generation can be judged morally only if the earlier generation had reason to anticipate negative future impacts and people failed to modify their present activities accordingly.

This is an example in which morality and moral responsibilities are highly dependent on the empirical facts of the situation. Although stone-age hunters with spears and stone axes affected their environment, their actions were less likely than ours to have large-scale and irreversible effects, given today's much larger populations wielding much more sophisticated technologies. Even when they were able to have huge and long-lasting impacts, as in the apparent destruction of the North American megafauna shortly after the arrival of stone-age hunters on the continent, it is unlikely that these actors had the conceptual tools and the necessary baseline data to judge that their activities would have these impacts. So any assertion of responsibility of our generation for impacts on future people rests on these two assumptions: that our choices have important impacts on future people and the choices they face, and that our scientific knowledge is sufficiently reliable that we can foresee and plan to avoid negative impacts and encourage benign ones. This latter assumption—that we have adequate knowledge to manage at all, even enough knowledge to start an experimental process—deserves very careful justification, because it is famously controversial; many politicians hide behind uncertainty in order to avoid tough decisions. In sections 3.4 and 3.5 I show that however limited, tentative, and uncertain our knowledge, it is adequate to undertake reforms of current policy and to begin a process of learning by doing as a community of communities. Before we take up that argument, however, it will be helpful to survey (in section 3.3) the problem of "uncertainty" and the range of available philosophical responses to it. Later, in something of a diversion from the practical arguments at hand, I explore (in section 3.6) why it is appropriate to describe adaptive management as adaptive in the traditions of evolutionary thought.

3.3 Uncertainty, Objectivity, and Sustainability

Perhaps no issue confounds environmental managers more than the "problem of uncertainty." On closer look the "problem" of uncertainty is really a grab bag of more or less related problems, all resulting from the fact that our finite knowledge will always fall short of any ideal of "full" knowledge upon which to base everyday decisions. Uncertainty, in this sense, is just a general label for all the failures of our scientific models. Speaking more precisely, experts have classified the types of uncertainty according to a number of taxonomies. For example, Granger M. Morgan and Max Henrion separate uncertainty into two classes: uncertainties about empirical quantities and uncertainties about the functional form of models.[7] Another classification, due to Sylvio O. Funtowicz and Jerome R. Ravetz, lists three categories of risk: technical uncertainties (concerning observations versus measurements), methodological uncertainties (concerning the right choice of analytical tools), and epistemological uncertainties (concerning the conception of a phenomenon).[8] In another useful taxonomy, Malte Faber, Reiner Manstetten, and John Proops speak of "open" and "closed" ignorance. The latter, what was called "ignorance of ignorance" by Plato, blocks inquiry; but people can shift to an open attitude if they recognize their ignorance. Open ignorance, then, can be understood as reducible if there is a personal or communal means to learn or irreducible if it involves chaos or true, unpredictable novelty.[9]

All of these types of uncertainty—and more—matter in real management situations in which managers face real dilemmas, and it is fair to ask, How can adaptive managers claim to "manage" in the face of all these kinds of uncertainty? Adaptive managers' experimental approach to management requires that they claim at least some faith in the reliability of the scientific models used to describe human impacts upon natural systems. So adaptive managers need a method by which they can explain and justify their proposals to decision makers and the public. (See the next two sections, which respond to the problem of uncertainty with an "epistemology" of adaptive management.)

There are several strategies for dealing with uncertainty in the uncertain world of management. One approach would be to go through the above list of types of uncertainty and try to address each of these types, providing some intellectually respectable solution or way around the problems presented by each type of uncertainty. I confess that I would not be able to accomplish this task (I doubt that anybody can), so another strategy will be necessary.

One way to begin to understand the experimental attitude developed by the pragmatists and used here as an epistemology of adaptive management is to explore the pragmatists' reasons for rejecting a priori first principles as their bulwark against uncertainty. Pragmatism and adaptive management similarly

represent a rejection of the classical modernist philosophy of science, and with it the epistemological strategy of modern philosophy. At the very heart of modernism, eloquently posed—and inelegantly answered—by Descartes himself, was the question of certainty.

Descartes saw the problem of justifying actions as one of deriving justifications from fixed, unalterable, universal, and indubitable principles. This involved, for Descartes and subsequent rationalists, the articulation of self-evident principles derived from reason alone, followed by the application of these principles in an objective material world, a world that exists independent of human perception and ministrations. Descartes thus posed the apparently unavoidable problem of modernism: how can humans, in their finitude, trust their sensory knowledge of the real world? The question is terribly perplexing because a successful strategy, almost by definition, requires that we somehow perceive the (by hypothesis) unperceivable "reality" that lies beyond experience. How else would we be able to base our beliefs upon it? Since experience was denigrated by the rationalists as a necessarily flawed tool for ascertaining reality, Descartes rested his case on God's existence and veracity. He then based his proof of God's existence on the self-evident premise that every event must have a cause. Descartes's solution, one might say, has proved controversial.

Indeed, the history of modern philosophy since Descartes can be described, not inaccurately, as a series of failed attempts to respond to or avoid Descartes's epistemological question and its implications for action. The great British empiricists, for example, including John Locke, Bishop Berkeley, and David Hume, all struggled in some way to resolve Descartes's problem, as did Immanuel Kant. Centuries of attempts fell short; Descartes's question proved unanswerable, even by the greatest philosophical minds. Pragmatists, however, attacked Descartes's formulation of the question itself, arguing that his comprehensive doubts and appeals to universal truths confound our limited faculty of reason. Reason—pragmatists preferred to speak of "intelligence" and "logic," to avoid any association with rationalism and its problems—is a faculty that evolved within human communities, as a means to solve problems affecting survival of individuals and groups. Doubt occurs in real situations; it is individual and local, and it is encountered in a context in which a person or a group sets out to achieve some objective. Intelligence and logic function in concrete instances of real doubt, rather than at the universal level of systematic doubt, which can only be met with universal principles.

Furthermore, pragmatists reject the Cartesian implication that objectivity consists in a simple relationship between an assertion and some fact in the world. They recognize that ascertaining the truth by associating it with a chunk of reality beyond our experience, as Descartes attempted to do, is im-

possible. Pragmatists therefore seek an alternative means to create confidence in our beliefs and theories; that alternative is to submit them constantly to varied experimental tests. Finally, pragmatists seek objectivity not in relations of correspondence between assertion and unperceived reality, but rather in processes and methods that function within human experience, within, in particular, a community of truth-seekers. Pragmatism, then, represents an important epistemological break with the Western philosophical tradition in that it seeks the truth within everyday, constantly changing reality. Similarly, adaptive managers daily seek the truth without benefit of first principles. Can the pragmatist approach, in response to the pervasive uncertainty that is endemic to environmental problems, provide a sufficiently reliable epistemology for adaptive management?

Leopold, as noted above, absorbed some key pragmatist ideas from Arthur Twining Hadley, but we don't know in detail how much Leopold studied Hadley's ideas or how explicitly he adopted these as a basis for his scientific and managerial work. What we can show is that the ideas Leopold appealed to and used—ideas that have now been embodied in the methods of adaptive managers—emerge from a rich naturalist tradition in American intellectual history. Among other innovations, this tradition provides an alternative conception of truth and objectivity and a different approach to addressing problems of skepticism and uncertainty—by offering a fresh take on doing and learning.

We can begin to appreciate the radical nature of the pragmatists' epistemological departures from the modernist approach to epistemology—and also see how this new approach to epistemological uncertainty provides a useful strategy for adaptive managers—by starting with what is sometimes called the "pragmatic conception of truth." Leopold appealed to this principle, indicating Hadley as his source for it. Referring to Hadley, Leopold quoted the definition "Truth is that which prevails in the long run." As noted in section 2.3, this passage led Leopold directly into a concise but penetrating discussion of an ethic of sustainability based on broad anthropocentrism and the requirement that if we are "logically" anthropocentric, then we must care about the future of our culture and society. Although Leopold credited Hadley, it was C. S. Peirce who most clearly articulated what has come to be referred to as the "pragmatist conception of truth." Representative versions of Peirce's definition are (1) "Truth is that concordance of an abstract statement with the ideal limit towards which endless investigation would tend to bring scientific belief" and (2) truth is "the last result to which the following out of [the experimental] method would ultimately carry us." One reason to examine Peirce's definition, given its "forward-looking" temporal horizon, is that it provides an interesting analogy to problems in defining sustainability. Moreover, Peirce understood

his notion of the search for truth as the defining pursuit of a community of inquirers who start with diverse viewpoints but are carried forward toward the truth "by a force outside of themselves to one and the same conclusion."[10] Surely any acceptable definition of sustainability must embody the idea of a forward-looking community that is normatively respectful of the pursuit, and also the perpetuation, of knowledge; so this approach to truth may be attractive to adaptive managers and advocates of sustainability.

Peirce's definition of truth expresses the philosophy of naturalistic epistemology that was emerging in the nineteenth century as a distinctively American alternative to the traditional philosophies of Europe. In *Walden*, Henry David Thoreau anticipates Peirce's definition of truth: "No face which we can give to a matter will stead us so well at last as the truth. This alone wears well."[11] The naturalism of Thoreau and Peirce addresses the problem of objectivity not in the usual terms of a time-bound relationship between thought and a chunk of the contemporaneous "external" world, but as an intertemporal relationship between present beliefs and future outcomes. Near the end of the explanatory chapter of *Walden,* "Where I Lived, and What I Lived For," Thoreau says: "Let us settle ourselves, and work and wedge our feet downward through the mud and slush of opinion, and prejudice, and tradition and delusion, and appearance, that alluvion which covers the globe, . . . through poetry and philosophy and religion, till we come to a hard bottom and rocks in place, which we can call *reality.*" This passage emphasizes Thoreau's commitment to truth, not just opinion, and also links this idea to an experience-based process, a lifetime—even eternal—pursuit: "If you stand right fronting and face to face to a fact," Thoreau said, "you will see the sun glimmer on both its surfaces, as if it were a cimeter, and feel its sweet edge dividing you through the heart and marrow, and so you will happily conclude your mortal career. Be it life or death, we crave only reality."[12]

Thoreau anticipated two key aspects of the pragmatist's approach to truth and objectivity. Besides anticipating the temporal, forward-looking notion of truth, he also anticipated the idea that the struggle toward truth and objectivity takes place entirely within human experience, as we live, act, and observe within our world. In his journals Thoreau said, "I am not interested in mere phenomena, though it were the explosion of a planet, only as it may have lain in the experience of a human being."[13] Truth is not a matter of correspondence with an external reality.

As noted above, Western philosophy since Aristotle sought truth and objectivity in a correspondence between thought and a reality behind or beyond experience. Thoreau and later the pragmatists challenged the Cartesian dualistic world that separated human experience from the "real" world. For the new naturalists, truth is not a matter of correspondence to an element of real-

ity located outside or beyond experience; it is rather a matter of struggling to separate reliable from unreliable bits of experience by seeking out more and more experience through time.

Thoreau, I believe, placed undue faith in what he called individual "genius," and it was thus left to Peirce to reconstrue the temporal relation more concretely as a *community* process, a process pursued by a very special community of scientific inquirers—the lovers of truth. This community has implicit norms and explicit methods for approximating the truth and can consciously study the "logic" of their enterprise. So I shall follow Peirce, not Thoreau, in construing the process of winnowing through many experiences as a community-based one, which points the way toward a pragmatist, community-based approach to knowledge.

3.4 A Pragmatist Epistemology for Adaptive Management

I have recommended that in order to respond to the pervasive uncertainty plaguing environmental action, adaptive managers explicitly adopt the pragmatist method of experience and that they focus attention on the way expanding experience—especially when experience is fortified with an explicit logic that governs experimentation and careful observation—can eventually reduce uncertainty and result in cooperative action by communities. One might, however, still reasonably ask about the problem of uncertainty in the present: Are there adequate reasons to believe current science can help us to foresee consequences of our actions? And what can scientists, given the uncertainty of many of their research conclusions, contribute to farsighted environmental management? If adaptive management is to be a plausible candidate for a democratic approach to environmental management, and yet we want our policies to be guided by good science, these questions must be answered. Does uncertainty undermine our ability to act decisively to protect people of the future, for example? This question requires in turn a response to the deep epistemological conundrum first articulated by Descartes in the seventeenth century, to the bedevilment of modernists since: If our knowledge is less than certain, how can we act responsibly in an uncertain world?[14]

As a first step in unraveling this complex of problems of uncertainty, we can distinguish between uncertainty as it is experienced within real situations where people face difficult decisions with less information than would be ideal, on the one hand, and the universal skepticism that motivated the Cartesian search for certainty, on the other. Descartes set out to doubt all of his beliefs about the world, limiting himself only to his certain belief that he, a thinking being, existed: "Cogito, ergo Sum." He thus began his heroic attempt to reconstruct knowledge of the world by doubting his senses, relying instead