must acknowledge Molly Mullin: she is my inadvertent muse. And for nurturing my interest in the thoughtful life many years ago, and for continuing to send me lists of all the birds he has seen (602 species at last count), I'd like to thank Jim Edwards, a genuine intellectual and a philosopher in the best sense of the word.

Finally, for listening to me when no one else was available to hear what I had to say, I must thank Rita Barnard. She set me straight on some theoretical issues, gave me the best editorial suggestions I ever expect to hear, kept me company, and made the sandwiches, too. It was only fair that I should have made the coffee.

Preface: Nature, Culture, and Literature in America

"Think like a mountain": the task promises to be a bit tricky for some.

Ferry, *The New Ecological Order*

We assume that the truth about nature is straightforward. Many of us still believe that ecologists can meet our need for a better understanding of natural processes simply by thinking "like a mountain," as Aldo Leopold once urged them and all of us to do. "Only the mountain has lived long enough to listen objectively to the howl of a wolf," Leopold wrote. "Only the ineducable tyro can fail to sense the presence or absence of wolves, or the fact that mountains have a secret opinion about them."[1] Inspirational they may be, but these words understate the difficulty of the thinking we need to do. Luc Ferry is right to suggest that the task Leopold sets us "promises to be a bit tricky," since even the best-educated among us fall short of rocklike objectivity and "can fail to sense the presence or absence of wolves." When it comes to environmental matters, all of us are going to seem like tyros if we measure ourselves by the alpine, inhuman standards of objectivity and sensitivity that Leopold postulates.

In recent decades, increasing numbers of ecologists have realized that knowledge of nature of the sort imagined by Leopold is impossible to acquire, and have suggested that our vision of ecology, and our ideas about and attitudes toward nature, need to be much humbler and a lot more supple than they are. Unfortunately, the humility and suppleness that we need to cultivate seem to be ruled out by the cultural presumptions that shape our thoughts about nature. In the United States, these presumptions give rise to a peculiar contradiction: some of those who still believe that this is nature's nation also believe that humans are alienated from the natural world by virtue of their enculturation, if not simply because of the bare fact of

consciousness. The two beliefs are incompatible: Americans cannot be natural and alien at the same time. And so round and round the mountain we go, trying to sense the presence of wolves and read the mountain's thoughts, yet secretly afraid we won't be able to do either.

We aren't alone, however, in our confused thinking about nature. Many less parochial conceptions of it, widely credited both in the United States and elsewhere, are also too pat, too vague, and more or less contradictory. For example, ecological research has shown that the ideas that nature seeks to establish balance and harmony and that everything in nature is interconnected are no better than platitudes. Ideas like these are belied by the natural world's tendency to chaos, competition, and continual evolution. Nonetheless, thoughtful and sensitive people, including many American environmentalists and Deep Ecologists, as well as Greens in other countries, still cherish the ideas of balance, harmony, and interconnectedness, and believe that the science of ecology has verified their truth.

Over the course of this book I will address misconceptions of and about both nature and ecology in a number of different contexts, though most often in the context of American literature and literary study. I focus on some attitudes toward nature long regarded as foundational to American culture, attitudes which can be traced back to Emerson and Thoreau, and still more distantly, to Crèvecoeur and Jefferson. My concern, however, is not with the development of these attitudes historically; in fact, I ignore Crèvecoeur and Jefferson altogether. And I have only a few things to say about Emerson and Thoreau, and say them more or less coincidentally, in connection with recent scholarly attempts to provide a genealogy for American nature writing that is rooted in transcendentalist thought. I am going to consider these attempts under the rubric of "ecocriticism," though I think this neologism is just as troublesome as it is helpful. Thus far it has been used to designate "a practice which is necessary," considering the growing importance of environmental issues, and yet "not accurate or coherent," as one British ecocritic has put it.[2]

While I have taken into account a number of issues and have covered a lot of ground in *The Truth of Ecology*, this book isn't meant to be a survey in the usual sense of the term. It doesn't pretend to be exhaustive, for one thing, and it is frankly argumentative for another; nor is it concerned to focus attention on and help create a canon of environmental literature. While writing it, I found myself less interested in establishing lines of descent and zones of influence, and more interested in calling things of that sort into question, especially as they have come to be regarded in ecocriticism. I also found myself concerned less with determining the true historical provenance of American attitudes toward nature than with the issue of whether these attitudes have shaped and continue to shape our thoughts about nature for good or for ill. By "our thoughts" I mean the thoughts of Americans in general, of American writers and critics, especially ecocritics, in particular, and of anyone else who might be interested in the motley interactions of nature and culture in relation to environmentalism.

To put the point another way, though much of the subject matter of *The Truth of Ecology* is American, its perspective is cosmopolitan and comparative, and it refuses to take the value of canons and canyons for granted, no matter how grand they may seem. While strictly speaking this book may be neither very cosmopolitan nor especially comparative, given its almost exclusive focus on American texts, in writing it I pursued a deliberate strategy of estrangement by adopting something like the distanced or comparatist's perspective described by Ursula Heise in her contribution to a recent forum on ecocriticism.[3] I also found myself relying (though not exclusively) on the insights of non-American critics, literary theorists, and philosophers at key junctures in my arguments, insights that on the whole tend to be more skeptical than otherwise. I believe that a skeptical approach to the culture of nature in America is both fully warranted and long overdue (skepticism about nature itself we have had already and in overabundance). As the environmental historian Richard White has noted, "Americans are constantly discovering nature, and through it, or so they think, themselves. But what they discover and how they discover it are hardly simple matters."[4]

The Truth of Ecology attempts to rediscover, to complicate, and hence to redefine ecocriticism, where despite the relative newness of the field, or perhaps precisely because of it, some creaky old traditions have found refuge and are giving off an odor of moldy fig, which is not the sort of green ambience ecocriticism ought to have. The first generation of ecocritics has embraced a curatorial model of literary scholarship and has spurned literary theory, apparently without having reaped the benefits of its close acquaintance. This has made ecocriticism seem overly devotional, and hostile to the intellect at times. And though the field has been described as an interdisciplinary one, ecocriticism has been lamentably under-informed by science studies, philosophy of science, environmental history, and ecology, subjects ecocritics cannot afford to ignore for reasons that should be obvious.

So far most of ecocriticism's efforts at being interdisciplinary have been limited to troping on a vocabulary borrowed from ecology, a limitation which is perhaps only to be expected given the traditional and quite belletristic conception of literature held by many ecocritics. It seems to me that to be interdisciplinary is to be plunged into the kind of uncertainty that calls traditional approaches like belletrism into question and creates a crisis, as Roland Barthes suggested some years ago, when the term first became fashionable. He wrote: "The *interdisciplinarity* which is today held up as a prime value in research cannot be accomplished by the simple confrontation of specialist branches of knowledge. Interdisciplinarity is not the calm of an easy security; it begins *effectively* (as opposed to the mere expression of a pious wish) when the solidarity of the old disciplines breaks down."[5]

With Barthes's observation in mind, I've argued in the first two thirds of this book that a satisfactory account of literature's relation to nature and culture can only be offered from a theoretically adventurous and conscientiously interdisciplinary perspective. In its last third, I've provided some examples of what ecocriticism writ-

ten from such a hard-won perspective might be like. In order to adequately address the most complex issues in ecocriticism, or rather in order to complicate the issues ecocritics face to the degree I think is needful, I must first review the history and current state of play in several fields of inquiry, principally ecology, science studies, and ecocriticism itself, with brief forays along the way into recondite subjects like evolutionary and cognitive theory, the history and philosophy of science, pragmatism, neopragmatism, semiotics, cultural studies, postmodernism, and poststructuralism, though with regard to the last items on this list I tread as lightly as I can to avoid setting off alarms and spending too much time lingering over ploughed ground. The need, as I see it, to broach all these topics means that the possibilities and pitfalls of thinking about nature and culture, in a space carved out (or more likely, left open) between disciplines not necessarily compatible with one another, is a central issue of this book.

Ambiguous spaces—desert wastes, barren shores, howling wildernesses—are said to inspire revelations, but interpreting revelations requires us to be as circumspect as possible, even if that means retreating behind closed doors so that we can mull things over in deep abstraction and giving free reign to our powers of doubt. It is interesting to learn, for example, that issues raised by its tendency to fall back on prophetic or literary means of suasion have been recurrent in the history of ecology, where an over-reliance on analogy and metaphor has posed an obstacle to the advance of theory and research. That it must struggle with rhetorical issues would seem to link ecology's misfortunes with troubles of a sort familiar to students of the humanities. They may feel tempted—and have been—to assert that improving our representations of nature and understanding the nature of representation are two aspects of a single philosophical enterprise, and that ecology is therefore on its way to being something literary and literature on its way to being something ecological (it just needs to be given a nudge in the right direction). To make these assertions is to indulge in lazy thinking: in many respects, the vagaries of ecological research and theory and those of literary and cultural studies are not in the least homologous, and it is important to recognize this dissimilarity. If we do, we will have to disagree with the British ecocritic Jonathan Bate when he writes, "Locked in the prison-house of language, dwelling in the *logos* not the *oikos*, we know only the text, not the land. Unless, that is, we could come to understand that every piece of land is itself a text with its own syntax and signifying potential."[6] In point of fact, ecology offers no support whatsoever for the view, very tempting to a literary critic, that "every piece of land is itself a text." Our motto, when it comes to judging these matters, should be Nietzsche's: "Seeing things as similar and making them the same is the mark of weak eyes."[7]

However skeptical this book may be about the importance of questions having to do with the vitality of our representations, questions that a number of ecocritics have thought it essential to ask, by no means does it embrace the proposition that nature is socially constructed because our knowledge is solely representational (and hence mostly unreliable). However attractive it may be when put to use polemically and deftly applied, which is a lot easier to do in some contexts than in others, as dogma the proposition that nature is socially constructed seems to me either nonsensical (patently false when applied broadly and by rote) or trivial (sometimes true, but in a sense which should prompt us to ask, "But so what?"). I think it is precisely as dogma that the theory of social construction has tended to function most of the time, except of course for those occasions when it has functioned merely as a fount of jargon.

I feel supported in my thoughts on this subject by the philosopher Ian Hacking, who writes, "Social construction has in many contexts been a truly liberating idea, but that which on first hearing has liberated some has made all too many others smug, comfortable, and trendy in ways that have become merely orthodox. The phrase has become code." Doctrinaire social constructionist arguments, Hacking says, are "dull—in both senses of that word, boring and blunted." They reduce the idea of social construction to "a dead metaphor."[8] One can see the potential for orthodoxy, dullness, and dead metaphor, and for triviality, too, in the carefully qualified statement that David Bloor makes about mathematics in his 1976 book *Knowledge and Social Imagery*, an important theoretical source for many social constructionists with an interest in science: "Such a statement sounds very odd, but if mathematics is about number and its relations and if these are social creations and conventions then, indeed, mathematics is about something social. In an indirect sense it therefore is 'about' society."[9] Not only does this sound odd, it also sounds empty.

Despite my lack of faith in the doctrine of social construction as a positive program for the understanding and interpretation of, say, mathematics, I do think that the doctrine can be useful polemically. There are brands of social construction that, if draughts of them are taken in the right measure and somewhat watered down, can help prevent and may even cure certain kinds of naiveté: some versions of realism, for example, though not all versions of it, and certainly not all versions of scientific realism, as devotees of strict social construction have claimed. Its embrace of (a version of) scientific realism notwithstanding, if this book expresses a single conviction most ardently, it is that the success of our efforts to discover whatever we can about the ecological character of the natural world does not hinge on the right representation of nature. And this means that satisfying our desire to value the natural world differently and more dearly than we do need not be thought to depend on the success of forms of representation that are both accurate and artful, and hence realistic in the literary sense of the term, *as opposed to* the scientific.

That satisfying our desire to value the natural world is so dependent has been one of the most frequent claims made to date by ecocritics. It assumes the ability of literature, in particular so-called nature writing, to go science one better by representing nature both with precision and with no sacrifice of literary quality, thereby heightening our perception of the natural world aesthetically while moving us to

greater environmental awareness and involvement, perhaps even revolutionizing our culture in the process. This claim about realism is being made by many ecocritics from what already can be described as an orthodox point of view (never mind all the talk of revolution), and it is based in large part on mistaken ideas about the antirealistic character of literary theory, for which a number of ecocritics have expressed considerable scorn. It is also based on mistaken ideas about ecology, which doesn't offer the support for their faith in realism that these ecocritics have assumed it does. In large part, their mistaken faith in realism results from their having taken popular ecological assumptions for granted. The environmental historian William Cronon writes: "Popular concern about the environment often implicitly appeals to a kind of naïve realism for its intellectual foundation, more or less assuming that we can pretty easily recognize nature when we see it and thereby make uncomplicated choices between natural things, which are good, and unnatural things, which are bad."[10] If the history of ecology teaches us anything, it teaches us that nature isn't so easily recognized.

In order to prepare for the trek across the larger cultural and philosophical landscapes this book traverses, I need to describe those landscapes and the theoretical gear that exploring them requires. Yet despite the metaphor I've just used, I should emphasize, before moving on to the debriefing conducted in chapter one, that I don't think the interdisciplinary study of nature, culture, and literature—or, in short, ecocriticism—will become convincingly theoretical simply by carrying a heavier toolbox, and by training itself to use the tools in that box in the approved manner and more ergonomically. Theories may or may not be like tools. To the extent that they are, their efficacy when we use them to perform the interpretive tasks for which they are designed may be less interesting than their usefulness when we need something handy to jimmy open a stuck concept or break up the hardpan of fixed opinion. I take it that this is why Nietzsche urged us to philosophize with a hammer.

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The imperfect is our paradise.
Note that, in this bitterness, delight.
Since the imperfect is so hot in us,
Lies in flawed words and stubborn sounds.

Wallace Stevens, "The Poems of Our Climate"

Though I personally would be satisfied to spend the whole of eternity gazing at a blue hill or a butterfly, I would feel the poorer if I accepted the idea of there not existing still more vivid means of knowing butterflies and hills.

Vladimir Nabokov, "Prof. Woodbridge in an Essay on Nature Postulates the Reality of the World"

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Michel Serres, The Natural Contract

1

Expostulations and Replies

Books! 'tis a dull and endless strife:
Come, hear the woodland linnet,
How sweet his music! on my life,
There's more of wisdom in it.

And hark! how blithe the throstle sings!
He, too, is no mean preacher:
Come forth into the light of things,
Let Nature be your teacher.

William Wordsworth,
"Expostulation and Reply"

The World, the Text, and the Ecocritic

Because American ecocriticism, as a movement, is only about a dozen years old, generalizations about it are hard to make and still harder to validate.[1] So I want to begin, not by describing the principles and practices of ecocriticism in any detail (in fact, that is something I want to delay, especially as regards the practices, until chapter four), but by looking at what seems to be, for many of its adherents, ecocriticism's moment of origin, which is threefold in its implications. This moment takes the form of an epiphany: of a discovery, or a renewal, of faith in all things green, just as the bewildered ecocritic emerges from the vale of all things black and white. The ecocritic's epiphany seems to make the newly enlightened student of literature and culture feel a lot better, at least for a moment, but it is actually an ambivalent experience and soon gives rise to a corrosive negativity. As interpreted by those who claim to have had it—and to judge from the evidence presented so far—the ecocritic's epiphany can be summed up by the propositions (1) that nature, which is refreshingly simple, is good; and (2) that culture, which is tiresomely convoluted, is bad; or (3) at least not so good as nature. And insofar as the ecocritic's epiphany inspires such thoughts, its implications are largely reactionary. This becomes increasingly clear as soon as one begins to view ecocriticism's moment of origin in its broader cultural and intellectual context (as I will do, more or less systematically, in the second half of this chapter).

The following passage, which I quote from Frank Stewart's book *A Natural History of Nature Writing*, can stand as a fair example of the more or less embittered way in which ecocritics interpret their epiphanies and begin their new careers as academic Jeremiahs and John Muirs:

> On a morning several summers ago, as I glanced up from researching the postmodern poets and critics, through the narrow window above my head I saw that the brightening dawn had made my reading lamp unnecessary. A pale mist hung like a veil over the deep meadow outside, and the violet morning colors were tinting the ends of the long grasses.

Unlike Zarathustra, the author of this passage does not emerge at dawn after a restful, strength-restoring sleep. This nascent ecocritic has been up early wrestling with abstruse, difficult texts, and once he has seen the light of day and the Wordsworthian "light of things," these "postmodern" texts will figure not as part of the solution, nor as part of the problem, but quite simply as *the* problem he must resolve or, in a concession of defeat, push to one side. Only then can he answer the beckoning call of morning mists and tinted grasses, having decided that "literary theorists and academics" tend to "distance the humanities and the literary arts from the natural world outside their offices," something he no longer wishes to do.[2]

Not that resisting the temptation to theorize is going to be as simple a matter as getting up and walking outdoors into the sunshine: the coils of culture, ecocritics like to remind themselves, are not to be shuffled off with an easy shrug. As Stewart puts it, "What we always see when we look at nature is our own eyes looking back at us, filtering and altering what we choose to perceive, what we emphasize or ignore, what questions we ask and pursue."[3] Thus the ecocritic's epiphany initiates a process of reflection (of an implicitly and ironically theoretical character), which seems to give the pursuit of the ecocritical vision a certain moral and philosophical grandeur.

A crisis of conscience and of consciousness similar to Stewart's is described in many of the ecocritical essays and monographs published since the late 1980s. This suggests that for ecocritics, invoking their epiphanies has become a ritual by means of which they can display their professional bona fides and, at the same time, register their critical opinions not only of literature and culture but of the academy, too. Quite possibly this ritual has become a signature feature setting ecocriticism apart as a minor genre all its own: much that calls itself ecocriticism may strike outsiders as having more in common with the personal essay than with literary and cultural criticism as currently practiced in the academy, and for the good reason that escape from academic constraints is one of ecocriticism's central themes. For instance, the ecocritic Patrick Murphy writes: "One day, while I was attending a seminar on Menippéan satire, the whole literary-criticism game became transparently irrelevant to events in the world." It was many years, he says, before his realization of the

irrelevancy of "the whole literary-criticism game" got cashed out in the form of ecocriticism.[4] Another ecocritic, SueEllen Campbell, reports feeling pulled in different directions by her attraction to theory on the one hand, and to narratives of wilderness adventure and nature writing on the other. She claims to have reconciled the two kinds of texts by pursuing a vigorous program of reading—and an equally vigorous program of backcountry hiking in the Colorado Rockies.[5]

That the ritual invocation of the moment of epiphany is centrally important to ecocriticism is also borne out by the work of Lawrence Buell, who since the publication of his book *The Environmental Imagination* in 1995 has emerged as a de facto spokesman for the movement. Like Stewart and many others, Buell argues that engrained mental habits and the forces of institutional inertia must be overcome before an ecocritic can kick free of the shackles of academic training and university life. Otherwise the longed-for epiphany may not occur, or when it does occur, it may have a decidedly bookish flavor—as it does when, describing a dawning of insight similar to the one described in the passage from Stewart's book that I quoted above, yet different from it in distinctive ways, Buell writes:

> The grove of second-growth white pines that sway at this moment of writing, with their blue-yellow-green five-needle clusters above spiky circles of atrophied lower limbs, along a brown needle-strewn ridge of shale forty feet from my computer screen—this grove can be found in the pages of American literature also, but it is not the woods imagined by American criticism.[6]

As this passage illustrates, odd wrinkles tend to creep into the fabric of the quintessential ecocritical experience, which isn't as decisive as ecocritics would like it to be. Here we are not confronted with a (relatively) clear-cut distinction between text and world—between postmodern poetry and criticism lit by electric lamplight, and pale mist and grasses illuminated by the morning sun. Instead, Buell presents us with a scenario in which an exemplary grove of white pines does not stand juxtaposed with and in indictment of the diminished and diminishing world of words, but is said to be in two places at once: forty feet from a computer screen, and "in the pages of American literature," where literary critics have ignored it, culpably so.

Several pages earlier, anticipating the charge of negligence he is about to lodge against his fellow critics, Buell writes: "When an author undertakes to imagine someone else's imagination of a tree while sitting, Bartleby-like, in a cubicle with no view, small wonder if the tree seems to be nothing more than a textual function and one comes to doubt that the author could have fancied otherwise."[7] Well, small wonder indeed, or so it seems to me, since this view of the tree, which in this case is without doubt a purely imaginary entity ("someone else's imagination of a tree"), is an eminently commonsensical one. The scenario Buell has sketched, both here and in the first passage I quoted, is much less scandalous than he seems to think it is, if it is scandalous at all.

I suspect that what really concerns Buell and his fellow ecocritics is the architecture and the interior design of the contemporary academy, where many of the rooms afford their tenants impoverished views of the extramural world. Ecocriticism has been eager to redirect its gaze toward this world, and understandably so. But its practitioners have been hasty in formulating their arguments about what it takes to shift the focus of our gaze, both individually and collectively, especially where the specifics of literary criticism and literary theory are concerned. The questions we need to ask of them, and of ecocriticism as a movement, with regard to those specifics, are these: We know you told us that it's a window, but isn't that actually a looking glass hanging there on your wall? Couldn't that explain why, when you try to look through it, what you see are your own eyes looking back at you, just as one of you (Stewart) has admitted?

To get a sense of the difficulties ecocritics will have when they try to answer these questions, it will help if we return to Buell's description of the vista he enjoys (as one of the lucky few) from his workstation. As I've suggested, the epiphany of the second-growth white pines is an odd one: in it, the pines figure as guidebook-perfect exemplars of their species. This is an impressive feat, given the vagaries of a pine tree's life in the open air and given the appearance of these particular pines "at this moment of writing," just when an apt illustration of the point being pressed is needed. Rhetorically, these are very convenient and uncannily obliging pines, "with their blue-yellow-green five-needle clusters above spiky circles of atrophied lower limbs." Most uncanny of all, I think, is their dual citizenship as inhabitants of the "brown needle-strewn ridge of shale" and of the pages of American literature. They are the ultimate screen saver for the writer eager to chastise his fellow critics, and fellow authors of criticism, for imagining that trees can serve literature only in the guise of textual functions.

Yet textual functions, in the form of words or phrases postulating an imaginary object, describing an imaginary setting, or suggesting a vaguely personified imaginary entity (such as the woods that we encounter in fairy tales), is surely what trees must be, and can only be, insofar as they figure "in the pages of American literature." It seems not so much naïve as occult to suppose otherwise. I wonder how we should regard trees that are *in literature* as something other than textual functions: I wonder what species of trees they might be, and by what right they will have acquired their unusual standing. Is Buell merely making a claim about the power of description or does he have something more iconic, or metaphorical and symbolic, in mind?

Given how his argument develops over the course of *The Environmental Imagination*, Buell seems to want there to be a relationship between trees in literature and trees in the world closer than a relationship of mere semblance would be, whether that semblance is descriptive, iconic, or metaphorical and symbolic. Such, at least, is the trend of his rhetoric, which throughout his book reveals an inchoate and perhaps not fully conscious desire for a literature of presence. This desire isn't nostalgic,

since in truth it is a desire for a literature the likes of which we've never seen before, however much it may have been intimated in the works of writers like Thoreau (whose admiration for white pines was unparalleled). If I follow Buell's arguments, this literature would be "environmental." It would evoke "the natural world through verbal surrogates," and would thereby attempt "to bond the reader to the world as well as to discourse." Most remarkably, it would enable the reader "to see as a seal might see."[8] But why environmental literature should be deputized to make the presence and reality of the natural world available to us by proxy, when that world lies waiting to be explored by bookworms and bold adventurers alike, is a question insufficiently mooted in *The Environmental Imagination*, and in ecocriticism generally speaking. Devoting our time and energy to the perusal of environmental literature would seem to be a roundabout way for us to secure a bond with the earth: it's as if we should spend our time poring over the personal ads, instead of striking up a conversation with the lonely heart next door.

In raising these questions about the status of trees and of the world in literature, questions about *mimesis* (and Buell does insist on using that term), I am broaching what has been a pivotal issue in American ecocriticism, one I would like to lay to rest, if I can, over the course of this book.[9] But first I should make my own position as clear as possible, since it is apt to be misunderstood: I am a sort of agnostic. I think we need to cure ecocriticism of its fundamentalist fixation on literal representation, and shift its focus away from the epistemological to the pragmatic. For a garden-variety pragmatist of the sort I think ecocritics ought to be, to assert the imaginary status of the things we find depicted in literature raises no issues of belief or of professional relevance. It's something we can do without positing anything controversial about either the world or the text, most especially the text, which if it is literary must be imaginative by definition and well-established convention. Otherwise the garden-variety pragmatist is perfectly happy to take the representational powers of language for granted, much in the same carefree way that the force of gravity is taken for granted. Not that the garden-variety pragmatist would deny that there are important questions to be asked about representation and gravity once we depart from the workaday realm of common sense: that's something we are compelled to do sometimes, if we happen to be literary critics, philosophers, physicists, or rocket scientists, who can't always be insouciant about such matters for professional reasons.

While lodging its complaints about the limitations of literary study, ecocriticism has regularly gone well beyond the realm of the plausible in its declarations about what literature can and ought to do. It needs to be reminded that the difficulty of making a case for mimetic representation is not solely a freakish by-product of the strange weather of recent academic debate over the latest theories: in certain quarters, mimetic representation has been regarded as a dubious idea all along. In a 1980 essay on the supposed "crisis of representation" in contemporary culture, Umberto Eco writes:

> Even assuming that whoever speaks of it has a definition of representation (which is often not the case), if I rightly understand what they're saying—namely that we are unable to construct and exchange images of the world that are certainly apt to convey the form, if there is one, of this world—it seems to me that the definition of this crisis began with Parmenides, continued with Gorgias, caused Descartes no small amount of concern, made things awkward for everyone thanks to Berkeley and Hume, and so on, down to phenomenology. . . . Those who rediscover the crisis of representation today seem to have charmingly vague ideas about the continuity of this discussion.[10]

With the continuity Eco describes in mind, I think we are entitled to ask just how viable ecocriticism's rehabilitation of mimesis is likely to be. It may be possible to qualify the idea of representation-of-things-just-as-they-are so as to make it seem at least reasonable (as Eco argues). Then we might buy into the idea but at a steep discount, recognizing the relative efficacy of language in depicting some parts or even the whole of the world, in response to specific and clearly articulated needs—ordering lunch, for instance, or planning the launch of a mission to Mars. Should we choose to do this, however, we will have to gut the idea of mimesis of most of its content, consigning the strict sense of the term to the history of philosophy, which is where it belongs. As a result, mimesis will come to seem devoid of literary interest, and we will have gained nothing, except perhaps for a short-lived peace of mind and a meaningless rearrangement of our definitions.

I think this is precisely the quandary ecocriticism has put itself in with regard to mimesis, or the representation-of-things-just-as-they-are. Realistic depiction of the world, of the sort that we can credit as reasonable and uncontroversial, is one of literature's more pedestrian, least artful aspects. It comprises, for example, such basics of technique as description. Those who are sticklers for precision and conversant with the long traditions of literary theory and philosophy can see no good reason why we should use a highly contested and highly charged word like "mimesis" to talk about matter-of-fact depiction of the descriptive sort, since doing so raises hackles and inspires distrust. To these sticklers, the issue of mimesis simply does not seem to be a live one. And ironically enough, ecocritics do acknowledge that this is, in fact, a closed file whenever they describe ecocriticism as a revival of mimesis and a counterinsurgency. The romantic appeal of opening a closed file is difficult for others to see.

To make the assertions I've just made is to slight neither art nor the world, though it may suggest that literary criticism still needs to be brought to heel. Consider, by way of illustration of my argument, a case of "dual citizenship" that I think is parallel to the one described by Buell, even if in formulating it I have stacked the deck differently than he has, and even if I am dealing from the bottom of the deck, where things become more obviously fictional and where there are, perhaps, fewer trees. An expatriate American in Paris is an expatriate American in Paris, but if his

name happens to be "Jake Barnes," he won't need a visa, a passport, and a birth certificate in order to establish his true national identity. He won't have one, however rounded his character may seem to Hemingway's readers, because identities are things had only *in the world*, a place where the preposition at issue ("in") seems unproblematic. By the same token, I think it is obvious that trees can never be, as Buell insists they are, *in literature*, and least of all *in a novel*, however much they may be "in" it figuratively and even if it is true that because books are made from paper, and paper from pulpwood, trees are in our books (and thus make up the sort of content more suited to chemical than literary analysis).

To insist that trees must be present *in literature*, just because they happen to be mentioned and described or even celebrated there, seems hostile to the very possibility of imagination, which pays its dividends in the coin of figuration, not representation. And to persist in thinking that trees might somehow be present in literature after all, despite the strictures of recent literary theory (and at least two thousand years of philosophy), is uncritical and, worse, hostile to criticism. If we cannot be imaginative, and we cannot be critical, then our only alternative, a poor one, is to be cryptic. Or sentimental, in a Joyce Kilmer-like way: as the reader may have surmised, the poet and author of "Trees" is one of the shadowy figures lurking in the background of this discussion. Another of those shadowy figures is the linguist Ferdinand de Saussure, who drilled his students in the arbitrariness of the sign and thereby helped to found much of what is now thought of as literary theory. It's a nice coincidence that Saussure's key example of the arbitrariness of the sign just happens to be the French word for tree (*le arbre*).

The critic and theorist who has put Saussure's linguistics to the most interesting use may be Roland Barthes, who in his essay "Myth Today" explains the concept of the arbitrariness of the sign as follows: "Nothing compels the acoustic image *tree* 'naturally' to mean the concept *tree*: the sign, here, is unmotivated." And in a passage even more directly relevant to the present discussion, Barthes writes:

> Every object in the world can pass from a closed, silent existence to an oral state, open to appropriation by society, for there is no law, whether natural or not, which forbids talking about things. A tree is a tree. Yes, of course. But a tree as expressed . . . is no longer quite a tree, it is a tree which is decorated, adapted to a certain type of consumption, laden with literary self-indulgence, revolt, images, in short with a type of social *usage* which is added to pure matter.

Viewed in Barthes's terms, Buell's suggestion that trees can occur *in literature* as something more vital than textual functions must be regarded as an attempt to supply a motivation for literary trees other than a social one. To attempt something like this, Barthes says, is the essential technique of ideology. He writes: "The passage from the real," by which he means the socially real, "to the ideological is defined as that from an *anti-physis* to a *pseudo-physis*." The latter is precisely the hallucinatory

stuff that trees-in-literature would have to be made of (if, that is, they are not so to speak "made of" images, ideas, concepts, and the like, as I am arguing they must be). The logic of the passage from social reality to ideology (or to myth) is, Barthes says, tautological, as when one righteously insists, "A tree is a tree," and means by that to include the tree even "as expressed." "Tautology is a faint at the right moment, a saving aphasia, it is," Barthes writes, "the indignant 'representation' of the *rights* of reality over and above language," and it "testifies to a profound distrust of language."[11] Barthes's point isn't that a critic should have no distrust of language whatsoever, but rather that this distrust should not be so extreme as to make the critic impatient with and dismissive of the niceties of language, oral or written, in particular those niceties having to do with verbal reference to things in the world. The critic needs to bear in mind a point that Barthes makes in his essay on "The Death of the Author," a point consistent with the arguments about the representational function of language often made by pragmatists: "As soon as a fact is *narrated* no longer with a view to acting directly on reality but intransitively, that is to say, finally outside of any function other than that of the very practice of the symbol itself, this disconnection occurs, the voice loses its origin, the author enters into his own death, writing begins."[12]

Clearly, only the kind of author who is also a critic and for whom writing truly never seems to end, so that it constitutes a sort of living death (here I speak advisedly), would spend time trying "to imagine someone else's imagination of a tree," to recall Buell's sketch of the critic's way of life. To spend time in this fashion already seems wasteful enough to those who think our turf ought to be literally turf, and who disapprove of the critic's lifestyle. This lifestyle dictates a daily return to the desk in much the same way that the vampire's ghoulish condition dictates a return, each dawn and for all eternity, to the coffin. I see no good reason to indict the odd-ball activity of criticism still further, on the additional grounds of its somehow being a slight to those splendid trees growing on that ridgeline over yonder—about which criticism probably has nothing pertinent to say, condemned as it is to approach to the world crabwise and confining itself to the shadows of print.

Confusing actual and fictional trees, or trying to conflate them (however rhetorically and provisionally), would seem to be a primitive error, both in the sense of its being the sort of error that perpetuates myth (or ideology) and in the sense that it occurs at a level of such fundamental philosophical importance as to lead anyone who makes it astray, sooner rather than later. In short, it is a critical error. To cite yet another observation made by Barthes, it overlooks the fact that while "the work is a fragment of substance, occupying a part of the space of books (in a library for example), the Text is a methodological field." It is "held in language," not "in the hand."[13]

Ecocriticism has been staunch in its refusal to view the text in this light. Buell insists that "to posit a disjunction between text and world is both an indispensable starting point for mature literary understanding and a move that tends to efface the world."[14] Frankly, I don't see how the second of these assertions follows at all from the first: the world isn't so easily effaced, unless one has very little faith in it to begin with. I think asserting that the text somehow contains the world or some selected portion of it is "a move that tends to efface the world," portion and all, albeit only *imaginatively*, and not *really*.[15] I can see no reason why the ecocritic should be filled with a burning desire to save the text before the world: texts are disposable, whereas the world is not. And I can see every reason why the ecocritic needs to have a perspicuous sense of the difference between words and things, if only to keep from bumping into the latter unexpectedly. To approach either text or world without a sense of this difference is to attempt the view through the looking glass, and we all know what you are going to see when you attempt this view. That is why the ecocritic's epiphany is more self-revelatory than revelatory of the world: the world, that is, of both words and things.

The Pastoral Is Another Country

Cause I was born in the country
She thinks I'm easy to know
Richard Brown,
"James Alley Blues"

What actually seems to be at issue in ecocriticism inspired by epiphanies about the paucity of the "postmodern" text, ecocriticism of the would-be realist variety, is something that the nature writer Barry Lopez has identified as the "interior landscape." In other words, the dynamic of such ecocriticism is, as I've already hinted, more personal than professional, since you don't have to be a geographer or an ecologist to develop what Lopez thinks of as a rich interior landscape. Though if you are neither of those things, it's going to be very difficult for you to grasp the subtleties that Lopez believes are crucially important. He writes: "I think of two landscapes—one outside the self, the other within. The external landscape is the one we see—not only the line and color of the land and its shading at different times of the day, but also its plants and animals in season, its weather, its geology, the record of its climate and evolution." The second landscape, Lopez argues, "is an interior one, a kind of projection within a person of a part of the exterior landscape." It "responds to the character and subtlety of an exterior landscape; the shape of the individual is affected by land as it is by genes."[16]

I have no wish to deny the rich inner lives of those attracted either to ecocriticism or to nature writing like Lopez's. But I can think of no compelling reason to accept the premise that we must establish and maintain firm connections between our inner and outer worlds, which is to say, in the final analysis, connections of likeness between those worlds, with likeness understood or rather misunderstood as identity. Granted, forging such connections might enable us (and I emphasize, *might*) to

go a considerable distance toward ensuring that culture becomes more like nature, and hence less "bad," than it now seems to be, at least in the eyes of those observers who, rightly or wrongly, are disenchanted with the current status quo. But as humans, we just don't have the "kinds of minds" that would permit us to make our culture more "like" nature than it already is. As the philosopher Daniel Dennett has argued, "We must be very careful not to think of the inner environment of a Popperian creature" (a creature capable of formulating hypotheses about or, unhappy usage, "representations of" the "external" world) "as simply a replica of the outer world, with all the physical contingencies of that world reproduced. In such a miraculous toy world, the little hot stove in your head would be hot enough to actually burn the little finger in your head that you placed on it!" As with minds, so with texts, those prosthetic extensions of our minds in which we higher "informavores" offload all the stuff we would find it too cumbersome to carry around with us inside our heads, such as warnings about hot stoves, or information about trees and landscapes: about all those things which, taken in sum, add up to our environment.[17]

To be fair to Lopez, he doesn't say that the interior landscape corresponds to the exterior, but that the interior landscape should respond to, must be responsive to, the exterior. Does this not drive a wedge between his point and the point that I am making by citing Dennett? If so, it is the thinnest of wedges. How well it holds up depends on the construction one puts on Lopez's emphasis on "perceiving the relationships" in the exterior landscape.[18] What degree of abstraction is such a perception meant to have: is it a matter of theoretical insight, or is it more of a direct apprehension and reproduction in the mind of what Dennett calls "physical contingencies"? Just what kind of perception is it, exactly? This question, or one like it, has been important for ecocriticism, and not coincidentally ecocritics have found Lopez's ideas about landscape and narrative attractive.[19]

Unfortunately, Lopez himself makes it very clear that he thinks of "perceiving the relationships" in a given landscape as a simple matter of apprehending its many physical contingencies and storing them inside one's head and heart. He writes:

> If you walk up, say, a dry arroyo in the Sonoran Desert you will feel a mounding and rolling of sand and silt beneath your feet that is distinctive. You will anticipate the crumbling of the sedimentary earth in the arroyo bank as your hand reaches out, and in that tangible evidence you will sense a history of water in the region. Perhaps a black-throated sparrow lands in a paloverde bush—the resiliency of the twig under the bird, that precise shade of yellowish-green against the milk-blue sky, the fluttering whir of the arriving sparrow, are what I mean by "the landscape."[20]

For Lopez, a landscape is something much more immediate and more discrete than the term usually implies: he focuses on the painter's individual brush strokes, as it were, rather than on the completed canvas. Thus his use of the word "landscape" seems to reverse its meaning as a term of art. "Landscape" usually implies thoroughgoing composition on the part of an observer, and as a rule, landscapes do not encompass tactile or auditory phenomena (like the feel of sand beneath one's feet or the flutter of a bird's wings), only visual ones (like the yellowish green of paloverde against the milk-blue sky). I think Lopez's use of the word "narrative" is equally eccentric. By "narrative," he seems to mean description: the depiction and perhaps even the reproduction in a text of the relationships, or in Dennett's phrase the physical contingencies, which make up an environment. And the word "narrative," like the word "landscape," also implies thoroughgoing composition on the part of an observer.

Narrative for Lopez is always best when delivered in oral form, but his treatment of storytelling also privileges description. "Landscape and Narrative," the essay from which I've been quoting, begins with Lopez's recollection of an evening he spent in Alaska's Brooks Range, listening to Nunamiut hunters telling stories about their experiences with wolverines. When the evening was over, Lopez stepped outside and into the landscape, which, he says, "seemed alive because of the stories. It was precisely these ocherous tones, this kind of willow, exactly this austerity that had informed the wolverine narratives." However, at the essay's conclusion, he does suggest a less factual, more imaginative model of narrative's power to engage us. "The interior landscape is a metaphorical representation of the exterior landscape," he writes; "the truth reveals itself most fully not in dogma but in the paradox, irony, and contradictions that distinguish compelling narratives."[21] Obviously there is a tension, unresolved in his essay, between Lopez's treatment of narrative as a precise and authoritative means of representing "ocherous tones" and willow trees, and his treatment of it as a metaphorical means of representing a landscape that leaves space for paradox, irony, and contradiction. However, Lopez leans much more toward the former treatment than the latter—so much so that his use of the adjective "metaphorical" at the end of his essay may be specious.

But whether you plan to do so literally or metaphorically, in order to apprehend the landscape as Lopez characterizes it, you must be armed in advance with some theoretical insights, such as an understanding of the relationship between sedimentation and hydrological cycles. If you aren't provided with insights of that sort, it will be impossible for you to "sense a history of water in the region." Nor will you be able to "see" the region's geology, or "the record of its climate and evolution," without a fair amount of tuition in those difficult subjects. What needs to be remembered with regard to our perception of such things is that much of the evidence for what we now call geology and evolution lay scattered about the earth's surface in plain sight long before anyone was able to see it, and describe it, for what it was, which suggests that narratives come before apprehensions and descriptions, just as hypotheses come before representations and are methodologically distinct from them.

I realize that the assertion that narratives come before apprehensions and descriptions, and that hypotheses come before representations, will strike some read-

ers as a very bold assertion, since making it appears to open up a metaphysical abyss at our feet. But I intend the assertion more pragmatically than otherwise: I am not asserting philosophical priority, in other words, only a matter of fact—of "natural history," you might say. Nor am I suggesting that narratives and hypotheses are somehow deterministic of apprehensions, descriptions, and representations solely by virtue of preceding them. The former come before the latter only in the sense that recipes and cookery come before a fine meal, yet don't guarantee good things to eat.

The natural history writer Sue Hubbell confirms the humble view of our powers of apprehension, description, and representation that I am proposing here. She writes:

> The bits and pieces of life are so numerous that we need to order and classify them before we can think about them. Our sort of brain cannot handle the world in the raw. We have to arrange all the bits into piles, and if there are too many piles we arrange those into clusters. Without ordering systems, which is what taxonomies are, we can't think, live, or work with our world.[22]

Recipes and kitchenware, it seems to me, are also ordering systems that help us cope with a world presented to us "in the raw" and difficult to digest. Such is life on the uncertain borders where nature and culture meet.

For these reasons, and more, our relationship to landscape is not and cannot be a determinate one, as Lopez seems to be saying it is. "The shape of the individual" may be "affected by land," but not in anything like the way it is affected by genes. A landscape is either conjectural, an educated guess about the lay of the land, or it is an artifact that has been shaped by human hands, possibly for millennia (so environmental history teaches us). It isn't "a gestalt that can impress itself on the mind or text" in a "fundamental and binding way," as Buell, who is paraphrasing Lopez, insists that it is.[23]

The "interior landscape" thus seems to be a dubious idea, so very dubious as to force us to acknowledge that "the environmental imagination" should not be understood as a faithful copyist of natural relationships. The phrase "the environmental imagination" if it belongs to anyone belongs to Buell, who first used it as the title for his 1995 book. Yet he rarely uses it, to employ a dicey preposition, *in* his book. There the preferred terminology seems to be "environmental representation," which seems to me to be a much less suggestive phrase and an altogether unsatisfactory idea. And I'm not alone in my sense of its limitations and of the unlikelihood of completing the agenda it sets for ecocriticism: Eric Smith, for example, has pointed out that ecocriticism tends to take "the distinction between 'culture' and 'nature'" for granted. The inevitable result, he argues, is that any given answer to "the question of 'what the land means' carries only as much weight as the person arguing for it." The interpretations generated by most attempts to answer this question are the fruits, Smith adds, of a commitment to dichotomies like subject versus object and society versus nature, and these are "remarkably homogenous classifications for the amazing variety of entities and relationships in the universe."[24]

If we don't have the "kinds of minds" enabling us to make copies of and represent "the amazing variety" of our environment fulsomely, it is very unlikely that the kinds of texts we create are going to be any more representational than our minds are. Our minds and our texts are less than fully representational as a matter of practical necessity because we couldn't do anything worthwhile with them if they weren't. "The environment contains an embarrassment of riches," Dennett writes, "much more information than even a cognitive angel could use. Perceptual mechanisms designed to ignore most of the flux of stimuli concentrate on the most useful, most reliable information."[25] Most of this information will be visual, rather than auditory or olfactory (because of the way our sense organs are structured, because of the way they interface with or bypass the centers of consciousness in the brain, and because smells and sounds are of very low fidelity compared to sights). And most of this information will never find its way into our words: the verbal is not (merely) a handmaiden to the visual.

Ecocriticism, which has tended to take its cues from nature writers like Lopez, wants our sense of things, and our expression of that sense, to be more synthetic than it is, and even synesthetic. But our sense of things is, and will remain, analytic—ineluctably so, and not because of intellectual fashions that make too much of abstraction. Ecocritics who complain that representation has gotten a bad rap in recent decades are every bit as guilty of abstraction as those they chastise for being overly theoretical. They simply prefer a different variety of abstraction, and a more redoubtable one, which they hope will prove impermeable to further analysis. In other words, they want ideas to have the status of facts: they want the world to be in the text.[26]

Ecocritics who want the world to be in the text often describe environmental literature as a kind of writing, in the narrow sense of *inscription*, which bears little of the freight associated with traditional genres and forms. Their description of environmental literature implies that the category must be all but exhausted by so-called nature writing, of which Lopez's work is a leading example, and which ecocritics are inclined to interpret as if it were veritably a form of writing degree zero, as indeed it often tries to be. Thus ecocriticism's fretting about the otherwise unremarkable circumstance described by Buell, who points out that "writing and reading are acts usually performed indoors, unachievable without long shifts of attention from the natural environment."[27] Personally, I find it hard to see why this should be viewed as anything other than a simple matter of practicality: writers and readers do need to seek shelter from cold winds and damp airs, and to concentrate on their texts, when they write and read.

Yet many ecocritics seem to feel that something culpable is going on here, particularly where the scene of reading is concerned. "It is easy to persuade oneself on the

basis of the average critical discussion," Buell complains, "that the literary naturescape exists for its formal or symbolic or ideological properties rather than as a place of literal reference or as an object of retrieval or contemplation for its own sake." And so it is; but are "its formal or symbolic or ideological properties" not the things that make a "naturescape" literary, as opposed to literal, in the first place? Description is not and need not be the same thing as documentation. The scandal that alarms ecocritics of the realist stripe only arises if one assumes that the fictional dimension of literature—of all literature, even the nonfictional, paradoxical as this may seem—is somehow the source of its faults. Only then will one seek to treat literature as no more than a kind of writing, and writing as no more than a form of bookkeeping. Only then will one seek to reign in what Buell refers to, scathingly, as "the power of imagination, textuality, and culture over the malleable, plastic world that it bends to its will," all of which he opposes to "thick description of the external world."[28] But without "the power of imagination, textuality, and culture" to enrich it, thick description may form only a hard crust of verbiage with little of literary or cultural interest at its center. It may be virtuous, yes, but it's also likely to be boring.

Because it needs to stave off the threat of boredom, propping up discredited theories of representation is only one of the strategies ecocriticism has adopted to offset what it sees as the problematic status of textual functions, and to compensate for the formal, symbolic, and ideological properties of works of literature, or all those things that damage literature's truthfulness. If the postmodernist poets and critics, not to mention the postmodernist novelists, playwrights, and journalists, along with their ugly cousins the poststructuralists and deconstructionists, are to blame for the constriction of the current academic and cultural purview, then the obvious thing to do is to find a reasonable alternative to their arcane complexities and sneaky sophistries. For many ecocritics, one of the oldest varieties of literary expression, the pastoral, has seemed to provide this reasonable alternative, not only as object of study but also as mode of scholarship. Buell, for example, suggests that his book, "in focusing on art's capacity to image and to remythify the natural environment, is itself a kind of pastoral project," and other ecocritics have made similar claims.[29] For the most part, however, ecocritics have used the word "pastoral" very broadly to mean "having to do with nature," while ignoring or dismissing as irrelevant its less convenient and more literary implications.[30]

That one might invoke a category like the pastoral without simultaneously activating its rules and imperatives, and without buying in to some, at least, of the theories elucidating its rules and imperatives, seems improbable, since these are the very things that make the pastoral a distinct category in the first place. Those who argue that ecocriticism should focus on the pastoral, and that it ought to be a version of pastoral in its own right, too, also must downplay the fact that the pastoral seems to be an ideologically compromised form because of its deployment, especially in British literature, in service of class and imperial or metropolitan interests. In varying degrees, ecocritics are of course aware of the pastoral's checkered past, and

hence of what would seem to be its diminished capacity at present. It is possible, however, that American ecocritics are less savvy than others when it comes to sensing just how problematic the pastoral is, considering the relatively minor role played by the pastoral in American culture, both as literary mode and as an alternative way of thinking about the development and preservation of land. And hence they resist arguments that challenge both the pastoral's worthiness and the possibility of its revival in something other than a watered-down and compromised form.

Given the pastoral's historical tendency to transmogrify and to splinter into different versions, many of which seem incompatible with each other because they serve radically different interests and purposes, I doubt whether ecocriticism will find the pastoral congenial over the long haul. Ecocriticism is impatient with versions—impatient, that is, with texts not tied discretely to referents of fairly specific latitude and longitude, like the white pines of New England or the arroyos of the Sonoran Desert. Buell suggests, however, that at the very least a case can be made for pastoral's "adaptability for ecocentric purposes" and for its capacity to be pressed into service "as something more than ideological theater," and this suggestion would seem to be a reasonable one. That it is so commodious is one reason pastoral is defined as a mode rather than as a genre: it can assume more than one form, and serve more than one master. However, Buell also suggests, much more problematically, that pastoral has the capacity "to register actual physical environments as against idealized abstractions of those," and to make this claim is to argue on behalf of a pastoral that has had its imaginative arc flattened out.[31] (Unless, of course, it is merely an attempt to give the generically and formally ambiguous texts of the nature-writing tradition a more distinguished label than the one they now bear, which seems to be only a list of ingredients—albeit a short one.)

To make the claim that pastoral can "register actual physical environments" is also to argue in the face of the best theories we have about pastoral, all of which stress the pastoral's tendency to treat physical environments idealistically and idyllically, and to wholly transform them imaginatively, too, if that suits its purposes. The most widely known of those theories is adumbrated in William Empson's *Some Versions of Pastoral*, which emphasizes pastoral's status as a "puzzling form" owing to its mutability. The pastoral, Empson argues, can twist itself into such unlikely shapes as the proletarian novel and *Alice in Wonderland*, in which shepherds and their flocks are few and far between, and where "idealized abstractions" are rampant. What makes this contortion and imaginative license possible is something Empson calls "the pastoral process," a process of "putting the complex into the simple."[32]

Applying this definition of the pastoral process to ecocriticism itself is helpful: the urge to do an end run around contemporary literary theory and culture seems to have found an outlet in attempts to put "the complex into the simple" and to restore our sense of the positive achievements and undiluted pleasures of the literary text. But Empson's definition of the pastoral process is distinctly unhelpful when one attempts to apply it directly to the objects of ecocritical interest: texts that engage, or

which are purported to engage, the natural world imaginatively. And this is true whether the engagement of those texts with the natural world is described in terms of their containing propositions meant to be representational, or in terms of their containing propositions meant to be merely speculative and hypothetical. In either case, but especially in the former, "putting the complex into the simple" is bound to fail, not only because we aren't cognitive angels, as Dennett has pointed out, but also for reasons having to do with the character of the natural world. One of the limitations of the pastoral, quite apart from its tendency to project the preoccupations of a certain social class or a particular empire upon a countryside or a territory imagined as blank—its tendency, as it were, to citify the countryside and to colonize the territory—is the pastoral's tendency to assume that the countryside and the territory are much *simpler* places than the city or metropolis, when in fact they aren't.

Leo Marx addresses the assumption of exurban simplicity—the assumption that the country is easy to know—in his discussion of the "pastoral impulse," which is, he writes, "a desire, in the face of the growing power and complexity of organized society, to disengage from the dominant culture and to seek out the basis for a simpler, more satisfying mode of life in a realm 'closer,' as we say, to nature."[33] The quotation marks that Marx has placed around the word "closer" are telling: the pastoral impulse may lead us astray, away from the dangerous city and into the perhaps still more dangerous countryside.[34]

I think Marx is right to express misgivings about the pastoral impulse. Given what we know about the natural environment—given, that is, its inordinate complexity, about which we don't know nearly enough—the pastoral impulse will surely lead us astray. The assumption behind the pastoral impulse or process, and not the impulse or process itself, is what we must regard as faulty. If anything, the city is the simpler place environmentally or, rather, ecologically, in light of the fact (the historical fact) of its having been made over into a greener and more pleasant space, and therefore a more "pastoral" one, or so we might argue. The city has been cleared of its native flora and fauna and drained of standing water to get rid of the effluvia and pesky bugs that make country living difficult to survive. It also has been plotted in a rational, easy-to-comprehend grid, then replanted in exotic shrubbery, grasses, and flowers, and then stocked with pigeons for retirees to feed and dogs for children to pet. Because the countryside has not been groomed quite in the same way and to the same exhaustive degree, to go into the countryside is to go *up* the scale of complexity, not *down*, despite the bright lights, noisy uproar, tall buildings, convoluted traffic patterns, and rich human mosaic of the contemporary city—all those things addressed by street smarts. It follows that the pastoral process is one in which ecocritics (and environmentalists) ought not to engage if they want to assert the importance of understanding the untamed natural world.[35]

The upshot of all this may be that ecocriticism should be *more* antirepresentational than other forms of criticism, not *less*, and perhaps more antipastoral and antihumanist as well. That is, it should be neutral with regard to representation, the pastoral, and humanism, since those things, far from being elements of its purview, should be part of the domain it surveys critically. After all, to assume that literature can put nature right again—in the world, in texts, and in our hearts and minds—begs all of the questions ecocriticism has volunteered to try and answer. I think ecocriticism ought to cultivate an attitude of wary impartiality, which should be the best way to avoid what Buell calls the "environmentalist's dilemma of having to come to terms with actual natural environments while participating in the institutions of a technological culture that insulates one from the natural environment and splits one's allegiances." This is a dilemma that Buell says the pastoral "anticipates," and I agree, because I think it's a dilemma that by anticipating the pastoral first helps to create, then sustains and exacerbates.[36] The pastoral does this when it buys wholesale the distinction between natural environments and "the institutions of a technological culture," a distinction ecocriticism thinks it must overcome by making those institutions (beginning with literature) somehow more natural than, at present, they are.

To phrase the point I have been making in more theoretical terms, the pastoral process of putting the complex into the simple is a process of troping. It is, moreover, an extremely reductive process, however imaginative it might seem, if it is true that the essential trope of pastoral is metonymy.[37] As Paul Alpers argues, "Metonymy is a trope we associate with prose narrative and particularly with the realistic novel. But it is also appropriate to pastoral, in which . . . the ethos of cultivated sensibility produces a rhetoric of discretely apprehended pleasures."[38] A good example of a metonymy that has been serving a pastoral function in the text of ecocriticism might be the use of the term "landscape," as devotees of discretely apprehended pleasures like Lopez use it, to mean "environment." Landscapes are more easily apprehended than the environments in which they are situated in space, for the simple reason that environments are not spaces but hyperspaces. Of course, to refer to environments is also to avail oneself of a trope (a synecdoche, perhaps, since the whole is made to stand for all of its parts), but we have got to call environments *something*, even if properly speaking "they" aren't "things" at all and therefore should not be referred to as if "they" were. As for landscapes, I very much doubt whether we can make sense of them in the piecemeal fashion that Lopez advocates. Some tropes serve us better than others, and I'm forced to concur with Flaubert's sardonic dismissal, in his *Dictionary of Received Ideas*, of landscapes on canvas as "always so much spinach." Landscapes in words, it seems to me, are monocultural and monotone—and full of spinach—in just the same way. They also lack the complexity and biodiversity that make natural landscapes compelling, and thus they inspire a false confidence in fusty categories like the pastoral.

When I say that environments are hyperspaces, I have in mind the definition of the term "niche" preferred by contemporary ecologists: the niche is not an address, they like to say, but a profession. In other words, they try to correct for the mistaken impression one might get of the ecological niche owing to the spatial connotations of

the term "niche" in its original discursive context, which was architecture. An ecological niche is a multidimensional hypervolume, and not all of its dimensions are spatial: likewise, an environment.[39] In other words, relationships of contiguity, of mere juxtaposition in physical space (metonymic relationships, we can call them), may constitute a landscape without constituting an environment, which is an inestimably richer concept though not, for all its richness, a failsafe mechanism of ecocritical discourse. That discourse has yet to develop tropes enabling it to come to terms with the fractured (and fractal) realities of nature.

Having said the things I have just said, I have introduced several concepts and a term, "hyperspace," which will allow me to move on and explore the issue of postmodernism. As we've seen, ecocritics have characterized postmodernism as the philosophy espoused by the opposition and hence as something to be scorned. A case, I think, of sibling rivalry, since postmodernism and contemporary pastoralism appear to be two expressions of the same set of assumptions, more alike than their superficial differences would lead one to believe.[40]

The Truth of Ecology in a Hyperreal World

> The *truth: what a perfect idol of the rationalistic mind!*
> *William James,* Pragmatism

Near the end of his classic essay "Travels in Hyperreality," Umberto Eco describes a visit he once paid to the San Diego Zoo. The zoo, Eco realizes, is a lofty undertaking, a living natural history museum famous for its wild animal habitats designed with ecological rectitude in mind. Yet the zoo is also a theme park, and hence a place where poignant forms of duplicity are on display. Its split personality prompts Eco to comment, "Of all existing zoos, this is unquestionably the one where the animal is most respected. But it is not clear whether this respect is meant to convince the animal or the human." The ambiguity of the zoo's intentions was underscored for Eco at the time of his visit by the behavior of one of its inmates, a brown bear known not by the scientific name *Ursus arctos horribilis* but by a less daunting given name, which was Chester. The bear's behavior, like its name, had been modified: whenever one of his handlers tossed him a cookie, Chester would wave a friendly forepaw at passersby. Reflecting on Chester's winsome behavior and affable demeanor in his 1975 essay, Eco writes: "This docility arouses some suspicions. Where does the truth of ecology lie?"[41] I believe that Eco's question is still waiting for a good answer over twenty-five years later, and it seems to me that it's likely to have to wait even longer, since its final word can mean more than one thing. I'd like to think, moreover, that the double meaning of "lie" is not a spurious trace of the translator's art: I'd like to think that it is intentional, and that Eco is asking both where the truth of ecology is located, and whether it isn't subject to domestication of the sort that leads to distortion and falsification.

Thanks to Chester and to the equally theatrical antics of a few of his fellow inmates, Eco's visit to the zoo did nothing to disperse the atmosphere of hyperreality through which he made his way during his American travels. In fact, it heightened that atmosphere, since given its undeniably alive yet tame animals, its natural yet manmade habitats, and its allegiance to both science and the entertainment industry—to exact knowledge, and to all the emotions aroused, but not clearly defined, by art—the zoo seemed to acknowledge the truth of ecology and yet, in good hyperrealistic fashion, it also seemed to make this truth into a lie, by dislocating and distorting it.[42] Thus the zoo was no exception to the pattern Eco discovered as he traveled back and forth across the United States.

In his essay, Eco suggests that America's avid pursuit of the real invariably gives rise to the hyperreal. The result of this strange dynamic is a national culture in which imitations, copies, and fakes are cherished and proliferate wildly, so much so that they become indistinguishable from the genuine article, the original. And this strange dynamic is at work, Eco discovered, even where one might expect it least. In zoos and in other wildlife parks like Marineland, the animals seem paradoxical because they are both authentic, placard-bearing members of their species and highly trained performers conditioned to interact with and imitate humans. This creates a situation in which "all is reality but aspires to appear sign."[43] The oddity of this situation is, of course, not limited to zoos, wildlife parks, and other tourist attractions. In fact, it typifies American culture as a whole, or so Eco argues. His essay is an exhaustive inventory of the hyppereal, and he makes it clear that hyperreality is much more than a form of poor taste endemic to the vacationlands of California and Florida. It is a full-blown cultural condition shared in equally by all Americans, not excluding literary critics. So no matter who or what you may be, you cannot escape hyperreality by wishing things were more authentic than they are. Hyperreality is too substantial to be dealt with that way, and it is epistemologically perverse, in that your wish for authenticity is one of its root causes.

The most peculiar thing about the hyperreal is that while it may not be genuine, it is real and forms a part of the actual fabric of things. This peculiarity is particularly frustrating with regard to a subject like ecology, an area in which the hyperreal has made still more inroads since Eco published his essay. To cite an apposite example, the San Diego Zoo recently featured a display of topiary rhinos in which the leafy pachyderms were portrayed as California surfers, a choice of stereotype inspired by and cross-marketed with a popular children's book. The display was, alas, only temporary, but those of us who failed to make it to San Diego to see "Rhinos Who Surf" in person didn't have to feel that we were missing something vital. We could do a little surfing of our own, visit the zoo's Web site, and have a look at the exhibit online. As we pondered the images of sportive rhinos and the associated text,

we had to concede that the implications of an exhibit like "Rhinos Who Surf" were difficult to sort out, as Eco realized years ago. Clearly the exhibit was pachyderm-positive, but its positive attitude toward the rhinos was purchased at the price of misrepresenting them, no doubt in order to make them more appealing to small children and parents than, truth be told, most large, slow-moving, leaf-munching herbivores are: in their natural state, rhinos can be as placid as horned cattle. Possibly the exhibit of topiary rhinos was intended to teach an important ecological lesson having to do with the food chain ("You are what you eat") allegorically, albeit paradoxically, by being rigorously literal-minded about it. Perhaps the green medium was the green message, but I doubt it: the exhibit didn't seem that clever.

Nonetheless, it would be a mistake for us to think the San Diego Zoo's further ventures into popular entertainment and new media mean that it has abandoned, scaled back, or fatally compromised its educational, scientific, and conservationist missions. Its Web site also documents the zoo's ongoing involvement in efforts to restore to sustainable numbers a number of species currently on the brink of extinction.[44] Such efforts are controversial, however, and like "Rhinos Who Surf" they tend to produce mixed results. A few once-endangered species have benefited from our attempts at animal welfare and their numbers have rebounded, while others, despite years of captive breeding and habitat preservation guided by the best theories and the most sophisticated techniques of applied science, still hover at or near the vanishing point. Some of our efforts to save endangered species seem to have had the unintended consequence of adding to their already considerable burden of stress.

In light of mixed results like these, and in view of the mounting evidence generated by research in the field, ecologists now acknowledge that nature is extraordinarily complicated and that it is therefore much harder to figure out than they once believed it would be. In fact, complexity itself, once thought to guarantee ecological stability, is now seen as, well, more complex than that. The difficulty of understanding nature is compounded still further by the fact that while it may be thoroughly implicated in culture, as Eco suggests, the reverse is also true: culture is thoroughly implicated in nature. Whenever we try to figure out nature, we are also trying to figure out ourselves; and we are creatures capable of inventing surfing rhinoceros topiary while earnestly expending enormous amounts of money, time, and effort to restore the same species we once tried, and in a few cases are still trying, to obliterate—including, not coincidentally, the rhinoceros.

What to think, then, about what Eco calls "the truth of ecology"? As another pioneering explorer of hyperreality, Guy Debord, once put it, "Within a world *really on its head*, the true is a moment of the false."[45] Of course, if the radical point Debord makes is to be a self-consistent one, then it also must be the case that there are times when the false is a moment of the true. "But surely," we may be tempted to protest, "appealing to nature will help us to cut through this kind of guff. Surely the epistemological quandary we find ourselves in at junctures like these is merely the result

of the cultural confusion engendered by hyperreality or, to use the more widely circulated and, indeed, almost hackneyed term, by *postmodernism*?"

The impatience that this protest expresses is another of the feelings lurking behind Buell's arguments in *The Environmental Imagination*. The book's third chapter ends with a brief attack on hyperreality, both as idea and as phenomenon instanced in such recent developments as the computer technologies we take advantage of when we do things like visit the San Diego Zoo's Web site. Buell takes Jean Baudrillard to task for arguing, sensationally, that virtual reality generates "an entire ecology." No doubt this claim is hyperbolic, as Baudrillard's claims tend to be, but I don't see how it differs in kind from the claims ecocriticism has made about the potential richness of the interior landscape, be it psychological or textual. It is hard to see why the interior landscape is not equivalent to "an entire ecology" as well, especially given the fact that Baudrillard cashes out his idea in terms of a "sensorial mimetics and tactile mysticism," terms and concepts very similar if not identical to those many ecocritics and nature writers assume and like to use.[46] What is the interior landscape's saving grace? And what makes environmental literature innocent of the hubris expressed in and by virtual reality?

Buell's answers to these questions are that the interior landscape knows its place, and that environmental texts unlike hypertexts are more self-effacing and less self-important when it comes to representing the natural world, since they recognize the "comparative impotence" of literary realism. In short, the difference between hypertexts and environmental texts is only a difference of degree. Environmental literature takes the Goldilocks approach to mimesis: it is realistic, but not too realistic—only just realistic enough. Thus it avoids being "a way station on the path toward total technological control over reality." "Environmental literature in particular has to defer," Buell argues, "to the authority of external nonhuman reality as a criterion of accuracy and value."[47] It therefore speaks in a still, small voice; it is not writ large; it charts the scaled-down topography of the interior landscape, the modesty of which makes it more virtuous than virtual.[48]

But as Eco argues, deferring "to the authority of external nonhuman reality as a criterion of accuracy and value" is no safeguard against hyperreality, which is engendered by what he calls a "reconstructive neurosis." In other words, once you start appealing to reality, it's as if you can't help yourself. Precautionary measures not only are bound to fail, they are bound, like all repressive measures, to exacerbate the very condition they are designed to address. Eco writes: "The frantic desire for the Almost Real arises only as a neurotic reaction to the vacuum of memories; the Absolute Fake is offspring of the unhappy awareness of a present without depth." He might as well have said that the Absolute Fake is the offspring of a pastoral impulse. If America is both the site and subject of a new pastoral, as some ecocritics have argued, and "a country obsessed with realism, where, if a reconstruction is to be credible, it must be absolutely iconic, a perfect likeness, a 'real' copy of the reality being represented," as Eco argues, then in order for American literature's pastoral

representations to be recognized as its marks of authenticity, as ecocriticism would like them to be, the textual and the factual simply must be brought into greater accord. This, Eco says, is precisely where hyperreality lays its trap: "To speak of things that one wants to connote as real, those things must seem real. The 'completely real' becomes identified with the 'completely fake.' Absolute unreality is offered as real presence."[49] So protests against hyperreality, when couched in the form of complaints about its unreality, can be unwittingly contributory to it. Hyperreality is rubber, and it is glue: what you say about it bounces off, yet sticks to both it and you.

With this thought in mind, we are in a position to notice something we haven't noticed before about those white pines that, according to Buell, are "present" both outside his office window and in the pages of American literature. Like the topiary "Rhinos Who Surf," the white pines are problematic entities, in that they, too, seem to be hyperreal, and not despite but precisely because of their guidebook perfection. They are flawless, and their tractability "arouses some suspicions," as Eco says of Chester the bear's friendliness, because it is compulsory. *Must we say what we see?* Ecocriticism has thought that we must.[50] It wants to flatten out the arc of imagination horizontally, in order to bind the imagination more securely to nature as "criterion of accuracy and value," whereas postmodernists see this arc becoming steeper and steeper as the imagination is bound ever more securely to the vertical axis of culture.

The postmodern idea about nature is that nature is largely irrelevant to today's culture both on philosophical grounds (grounds articulated by poststructuralism and similar schools of thought) and as a matter of historical fact, despite our continued interest in nature as evidenced by all those zoos, parks, books, Web sites, documentaries, and essays in ecocriticism. Postmodernists like to dismiss nature by tossing off a world-weary apothegm, implying that either you savvy nature's irrelevancy immediately or you do not, and if you don't savvy it you won't get to be a postmodernist. To the uninitiated, postmodernist discourse seems to be wholly a matter of rhetoric and style. It seems, that is, to be wholly a matter of retailing anecdotes and making aphorisms couched in the Hegelian, Nietzschean, and Heideggerian rhetoric of negation, paradox, and wordplay, and not at all a matter of making closely reasoned arguments. The conclusion that this impression is an accurate one is difficult to avoid when we review the coroner's reports certifying the death of nature issued by a number of prominent theorists and critics of postmodernism since the 1970s.

Only a few of the more choice passages from these coroner's reports need to be cited here. The medical metaphor is appropriate, given Jean-Francois Lyotard's breakthrough diagnosis of postmodernity as a terminal "condition," especially where nature is concerned, and in more than one sense of the word "terminal." "Data banks," Lyotard writes, "are the Encyclopedia of tomorrow. They transcend the capacity of each of their users. They are 'nature' for postmodern man."[51] Baudrillard makes essentially the same point about the epoch-making significance of computers as Lyotard does, but he makes that point more epigrammatically and portentously, as is his wont, and with a less gracious bedside manner. "Digitality," he intones, "is with us."[52] Linda Hutcheon's gloss of the magisterial judgments of writers like Lyotard and Baudrillard captures both the full sweep of their dismissal of nature and the paradox they imply. She writes: "Even nature, postmodernism might point out, doesn't grow on trees."[53] Her recycling of the cliché about money is exemplary: it is axiomatic that postmodernist irony thrives on the salvaging of hackneyed language and familiar imagery.

Hutcheon may be guilty of trying to give an old saw new teeth, but it nevertheless seems to me that when she says nature "doesn't grow on trees," she sums up the postmodern consensus about the unnatural character of nature in today's world. To hardcore partisans of culture, certain gestures of affection for nature—tree hugging, for example—have begun to seem less than relevant, and even embarrassing. These partisans argue that nowadays everything belongs to culture, which explains why they dispense with nature summarily. From their certifiably postmodern point of view, nature is at best a remnant of what it used to be, and when culture looks at nature, it says, "Been there. Done that." As postmodernists tell the story, culture is very glib, even if it isn't very original.

Here, then, is the postmodernist scenario that ecocriticism finds objectionable: "When nature was still natural, it was analog, and we found its nuances difficult to capture. We had to hunt and gather or sow and reap, and we found nature hard to represent in anything other than schematic ways—myth and the pastoral mode, for instance—all of which were, like topiary, of disappointingly low definition. Now, thanks to the successes and excesses of modernity, nature is almost entirely a cultural phenomenon, and contemporary culture isn't at all analog. 'Digitality is with us.' All we have to do is point and click. We can forage electronically, not only for food and clothing when we 'go' home shopping but for data and imagery too. Tides and temperatures, storm fronts and stream flows, intimate views of wild animals, and of some which are not so wild, like the surfing rhinos, are captured by satellites, remote sensors, and Web cams, and made available to us instantaneously and at high resolution. Space is abolished. Time has become download time, measured not in hours, days, and seasons but in bauds and kilobytes. It follows that nature itself is no longer natural. We have conquered nature, even if our victory over it seems in many respects to be an object lesson in debilitating side effects like acid rain and global warming. Digitality, as Baudrillard calls it, is notorious for producing just that sort of irony: the archetypal form of digital technology, the computer, is a tidy little package of toxic compounds and heavy metals. So much for a sleek future brokered for us by our electronic brains! This is why there is a 'post' in 'postmodern.'"

One sign of the seductiveness of postmodernist discourse is that even its sharpest critics accept some of its least persuasive claims, especially if they happen to be claims about nature. For example, in a widely read 1984 essay, Fredric Jameson, whose critique of postmodernist thinking is among the most trenchant, wrote that

he was "tempted to speak" of a "new and historically original penetration of Nature" effected by what he called "the logic of late capitalism," or in a word postmodernism.[54] Of course anything penetrated by capitalism, early or late, is likely to be badly shopworn thereafter, an implication borne out by Jameson's subsequent statements regarding the fate of nature. In a 1991 book that massively expands upon the ideas he had expressed on the subject seven years earlier, he writes that postmodernism "is what you have when the modernization process is complete and nature is gone for good." This last phrase should bring us up short: we have traveled a great distance in a very brief time if nature's condition can be downgraded from poor in 1984 to "gone for good" in 1991. Why, one wonders, does Jameson say "nature is gone for good"? He takes others to task for expressing apocalyptic sentiments of this sort when he complains about the "inverted millenarianism" of postmodernist discourse. How is his hyperbolic suggestion that "nature is gone for good" not an example of the "inverted millenarianism" he dislikes? He writes that "the other of our society" is "no longer Nature at all," "but something else which we must now identify," and this certainly *sounds* apocalyptic.[55]

I think Jameson would respond to the questions I have raised by arguing that his statements about nature are not apocalyptic at all but, to use a term he favors, "historicized," by which he would mean that his statements are historical *and then some*, or both factual and theoretical at once. So when he says nature is gone for good, he means that nature-as-anyone-who-is-steeped-in-Marxist-theory-might-view-it is gone for good, that nature as a resource to be exploited by whatever means of production are available is all but exhausted, or at the least, severely depleted.[56] Heavy industrial production on the grand scale of the nineteenth and the first half of the twentieth century is supposed to be winding down, at least in the west; thus Jameson favors a maximally sophisticated variety of Marxist analysis no longer attending so closely to the trade of gross commodities like sugar, wheat, coal, oil, iron ore, and the labor it takes to produce them. Neomarxist or postmarxist analysis à la Jameson will instead contemplate the less material and more refined, almost ethereal modes of production of multinational capital.

The new modes of production are primarily and splendidly electronic (or so Lyotard and Baudrillard once asked us to believe: we now have good reason, in the wake of the failed dot-com revolution, to suspect otherwise). Capitalism's boldest endeavors no longer involve the extraction of raw stuff from the earth, but endless recycling. However, it isn't the recycling of paper, plastic, glass, and other not-quite-consumables that interests venture capitalists, and is of concern to critics and theorists like Jameson, but the elliptical orbits of credit, debt, imagery, and information, the ever-returning flux of myriad simulations of what used to be called cash value. This flux now constitutes an entire economy, to paraphrase Baudrillard. As for use value, that once-cherished quality seems scarcely to exist anymore, and we are left to wonder what it was, exactly. Not that we ever really knew; as Jameson points out, use value "at once drops out of the picture on the opening page of *Capital*," so that

for Marx, "henceforth value as such and 'exchange value' are synonymous." All this happens despite the fact that, as Jameson puts it, capitalism has created conditions in which "the deep underlying materiality of things has finally risen dripping and convulsive into the light of day; and it is clear that culture itself is one of those things." Yet it is equally clear to Jameson that the material isn't what it used to be, and that "we have had to learn that culture today is a matter of media." Matters of media have a knack for seeming wonderfully immaterial, existing as they do as pure notations of exchange. In this new atmosphere of immaterialism, and as some students of the so-called postmodern sublime have suggested, "the sacred and the 'spiritual,' which would seem to have been ruled out of court with the triumph of capital, may have gotten a new lease on life after all."[57] Where there is no television, the people perish; but where is there no television?

To sum up, postmodernity is what one gets when modernity is forced to eat its own young. Or to put the point another way, postmodernity is what one gets when modernity, having run out of ideas and raw material, can no longer "make it new," as Ezra Pound urged it to do, and must recycle everything, including its ideas, imagery, and metaphors.[58] When the arc of the imagination becomes too steep, it collapses, and culture can be relied on no longer, at least not in the old familiar ways. Culture may be gone for good, too; we begin to feel as nostalgic for it as we already do for nature.

You might think that postmodernists and their critics, too, would be less droll and less aphoristic when they bring us this bad news. But they often intimate that the disappearance of nature is not really news at all, which may be the truest measure of their attitude toward it. They regard nature's disappearance as the predictable and necessary outcome of modernism, and as such, it isn't altogether undesirable. The disappearance of nature is the price we have to pay for culture, which remains the highest value for postmodernists, just as it was for the modernists, even if postmodernists acknowledge that culture has been vaporized (decentralized, deconstructed, and digitalized). In other words, postmodernists are modernist in their values, but forlornly so, because they feel a nagging sense of having overrun the teleology of their favorite ideas. This is why they treat the metropolis as the cultural equivalent of an endangered species, and are panicked by the prospect of its disappearance. The classic statement of this theme is Debord's: "Economic history, which developed entirely around the opposition between town and country, has arrived at a level of success which simultaneously annihilates both terms."[59] The annihilation of terms and erosion of distinctions is a central motif of the postmodernist lament.

For just this reason, it seems clear that postmodernism is incapable of telling a coherent story, much less generating a *theory*, about the disappearance of nature. It simply has to take nature's disappearance for granted. That is why its doyens like to tell the rest of us, "Of course we have gobbled nature up and destroyed it; you seem to have forgotten that's what culture is *for*." Not in the least bit concerned with nature, postmodernism is instead a theory about the increasing absence of high culture

in its traditional home in urban space, owing to its steady leakage into suburbia, exurbia, and the media, from whence culture sometimes returns in a form hard to assimilate with avant-garde modernist values. That another result of the steady leakage of high culture from the city center is the accelerated diminution of the natural world is, as postmodernism sees it, only a coincidence. It's an instance of what military strategists call collateral damage. One can be witty about it.

Obviously the claim that culture has subsumed nature, and may have eradicated it entirely, is unsupported by the available evidence and fails to take into account the actual state of the natural world today. Postmodernists make this claim anyway, in large part because they continue to try to understand nature using a Marxist model (however modified) in which nature and culture are opposed, and in which much of the evidence about nature is perforce obscured. Ecologically, Marxism is an inadequate model because not everything that humans consume can be counted as something they produce, as the environmental historian William Cronon argues:

> What Marx labeled "relations of production" might in an ecological context better be seen as relations of *consumption*, since all human labor consumes ecosystemic energy flows in the process of performing physiological and mechanical work. This has the consequence of seriously undermining Marx's labor theory of value, in which commodities acquire their use value almost entirely from the human labor that workers contribute to their production.

Cronon's point is that what is called "production" is as much a matter of *taking* as it is of *making*. Production and consumption are therefore not two different moments of a dialectical process, but are interwoven with each other each and every step of the way. Cronon argues that schemes, like Marx's, which treat production and consumption separately and seek to describe all possible modes of production, do "violence to the diverse complexity of ecological (and historical) reality." "The phenomenon called capitalism," he suggests, is especially "hydra-headed."[60] Because they are unschooled in environmental history, many postmodernists, and their critics, too, conflate the cultural logic of late capitalism and its natural logic, making it difficult for them to assess capitalism's ecological impact and causing them to overlook the fact that, as the philosopher Michel Serres observes, "we receive gifts from the world and we inflict upon it damage that it returns to us in the form of new givens."[61]

Postmodernists also tend to rely on forms of reasoning based on the supposed primacy of representation in culture when they turn to consider the natural world, just as many ecocritics do. But relations of cause and effect cannot be reduced to relations of signifier and signified. Thus postmodernists fail to recognize that the efficacy of human designs for and intentions toward nature is sharply limited. This is precisely why coyotes have become common in the eastern United States, despite the volumes of discourse dedicated to establishing their status as varmints, and despite decades of efforts to eradicate these creatures in their western homelands, where they have more than endured.[62] The New York state legislature can set aside Adirondack lands for a park, but the legislature cannot keep coyotes out of that park. Nor can the U.S. Fish and Wildlife Service ensure that the endangered whooping cranes, Florida panthers, red wolves, blackfooted ferrets, and greenbacked cutthroat trout entrusted to it will survive, even if it preserves the habitats in which those creatures are known to have evolved, no matter what cultural resources it employs. Many endangered animals may be living in too diminished a gene pool to increase their populations effectively, and their habitats may be too fragmented to serve their needs. Even if every other factor works in their favor, these animals may have a run of bad luck as a result of harsh weather during their first breeding seasons back in the wild, in which case coyotes will be only too glad to scavenge the carcasses of the last survivors. When they do, it will be a sad day, but it won't be the end of nature. Coyotes have been playing the role of scavengers for millennia.

It's a Real World After All

> *Here they are. The soft eyes open.*
> *If they have lived in a wood*
> *It is a wood.*
>
> *James Dickey,*
> *"The Heaven of Animals"*

In an intellectual and cultural atmosphere of hyperreality and in a natural environment like the troubled one I've just described, it isn't surprising that the concept of truth should seem to have suffered some grave damage, beyond repair, and to have become infected with falsity, so that some truths now seem to be lies. There is something missing, however, from the picture of hyperreality's relationship to postmodernism, and of the relationship of both to the natural world, that I have sketched thus far. When Eco asked his question about the whereabouts of ecology's truth in his 1975 essay, he did so in wonder and in a spirit of intellectual adventure. However distorted by hyperreality he thought it had become, he had not given up on ecology's truth altogether, as some postmodernists appear to have done. I think this is the case because of the fact that Eco, since he is not only a semiotician but a literary critic and a novelist, too, is not given to metaphysical turns of mind, as many postmodernists are, despite their belief in the end of philosophy. To his great credit, Eco always keeps his wit and his wits about him: he is an extremely subtle student of contemporary life.

Eco is also a funny sort of pragmatist.[63] There may not be any other kind, given William James's definition of the "radical pragmatist" as "a happy-go-lucky anar-

chistic sort of creature."[64] Like James, Eco realizes that the distinction between truths and untruths has never been quite so sound as we would like to believe: that "the truth" has been worshiped as a false idol. This means that it also may be possible to be a happy-go-lucky postmodernist, a creature of lively paradoxes, and to agree with Paul Feyerabend when he writes, "As regards the word 'truth' we can at this stage only say that it certainly has people in a tizzy, but has not achieved much else."[65] It is crucial to recognize that Feyerabend wrote these words as a skeptical philosopher of science, but as a great admirer of science nonetheless. As happy-go-lucky anarchistic sorts of creatures, we should understand that being in less of a tizzy about truth means treating the distinction between the true and the false as less than essential, yet still extremely important.

Other distinctions, and not least of all the distinctions between reality and hyperreality, modernity and postmodernity, nature and culture, will need the same kind of treatment. In order to come to grips with this new breed of distinction we are going to need, among other things (like good luck), not the reinvigoration of time-honored categories like the pastoral or the realistic, but a greater sense of irreverence toward our own received ideas and a willingness to improvise—a willingness, as it were, to philosophize with a hammer. In his book *We Have Never Been Modern*, Bruno Latour addresses this need. He suggests that what makes the contemporary world particularly difficult to understand is the fact that in it, "all of culture and all of nature get churned up again every day." The evidence of this churning up of culture and nature is to be found, he says, all around us. In our daily newspapers, for instance, where we can read the latest stories about genetic engineering, AIDS, tropical deforestation, global warming, and so on. Reacting to a story about the hole in the ozone layer, Latour writes:

> The same article mixes together chemical reactions and political reactions. A single thread links the most esoteric sciences and the most sordid politics, the most distant sky and some factory in the Lyons suburbs, dangers on a global scale and the impending local elections or the next board meeting. The horizons, the stakes, the time frames, the actors—none of these is commensurable, yet there they are, caught up in the same story.

All of these incommensurable things might be described, and have been, either as cultural or as natural. Yet intentionally or unintentionally, human hands have refashioned even the most natural of them, so that they also seem intensely cultural. At the same time, many phenomena that seem fully cultural are bound up and run together with things and events in the natural world. The effect of this multiple causal heritage, shared by everything that we touch and everything that touches us, is the confounding of our basic categories. Things are too richly determined: our categories cannot cope. We live in a mongrel world, a world tinged with unreality but fatally real for all that. Latour puts the point this way: "The ozone hole is too social and too narrated to be truly natural; the strategy of industrial firms and heads of state is too full of chemical reactions to be reduced to power and interest; the discourse of the ecosphere is too real and too social to boil down to meaning effects."[66]

In his reflections on our current state of confusion, Latour doesn't say what his critics, who accuse him of being a postmodernist, as well as his admirers, who welcome him to the fold as a fellow postmodernist, might expect him to say. He doesn't say that "the ozone hole" is evidence of the fact that for the first time in our history, culture has supplanted nature altogether. Instead, he says that the power of technology to churn up culture and nature is nothing new; therefore, the contemporary world cannot be literally a postmodern one, and no one, or at least no one who wants to keep their wits about them, can be a dyed-in-the-wool postmodernist. Uncompromising postmodernism is impracticable, Latour argues, because its view of nature is both impoverished and impossible to maintain. Latour writes: "No one has ever been modern. Modernity has never begun. There has never been a modern world." He adds that this explains "the hint of the ludicrous that always accompanies postmodern thinkers; they claim to come after a time that has not even started!"[67] By insisting on the absurdity of such claims, Latour does not mean to imply that he thinks the earth is flat and flying machines are only a silly pipedream. His point is that while the discovery that the earth is a sphere and the Apollo landings on the moon are real achievements of genuinely historic importance, they do not entail the total conquest and liquidation of nature by culture, contrary to what modernists, postmodernists, and antimodernists, too, may have thought.

Scientific discovery and technological achievement do not mark our final alienation from nature: they mark our ever-greater involvement in it. Once upon a time, Latour writes,

> Nature seemed to be held in reserve, transcendent, inexhaustible, distant enough. But where are we to classify the ozone hole story, or global warming, or deforestation? Where are we to put these hybrids? Are they human? Human because they are our work. Are they natural? Natural because they are not our doing. Are they local or global? Both.

Postmodernist thought has a hard time accounting for the hybrid, monstrous phenomena created by contemporary environmental disasters and maladjustments, Latour argues, because it only juxtaposes the "three great resources of the modern critique—nature, society, and discourse—without ever trying to connect them."[68] Unlike most historians, critics, and philosophers, Latour resists epoch-making distinctions, like that between the premodern and the modern, or that between the modern and the postmodern. He also resists what Barthes calls "that inveterate emblematism which has us turn every word into a watchword against its opposite (creativity versus intelligence, spontaneity versus reflection, truth versus appearance, etc.)."[69] Latour suggests that watchwords are something to watch out for, and that

epoch-making distinctions obscure as much as they reveal. More discerning diagnoses and subtler physicians are needed in the treatment of our contemporary condition, whatever name we choose to call it by.

Most postmodernists are, as Latour would point out, intellectuals of the literary sort, and the fact that some of the most noted of them (like Lyotard and Baudrillard) have been French philosophers, rather than mere *litterateurs*, doesn't alter the case at all, though it does deepen its peculiarity. But perhaps it also helps to explain why they seem content to deal in large abstractions and don't bother to expound a definition, much less a philosophy, of nature: they simply feel no need to do so. Their turf isn't natural but cultural, which means that they are content to take for granted much if not most of what culture has bequeathed them, and to define nature solely by means of example and by negation. Postmodernists point to the disappearance of nature, all those vanishing acres of rainforest and all that dissolving atmospheric ozone, and describe it as a triumph of culture, a triumph some of them seem, perversely, to relish.

As Latour suggests in his remarks about the inherent limitations of contemporary intellectual culture, the puzzle posed by postmodernism has its source in an unacknowledged indebtedness to the very traditional ways of thinking that postmodernism claims to overthrow, but in fact only reaffirms. Just as philosophy used to do, and no doubt in some precincts still does, postmodernism aspires to be a theory-in-general by virtue of achieving the equivalent of "the view from nowhere."[70] Its adherents represent themselves as intellectuals without portfolios, wandering the cultural landscape at large and speculating about it freely. Because they take a generic approach to things, they often rely in their books and essays on the house style of modern philosophy, which presumes to offer us the generic view of things par excellence. Postmodernism is rife with philosophical language despite its disavowal of both the argumentative procedures of philosophy and philosophy's habit of making truth-claims (or claims about the possibility of making truth-claims).[71] And using philosophical language leads postmodernists to make statements about the natural world more hyperbolic and more gnomic than need be.

Notoriously, "nature" is one of philosophy's least precise and most contested terms.[72] Philosophers working in the modern metaphysical tradition tend to treat "nature" like the other terms they use in their arguments, terms like "being," for example. When philosophers speak about nature, they are concerned not with the biosphere but with something else, and just what this something else might be, if it "be" anything at all, is hard to say. The result is that in philosophical jargon "nature" functions as a catchall term whose referent is a poor sort of *Lumpenphänomenon*: nature is everything that culture is not, and it gets treated (thought of and written about) as if it were nugatory, a trifle. And while nature may be everything that culture is not, this does not mean that nature is admitted to be "something," if I may borrow the word Eco uses to define "being."[73] To stipulate that nature is something, and not just something else (who knows what?), would be to concede more ground to common sense than either philosophy of the modern, metaphysical kind or postmodernism is willing to give up.

From an environmental as well as an ecocritical point of view, to think that nature is merely a resource for humans or a backdrop for their activities is unsatisfactory. Thinking of nature this way tends to rule out in advance any form of argument that might with justification be called environmental or ecocritical. If the extreme forms of the postmodernist argument were correct, environmentalism and ecocriticism would have no proper subject matter. The problem with postmodernism, however, is not so much in its conclusions as in its initial assumptions, which insofar as nature is concerned are all hand-me-downs from the philosophical tradition. This is an amusing circumstance, since postmodernism is supposed to mark the abrogation of that tradition; but many postmodernists still belong to the same old unhappy tribe in which the *a priori* is worshiped as the reigning god, even if they suspect that the Great God A Priori has absconded.[74] Postmodernists are the kind of relativists who become relativists because they begin life as absolutists and grow unhappy when things don't work out as promised by tradition. As Richard Rorty has noted, with regard specifically to Lyotard, postmodernist "end-of-philosophy thinking sees the philosophical tradition as an extremely important failure."[75] If it seems to postmodernists that philosophical argument is inadequate and that nature has disappeared, it only seems that way because they once held unreasonably high hopes for the adequacy of philosophical argument and the resourcefulness of nature.

Postmodernists, Latour says, are "disappointed rationalists" who continue to accept modernism's "way of dividing up time." Postmodernists "feel that they come 'after' the moderns, but with the disagreeable sentiment that there is no more 'after.' 'No future': this is the slogan added to the moderns' motto 'No past.' What remains? Disconnected instants and groundless denunciations."[76] If Latour is right, postmodernists must lack a sense of mission. They must be discouraged by the tedium of discovering (*a posteriori*, of course) what the philosopher Max Black calls the "regularities and irregularities of experience," since they have no taste for the kind of work such discovery involves. They are disappointed to learn that there are "inexorable limits" placed on our desires, especially our intellectual desires, and specifically our hopes for language, since "no roads lead from grammar to metaphysics," as Black says.[77] The curious thing, and it is an enduring curiosity, is that anyone ever should have thought that there might be such roads. Baudrillard notes that "the objectivity of the fact does not check" what he calls the "vertigo of interpretation."[78] True enough: interpretation does tend to run wild and make one dizzy. But why should that count as an original, "postmodernist" observation? Or are we once again witnessing the ironic, "postmodern" refurbishing of a stale insight?

I agree with Latour that we can argue entirely on *a posteriori* and therefore not on philosophical grounds (relatively speaking, of course) that postmodernism offers us an inadequate account of the contemporary world. All we need to do is pick up a newspaper, as Latour says. Or we might try conducting one of the thought experi-

ments described in *We Have Never Been Modern*, where Latour argues that contemporary intellectuals need to come to terms with the fundamental continuity of human life throughout history and of "nature, society, and discourse." To help us grasp these continuities, Latour sketches the following scenario: "I may use an electric drill, but I also use a hammer. The former is thirty-five years old, the latter hundreds of thousands." Having offered this image of himself with both ancient and contemporary tools in his hands, he then asks, "Would I be an ethnographic curiosity?" The answer is no, because electric drills and hammers aren't categorically different kinds of objects. Both are hand tools, as are tools involving so-called high technology—like computers, for that matter. By the same token, even things as apparently novel as the hole in the ozone layer are nothing new under the sun: the earth has a long history of global environmental maladjustments. As Latour says, "We have never really left the old anthropological matrix behind," and "it could not have been otherwise."[79] The old anthropological matrix is our necessary context, in which we evolved and will continue to evolve as a species, or not (in which case the coyotes will be happy to scavenge our remains). If there is an ethnographic curiosity to be explained with regard to the truth of ecology, presuming for the moment that there is such a thing, it is the frequent denial by humans of the continuity of their life in nature and on earth.[80]

To restore our sense of the richness of the anthropological matrix, and to jar us out of stale habits of thought by exposing and exploding them, Latour constructs puzzles like that of the hammer and the electric drill, and then he disassembles those puzzles in fresh, unexpected ways. He argues that "the intellectual culture in which we live does not know how to categorize" the "strange situations" produced by the interaction, combination, and recombination of nature and culture because they are simultaneously material, social, and linguistic, and our theories are poorly adapted to them. Our theories take no cognizance of what Latour likes to call "nature-culture." He writes: "The great masses of Nature and Society can be compared to the cooled-down continents of plate tectonics. If we want to understand their movement, we have to go down into those searing rifts where the magma erupts."[81]

Venturing into this uncertain space, where the *terra* is not yet *firma*, will mean giving up or at least loosening our grip on the "distinction between objective fact and something softer, squishier, and more dubious," as Rorty phrases it.[82] It also will mean becoming more comfortably doubtful, and being in less of a tizzy about truth. We will have to think differently and from a different perspective, one less coolly objective than the one we have been imagining. And we will have to heed John Dewey's observation about the way in which we acquire our knowledge:

> Empirical facts indicate that not error but truth is the exception, the thing to be accounted for, and that the attainment of truth is the outcome of the development of complex and elaborate methods of searching, methods that while congenial to some men in some respects, in many respects go against the human grain, so that they are adopted only after long discipline in a school of hard knocks.[83]

Soft, squishy, dubious, error-ridden, and hard-won knowledge is not solely the subject matter of cultural critics and philosophers like Latour, Rorty, and Dewey. Scientists, too, are intimately familiar with it, and so are artists. In fact, we all are familiar with that kind of knowledge (there isn't any other), even if we don't always like to admit it, especially not when our veracity, our accuracy, or our expertise is challenged.[84]

That knowledge should be soft, squishy, dubious, error-ridden, and hard-won reflects the fact that sometimes the "social construction of nature" (to recall that ill-considered phrase) is efficacious and sometimes it is not. This is the case both for ecological reasons and, more broadly, for reasons having to do with the fact that, as Eco has said, "there are lines of resistance." Some lines of resistance are ecological, but many are not, because they are physical or chemical or geological or broadly natural in some other respect, and needless to say lines of resistance can be social or cultural, too. Because there are lines of resistance, "being, even if it appears only as an effect of language" (a proposition that Eco, as a semiotician, is willing to entertain for technical reasons, which needn't concern us here), "is not an effect of language in the sense that language freely constructs it." Being, it must be remembered, really is something. Eco points out that however formless and in flux being may seem, it has a habit of refusing our terms:

> Being says no to us in the same way a tortoise would say no if we asked it to fly. It is not that the tortoise realizes it *cannot* fly. It is the bird who flies; in its own way it knows it can fly and does not conceive of not being able to fly. The tortoise proceeds on its earthbound path, positively, and does not know the condition of not being a tortoise.[85]

The ability to tell a tortoise from a bird is a minimal requirement of environmental proficiency that most postmodernists and all ecocritics should be able to meet after a little study. There are no borderline cases, no creatures of either bird or tortoise kind presenting the careful student with anomalies of the sort literally embodied by ill-assorted creatures like the duck-billed platypus, the echidna, or the lungfish. Such being the case, we need not be unduly alarmed about the reliability of our knowledge of nature, and can try to move forward on our own earthbound path

This, however, is something ecocriticism has been slow to realize, which confirms that it has a lot more in common with postmodernism than it recognizes.[86] Like postmodernism, ecocriticism also assumes that we have become modern. The bulk of its efforts to trace the connections between culture and nature have been devoted to attempts to imagine what it must have been like in the good old days before

we were drawn into conflict with nature, conquered it, and then severed our connections with it, inaugurating modernity as "a new regime, an acceleration, a rupture, a revolution in time."[87] No wonder, then, that when they fight the good fight against postmodernism, ecocritics tend to backslide. Unless the proper discipline is maintained, such apostasy is probably inevitable. Ecocriticism, as an interdisciplinary enterprise, has had a hard time maintaining the proper discipline—a hard time remembering that, as Eco says, there are lines of resistance.

Consider what happens in SueEllen Campbell's "The Land and Language of Desire," one of the few essays to attempt a rapprochement between ecocriticism and postmodernism. Campbell argues that ecology (by which she means a form of environmentalism, specifically Deep Ecology) and contemporary literary and cultural theory are very much alike: "Old beliefs, old relations of power, old oppositions—ecology, like theory, would restructure them all." Citing Gary Zukav's New Age classic *The Dancing Wu Li Masters* (a study of what are supposed to be the deeply significant connections between Zen Buddhism and quantum physics), Campbell adds: "Theory and ecology agree: our perceptions are always subjective and we are always involved." Having established the idea of the theory-laden and relational character of our perceptions as a key principle, she applies it to the natural world:

> A deer, for instance, has no being apart from things like the presence or absence of wolves, the kind of forage in its environment, the temperature and snowfall of any given winter, the other animals competing for the available food, the numbers of hunters with licenses, the bacteria in its intestines that either keep it healthy or make it sick. Theory and ecology agree that there's no such thing as a self-enclosed, private piece of property, neither a deer nor a person nor a text nor a piece of land.[88]

This might seem like good intellectual doctrine to some, and the impulse behind it, the desire to see how things hold together in the natural world, is admirable. And yet Campbell's view of deer is flawed. She encourages us to treat deer, real live ones, fur, antlers, and all, as functions of the environments they inhabit. And on her view, these environments, along with everything in them (wolves, forage, snowfall, hunters, bacteria), must be subject in their turn to the same processes of qualification that effectively eliminate deer from consideration as beings that really are something. Considered at a certain remove and a high level of generality, Campbell's view may be persuasive as theory: as I pointed out earlier, environments are in fact entities that we have posited but have never observed in the wild, and never will. But deer aren't like that, and Campbell's view is nonsense as biology. No ecologist would agree with her that because they are caught up in ecological relationships larger than themselves, "there's no such thing" as a deer, or a piece of land.

Campbell makes an error complementary to the one made by antitheoretical, realist ecocritics who argue that texts are like the world: she argues that the world is like a text. She fails to recognize that deer are beings who can, in effect, say no even to ecology, and have said no to it more than once, on the many occasions when their behavior and population dynamics have failed to conform to ecological models. The view Campbell urges may be fine insofar as environments, which are merely suppositious, theoretical entities anyway, are concerned, but it isn't a practical view to take of deer.[89] Fortunately for them, deer can mount some resistance to our perceptions of them, as well as to wolves, hunters, microbes, and bad weather. Deer like tortoises are inveterate refuseniks, positively so; and if they have lived in a wood, it is a wood.

Loose Shoes

> *The features of objects reached by scientific or reflective experiencing are important, but so are all the phenomena of magic, myth, politics, painting, and penitentiaries.*
>
> *John Dewey,* Nature and Experience

Before we begin exploring nature-culture and the continuity of our lives in it, and before we begin probing "those searing rifts where the magma erupts" and the hard crusts of Nature and Society are first formed, it will behoove us to ponder a remark jotted down by Wittgenstein in one of his notebooks: "Philosophers use a language that is already deformed as by shoes that are too tight."[90] With this remark in mind, the questions we need to ask first, in our efforts to become more comfortably full of doubt, might be these. Do we need to discard the tight shoes our philosophical and cultural heritage has forced us to wear? Do we need to coin terms not already misshapen by prior application to nature or culture—to one or the other, that is, but rarely if ever to both? Are we going to need to gear up differently than we have in the past, so that in our thinking we are prepared to cover more arduous because more ambiguous terrain—metaphorically speaking, of course?

Yes and no. Such questions make the proposition implied by Wittgenstein's remark sound more dramatic than it really is. When Wittgenstein implies that we need a language not already deformed by its previous speakers, he isn't suggesting that we need *a new language*. For ecocriticism, this new language might take the form of an ecological Esperanto, which in all likelihood would devolve very quickly into a meaningless ecobabble. All Wittgenstein, who thought Esperanto was disgusting, is suggesting is that we come to terms with our language differently, not that we find new terms.[91] He thinks we should tell ourselves new and different stories with, in, and about the language we already have.

Rorty, who as a philosopher is very much influenced by Wittgenstein, argues that in order to "keep faith with Darwin" we must "think of the word 'language' not as naming a thing with an intrinsic nature of its own, but as a way of abbreviat-

ing the kinds of complicated interactions with the rest of the universe which are unique to the higher anthropoids."[92] For ecocriticism, which certainly should try to keep faith with Darwin, this means that restoring the world does not have to mean restoring the word.

One of the new and different, and more Darwinian, stories told by ecocritics will have to be a tale about how odd some of our old stories were, a tale about how they constrained us to make assumptions by which we were too tightly bound. In another of his notebook jottings, Wittgenstein reacts to a snippet of this tale, one pertinent to the subject matter of this book:

> It is very *remarkable* that we should be inclined to think of civilization—houses, trees, cars, etc.—as separating man from his origins, from what is lofty and eternal, etc. Our civilized environment, along with its trees and plants, strikes us then as though it were cheaply wrapped in cellophane and isolated from everything great, from God, as it were. This is a remarkable picture that intrudes on us."[93]

This "remarkable picture" is, I think, yet another version of pastoral. Wittgenstein described it in 1946 and, as Eco and Latour have demonstrated, it remains very much the picture on which we rely in most, if not all, of our thinking about environmental crisis and the intellectual tools we need to develop in order to cope with it. Most of those tools have been designed to punch through the cellophane and other cheap wrappings in which culture seems to us to have isolated itself from nature. We should consider Wittgenstein's suggestion that the cellophane is not really there, his suggestion that a picture, a *false* picture of our language and, by extension, of our culture, has held us captive.[94]

Philosophers and literary intellectuals are by no means the only ones among us who are susceptible to the seductions of this false picture of our world. Consider the environmental historian Donald Worster's outburst: "What is *truth*, what is *fact*, what is *health*, what is *beauty* in such a world? What can those words possibly mean? Total skepticism, total cynicism is the intellectual future offered by this industrial culture and its institutions."[95] Granted, I am quoting Worster's words here without regard to their context, but his despair seems overwrought. This makes it illustrative of my point, which is that we have no reason to assume that breaking the spell cast upon us by the picture Wittgenstein describes will be easy (as he knew only too well). Intellectually, breaking this spell involves a "refusal to draw a philosophically interesting line between nature and culture, language and fact, the universe of semiosis and some other universe," according to Rorty. Such a refusal becomes possible, he says, once "you stop thinking of knowledge as accurate representation, of getting the signs lined up in the right relations to the non-signs."[96]

I realize that Rorty makes our difficulty sound like a technical issue of concern only to intellectuals. While it's no secret that intellectuals often need recalibration, a larger, more broadly cultural readjustment must be made as well, because Worster's despair is widely shared in the community at large. We therefore need to reconsider the tissue of our ideas not only about nature and culture, but also about what Latour would like us to call "nature-culture," and to recognize that "our ideas" is a phrase to be understood in the broadest sense: it must comprehend the high-minded, the lowdown, and everything in between, "all the phenomena," as Dewey puts it, "of magic, myth, politics, painting, and penitentiaries."

Encouraged by Dewey and others, I am persuaded that the truth of ecology must lie somewhere, if it lies anywhere at all, in nature-culture, a region where surprising monsters dwell. In order to adapt itself to the vagaries of nature-culture, ecocriticism needs to be more willing to hybridize than it has been: it needs to have a heart and a brain as well as arms and legs, and as many of each as possible, and it should not hesitate to borrow additional body parts here and there as the need arises. To approach nature, culture, and literature equipped in this makeshift way may seem anarchic, but as Feyerabend notes, "*anarchism*, while perhaps not the most attractive *political* philosophy, is certainly excellent medicine for *epistemology*." In my view, this is just the kind of medicine ecocriticism needs to take in order to avoid the "comparative impotence" (as Lawrence Buell phrases it) brought on by dosing itself with a watered-down brand of realism. It ought, in other words, to use whatever "rags of argument" (Feyerabend's phrase) seem most helpful, without trying to coordinate and unify them as an ensemble and without binding them all to a particular point of view, since particular points of view are likely to be fraught with the metaphysics and received ideas ecocriticism needs to avoid.[97]

A hybrid blend of theoretical and philosophical insight, awareness of scientific method, and a thorough acquaintance with the facts (who knows what they will turn out to be?) is necessary if we want to address nature-culture in tandem and as a singular phenomenon, as a two-for-one, while also addressing, as need be, nature and culture as two things not quite one in some important respects, which will have to be identified, of course. Then and only then can we hope to trace the connections between nature, society, and discourse that Latour characterizes as comprising the anthropological matrix of nature-culture, while also recognizing the disconnections that put us in jeopardy environmentally. And then and only then can we hope to determine the ways in which those connections are strong or in need of maintenance, if not actually broken.

Of course, exploring the matrix of nature-culture should raise several questions for ecocritics of a more particular import. These questions are: What is the truth of ecology, insofar as this truth is addressed by literature and art? and How well—how ably, how sensibly, how thoroughly—do literature and art address this truth? Both questions have usually been ruled out of court in literary and cultural studies, thanks to a widespread skepticism about and blasé attitude toward the natural world. I share with other ecocritics a negative feeling about this blasé attitude, and I understand their scorn for what sometimes seems to me, too, to be a cheap skepti-

cism. However, I think a more effective counter to cheap skepticism than the renewal of belief in the veracity of the text is a skepticism that does its fair share, earns its keep, and pays its way, while never lapsing into indifference. So I would like to add another question to the ecocritical agenda, a question inspired by Umberto Eco. Does the truth of ecology lie "in" literature and art? Of course, the word "lie" should have the same ambiguity when ecocritics use it that it had when Eco used it or its Italian cognate twenty-five years ago. And they ought not use the word "in" without bracing it between a pair of quotation marks.

By taking a more skeptical approach, ecocriticism might avoid the dilemma posed by the rejection of theory, on the one hand, as needless abstraction, and by theory's rejection, on the other hand, of nature as a mere social construct or, still worse, as "gone for good." Rejecting theory leaves ecocriticism without a rationale for supporting its own assertions and minus the tools required to develop such a rationale: it can't get started. Meanwhile, the treatment of nature as something insubstantial by literary and cultural theorists bears us away from the shores where, despite all the things we've done to ruin them, we still must live.

I submit that the choice between theory and nature is a false one, since neither comes to us with its pristine character intact. Nature is not pristine for obvious reasons: we live in an age of overpopulation, hourly abuse of the natural world, and mass extinctions, and thus in an age of global environmental crisis. Theory is not pristine for the reasons cited by Joel Kovel, in his contribution to the notorious 1996 issue of the journal *Social Text* devoted to the "science wars" (about which I will have a few things to say in chapter three). If we can, for the moment, allow ourselves to conflate theory with postmodernism (not an unreasonable thing to do, if we put aside Latour's objections to the latter term), then a remark Kovel makes in his essay can help us begin to discover a way to bring theory and nature together more fruitfully than either the most hidebound theory or the most earthbound ecocriticism have managed to do. Kovel writes: "What might be oxymoronically called classical postmodernism"—or theory—"is now as obsolete as the high modernism"—and here we might fill in the blank in a variety of ways—"it punctured. Given the gathering threat, the postmodern critique of foundationalism clearly has to be rethought." He continues, "The postmodernist critique of science is true, and necessary, but also reductive insofar as it fails to recognize the material dimensions of the ecological crisis. And being reductive, it reveals its own false totalization, in this case, a crypto-idealization."[98] One way to translate Kovel's complaint about the false totalization or crypto-idealization of postmodernism is to put it into imperative form: postmodernism must be turned against itself. Its critical resources must be brought to bear on its own assumptions and presumptions. Or, in other words, theory itself must be subject to still more theory, and to some fact checking, too, the squishiness of the facts notwithstanding.

With these imperatives in mind, it's time to disenchant ecocriticism. We can do that by deploying theoretical, philosophical, and scientific insights in the development of a rationale for describing and interpreting the multifarious relations of culture and nature in the present day, as well as in the recent past. The difficult thing will be doing all this while avoiding the cryptic and totalizing tendencies, as well as the pastoral ones, that lead us astray, lest the deer start to look like less substantial beings to us than they once did, in olden days when we weren't as sophisticated as we are now. Attempting to disenchant ecocriticism also will encourage us to acknowledge that the work we do needs to involve argument. It needs to involve both vigorous internal debate and the painstaking working out of new insights that might make ecocriticism's argument more persuasive to outsiders and to insiders, too, than it has been thus far.

2

Ecology Then and Now

As a word, ecology has been so debased by recent political usage that many people employ it to identify anything good that happens far from cities and without human interference.

Stephen Jay Gould, An Urchin in the Storm

Ecology as Point of View and as Science

In the 1960s, ecology began to be popularized in the United States as one of the many utopian discourses for which the decade was both a watershed and, in the end, a burying ground. But the discourse of ecology was luckier than others: its credibility was strengthened both as the sixties wore on and in the decades to follow, despite the rise of neo-conservativism, which was quick to dismiss all things associated with the sixties as nonsense, and notwithstanding a general atmosphere, in the culture at large, of reaction and retrenchment. As a result, ecology has come to be identified in the popular mind with such values as balance, harmony, unity, purity, health, and economy. It's fair to say that many people regard these values, however utopian they may be, as all but indisputable and as all but synonymous with the very word "ecology." Few laypersons dare to question these values publicly, and imagery expressing our collective devotion to them, and indeed to everything green, pervades our daily lives. For those who applaud the apparent improvement in our attitude toward the natural world over the past forty years, the thought that the values of balance, harmony, unity, purity, health, and economy have something other than a transcendental basis—the thought that, unlike other utopian values, they are supported by ecology, which is to say, by all the authority of science—is a source of comfort and confidence.

In this chapter, I am going to violate what amounts to a taboo: I am going to argue that our confidence in ecology has been misplaced, or rather misjudged, and that we have been overly credulous when listening to its popularizers. The values to which ecology dedicated itself early on—especially balance, harmony, unity, and economy—are now seen as more or less unscientific, and hence as "utopian" in the pejorative sense of the term. And they are seen that way not only by critics who have a vested interest in distracting our attention away from a deteriorating natural environment, and who like to dismiss all ecological concepts as so much moonshine (lobbyists for oil companies, American automobile manufacturers, their bootlicking government apologists, and the like), but by a growing number of ecologists as well, who are, needless to say, in a position to know whereof they speak. Precisely because the values in service of which ecology was founded in the late nineteenth century were utopian, no one was certain of their meaning, and so they either gave rise to endless debate and speculation, or were abandoned as utterly impractical by dissident ecologists sometimes branded as heretics by their peers. I am going to try to show that the dissidents turn out to have been right all along.

To complicate these matters still further, another aspect of the story of ecology needs to be highlighted before I begin telling that story in proper chronological order and in detail. For it isn't just ecology's core values that have been cast into doubt and rejected as unfeasible: the situation is much more dire than that. Because its original objects of study—supposititious entities such as, for example, the *climax forest*—were not only poorly defined and poorly described but were also of debatable reality, ecology's history has been marked by conflicts growing out of a lack of consensus about the parameters that should guide the statement of hypotheses and the conduct of research. In other words, ecologists have not been able to agree about what actually counts as ecology. *Basic ecology*, that is, not cutting-edge or revolutionary ecology, but the sort of workaday science a Kuhnian would describe as "normal."[1] Ecological theories have tended to arise and flourish only very briefly, before their flaws are exposed by poor experimental results and by the keen eyes of critics.

These critics have pointed out, with almost monotonous regularity, that (1) ecologists need to define and describe their objects of study in terms unlike those used by other scientists, so that their own research will have a distinctly ecological content and a unique fund of core concepts on which it can draw; that (2) ecologists also need to find out how to work with the things they study experimentally, in a fashion that will help make ecology truly distinct from other kinds of biology; and that (3) both of these things have proved very hard for ecologists to do, and not for lack of effort. Ecologists have been forced, time and again, to borrow the terms and concepts of other sciences, as well as their objects of study and methodologies. Ecology's chronic indebtedness to other sciences has had the effect of making it appear overly metaphorical to outsiders, who often have regarded it as a fuzzily defined and value-ridden "point of view," rather than as a coherent scientific enterprise in its own right.[2]

So it was that beginning in the late nineteenth century, and for a long time thereafter, ecologists tried valiantly—and in many cases, vainly—to give their discipline a foundation of well-established facts and agreed-upon theories of the sort enjoyed by other sciences, especially physics, which seemed, rightly or wrongly, to be the very standard of objectivity and theoretical probity. Ecologists wanted to join in the family business of science without having constantly to review their intellectual pedigrees and capital resources. They knew that shoring up a scientific discipline's

foundations always means discovering and coming to terms with the fundamental forces, processes, entities, and mechanisms on which the discipline's efforts to understand nature, whether only in part or as a whole, must focus. Thus they found themselves struggling with awkward problems of scientific methodology, and asking difficult questions, first about what it really means to identify nature's cogs and wheels, and second about how one might, having identified them, then go on to describe the workings of those cogs and wheels. For starters, many ecologists wondered if mechanistic language of the sort I've just used should not be rejected out of hand as an implicit betrayal of everything that the word "ecology" implied. They thought organic metaphors might be more appropriate to the study of nature; in fact, many of them thought such metaphors really might not be that metaphorical after all, since they felt sure that nature itself was one vast organism, the parts of which formed a seamless whole.

Because there are a number of respects in which the discipline still struggles to define itself today, even if it no longer feels quite so abashed in the presence of an all-mastering, apparently all-powerful physics as it used to feel, in the pages that follow I am going to be especially concerned to explore the gap between ecology as a "point of view" and ecology as a science. Exploring this gap is a task incumbent upon anyone seriously interested in environmentalism and natural history, a task that in my view ecocriticism has put off for far too long. Further delay will mean that ecocriticism also continues to fall between two stools, and whether this will confirm its claim to be interdisciplinary or will cast doubt on it is unlikely to require a judgment call. As things now stand, ecocriticism is open to the charge that it, too, is no better than a "point of view," and a second-order one to boot, since in order to support its own assertions about how the green world is structured and functions, ecocriticism must appeal to and look over the shoulder of another discipline, which it supposes to be situated much closer to the action (to nature, that is).

In situations like this one, in which one discipline wants to piggyback upon another, an academic version of the tragedy of the commons transpires, as the space between disciplines gets treated as if it abounded in exploitable resources and as if it were infinitely divisible; and before long, range wars begin to erupt. Still more fundamentally, something like Zeno's Paradox comes to be in effect, so that assertions made by those working in one discipline never really connect with their targets in another, all appearances of good will and acquaintance with the facts to the contrary. To put the point I am making in yet another way, in interdisciplinary work of the kind that ecocriticism purports to be, the gaps between disciplines, especially the infamous gaps between the arts and the sciences, are apt be papered over rhetorically. All too often, little or no effort is made to confront these gaps directly and to bridge them argumentatively, where that is plausible (sometimes, of course, the gaps are simply unbridgeable, and the disciplines may have little, if anything, to say to one another). The inevitable result is that basic errors of fact and interpretation, especially of the latter, are perpetuated under the banner of interdisciplinarity.

For ecocriticism to be of substance as an interdisciplinary field, it needs to realize that ecology is not a slush fund of fact, value, and metaphor, but a less than fully coherent field with a very checkered past and a fairly uncertain future. I suspect that many ecocritics would be dismayed to learn that despite ecology's heroic popular image, it has been characterized as a relatively lightweight science by informed observers whose criticisms of it cannot be dismissed as mere carping, even if those criticisms have sometimes been too harsh, above all when other biologists less taken with fieldwork than ecologists are have held the floor.[3] In point of fact, ecology has not enjoyed as great a record of success as the other life sciences have. Nor has it always been entirely in line with the ethos prevailing in those other sciences, and this maverick quality has proved to be much less of a virtue than it once was assumed to be.

The divergence of ecology from what is widely regarded as the scientific norm becomes especially clear when it is compared to molecular biology. As a macrobiological science, ecology appears to be fundamentally at odds with microbiology, which has provided the dominant model, both theoretically and methodologically, in the life sciences since the late nineteenth century, owing in no small part to its tremendous successes, of which it should suffice to mention only the discovery of DNA as a leading example.[4] By bucking the trend toward reduction in biology, ecology has found itself in the unhappy position of seeming to disrupt the unity of the sciences. This is an especially embarrassing circumstance for a discipline in which a great deal has been made of unity as the supreme value established by nature itself. In light of this circumstance, it is clear to me that ecocriticism will have to abandon its rather mystical view of ecology as the binding force holding together not only all of the sciences, but nature and culture as well. Ecology sparks debates about environmental issues, it doesn't settle them; and it also sparks debates both about what should and shouldn't count as science, and still more fundamentally, about what should and shouldn't count as nature.

In all fairness, however, one has to note that ecology's reputation as a maverick science actually rests largely on a number of overstatements made by its popularizers, of which there has been no shortage, and hence on a series of false impressions. In fact ecology is not so radically different from other sciences as has been thought and said.[5] To point this out is not to gainsay ecology's differences from other sciences; it is, instead, to make those differences seem appropriately relative. Ecology's reputation as a science wholly unlike others is largely an artifact of its being still in the early stages of development after more than a century. Its rather halting progress toward maturity has gone mostly unnoticed, except in specialist journals and monographs, and this oversight has contributed greatly to a general misunderstanding of ecology's character, especially on the part of those who have wanted to procure its blessings for political purposes—or merely to credit themselves with some of its graces, as ecocritics arguably have done.

Given the abuses to which ecology has been subjected by its admirers and its detractors alike, it is crucial to understand that despite the popular image of its prac-

titioners as easygoing, nature-loving outdoor types with an eccentric affinity for newts, shellfish, algae, lichen, prairie grasses, and other life forms lacking in charisma, ecology is in many respects an extremely difficult science. That it is so difficult does much to explain its slow and uncertain advancement. Newts, shellfish, algae, lichen, prairie grasses, and the like aren't necessarily easy to know: docile and even immobile though they may be, they lead inordinately complicated lives.[6] This fact alone makes our misapprehension of ecology's true character very important to recognize as such. We want ecology to simplify things for us, and that is something it really cannot do.[7] Nonscientists often demand that science serve us as an augury of our collective fate. But this is a service science is usually unable to provide honestly and in the unambiguous terms that we nonscientists would like it to use.[8]

The distortion of popular ecological rhetoric reflects something more, however, than just the allure of utopian thinking and prophetic posturing. It also expresses a widespread distrust of science, which more often than not can be measured in units of ignorance, and which may very well mark the site of a massive cultural contradiction. We all want science to tell us what to expect in the future, but at the same time most of us really don't like to hear what science has to say. Many people believe that ecology is a science unlike others because by embracing holism it is supposed to have avoided the pitfalls of mechanistic reduction. Yet few if any practicing ecologists share the distrust of science attributed to them by those who glamorize and misrepresent their work. The same institutions that train physicists and molecular biologists, often vilified as the most reductive scientists of all, also train ecologists, who imbibe assumptions about methodology similar to if not identical with those that their peers in other disciplines are weaned on. Ecology's research agenda is increasingly directed toward making it look more like the harder, more mechanistic and reductive sciences, not less: and inevitably so, since it seeks "the same kinds of explanation as are sought in the other sciences."[9]

In pursuit of explanations that will stand up under the scrutiny of other scientists, the claims of ecologists about the natural world have become both much more specific and a lot more tentative over the past forty years, which explains the whiff of paradox that seems to hang about the more startling of their claims. Those claims tend to cast doubt on the practical importance of values like harmony, balance, unity, and economy in the day-to-day functioning of actual natural systems; in fact, they even call into question the very idea that nature contains anything so self-regulatory and so thoroughly integrated as to justify the use of the word "system" to describe it in the first place. The increased modesty of ecology, both in theory and in practice, also explains why and how its utopian impulse has been muted, if not rooted out altogether. Utopian yearnings are best expressed in glittering generalities, and ecologists have learned to be extremely wary of those: hence their current willingness to be more "reductive" than they were in the past. Curiously, their newfound willingness to be "reductive" also has had the rather surprising and possibly quite liberating effect of making ecologists more adventurous, where some cutting-edge ideas like chaos theory are concerned.

In any case, one can assume that the utopian aspect of their science always seemed less prominent and less promising to most ecologists than it did to conservationists, environmentalists, and other onlookers from outside the field. But as it so happens, the lay celebrants of ecology as a utopian discourse have included a number of people in a position to know better. They have tended, however, to ignore or downplay the cautionary statements made by practicing ecologists, when they haven't rejected them outright. One of the most prominent of these people, the environmental historian Donald Worster, is very much a case in point: he continues to exaggerate the scientific credibility of an old-fashioned variety of ecology that he finds more congenial than the skeptical variety that replaced it years ago.

I realize that for me to take issue with Worster may seem, to those who are familiar with his work, like hubris. For that matter, for me to try and tell the tale that I relate in this chapter also may seem like hubris, lacking in the relevant credentials as I am. And it may seem unnecessary as well, since Worster and other environmental historians have reported the story of ecology since its beginnings in the late nineteenth century already, and have done so in detail and very ably for the most part. They have focused on the development of ecological theory, on the genesis and growth of schools of research, and on the application of ecological science to questions of agricultural policy and to watershed, forest, and wildlife management, a roster of topics that might seem to exhaust the subject matter. This subject matter is one about which environmental historians are very keen, since they tend to be committed environmentalists in their own right, making their interest in ecology more than academic—as no doubt it ought to be.

However, for my purposes and for the purposes contemplated by ecocriticism, the stories that environmental historians have told about ecology need to be given a different and a less celebratory emphasis, so that the peculiar intellectual difficulties ecology faces, which have cropped up in all stages of its development as a science, can be underscored and addressed as frankly as possible, and in a more philosophically probing way than they have been in the past. This is particularly true, in my view, of the stories that Worster has told about ecology: his book *Nature's Economy*, which approaches the development of ecology from the vantage point of intellectual history, is often the only source that ecocritics cite in support of their claims about the natural world and the growth of our understanding of it.[10] That they should rely on Worster's book to the exclusion of others may be only natural, if you'll pardon the expression, since Worster is widely acknowledged as the dean of environmental historians—indeed, as one of the founders of the field of environmental history itself, in which the initial publication of *Nature's Economy* in the late 1970s was a seminal event.

However, to my way of thinking, Worster's influence on ecocriticism is unfortunate, and while some, at least, of the template I have relied on in telling my own story about ecology is borrowed from my reading of his work, I've also tried to incorporate in that story both the views of other environmental historians and of philosophers of science, and as much direct testimony from ecologists themselves as I could digest in an intelligible way. I've found this hands-on and ambidextrous approach to the history of ecology necessary in order to compensate for the distortions of those ecocritical statements on the subject that are quite purely and simply naïve, and with regard to cases where such statements have been better-informed, in order to counterbalance the influence on ecocriticism of Worster's work.

Worster's remarks about the increase in theoretical modesty in ecology since the 1960s demonstrate that he has little sympathy for the scruples ecologists increasingly feel. In fact, he expresses a prickly disdain for those ecologists who have pointed out the stumbling blocks strewn across the path of the discipline's progress as a science, and treats their misgivings as symptoms of intellectual timidity and a loss of faith in the ecological vision. Worster even goes so far as to hint that their expressions of doubt about such classic ecological concepts as, for example, the ecosystem may be politically motivated. "For some scientists," he writes, "a nature characterized by highly individualistic associations, constant disturbance, and incessant change may be more ideologically satisfying than Odum's ecosystem, with its stress on cooperation, social organization, and environmentalism."[11] Because of passages in which he makes insinuations like this one, Worster's work strikes me as biased, and in fairly obvious ways.

There is no doubt that the trend of recent ecological science toward revision makes life more difficult for the environmental historian, since it's harder to hit a moving target than a still one. But this doesn't mean that ecology has become ideologically suspect or is asleep at the switch, as Worster alleges.[12] He seems to think that the difficulty environmental historians face in constructing their accounts of ecology's development is not a historiographic difficulty, but is to be explained in terms of the changed character of the science since the 1960s. In other words, he seems to think that the object of study is to blame for the difficulty the historian of ecology faces when he or she tries to describe it accurately.[13] What Worster dislikes most about contemporary ecology is, essentially, that it is too much prey to the vicissitudes of science—that it is overly influenced by the evidence presented to it, evidence which runs contrary to some of the classic assumptions of the field. Worster thinks contemporary ecology ought to be more stouthearted ideologically, and ought to resist falsification more strenuously than it does. Environmental history, he writes, now has to contend with a science "caught in the middle of a revisionist swing that has left in some disarray the notion of what an ecosystem is and how it works, that has even cast doubt on such old intuitive notions as 'the balance of nature' and the role of diversity in promoting ecological stability."[14]

Such is Worster's fondness for those "old intuitive notions" that he actually understates the extent to which doubt has been cast on them and has left them in disarray.[15] He does so, I think, because he wants ecology to provide something more than sustenance for environmental historians hungry for fresh subject matter. He wants ecology to provide guidance, too, and not just guidance of a scientific kind. He would like to be able to depend on ecology as a moral compass, and he makes it clear that he is disappointed in "the new ecology" because its "lessons" are "not at all clear."[16] The new ecology, in Worster's eyes, is morally as well as politically suspect, since it is more value-neutral than the old, and therefore less socially and politically useful in the short term. As one of his colleagues, Richard White, has argued, "Worster's account of environmental history is as much a prescription as a description." White thinks Worster's influence on the field of environmental history has been less than entirely healthy: "Having defined the field, Worster outlines what might be called its methods. Here, however, under the guise of stating conventional wisdom, he is trying to create it, or rather to impose a much older construct on the field."[17]

Environmental historians have tended to be hopeful, and a little prescriptive, in their appraisals of ecology, White argues, because they have tended to be hopeful and a little prescriptive about environmentalism. He writes:

> Environmental historians once thought that they had a firm basis for their morality and causality. Historians read the science of ecology as both detailing basic natural processes and yielding certain moral verities: complexity is good, simplicity is bad; natural systems seek equilibrium and battle disruption; there is an ideal balance in nature that, once achieved, will maintain itself. Those verities gave historians standards against which to measure and evaluate the repercussions of human action.

Now that the verities of ecology have been shown to be less than wholly veritable (or less than wholly verifiable), White suggests that environmental historians also have been plunged into uncertainty: "Historians thought ecology was the rock upon which they could build environmental history; it turned out to be a swamp." White also suggests, on the other hand, that it is possible to overreact to the apparently dramatic change in ecology's character. He reminds his reader that although in popular usage the term ecology is used loosely to refer to "nature," its referent "is, in fact, only an academic discipline."[18]

Ecology of the holistic sort that, like other environmental historians as well as many ecocritics, Worster still idealizes, has passed out of fashion largely because of the poor results it generates when put to the test experimentally. Many ecologists now see concepts like cooperation and social organization, when applied to the natural world, as ambiguous at best and irrelevant at worst. These ecologists are still very much committed to environmentalism, even if they don't express their com-

mitment in the glowing, uplifting terms that environmentalists would prefer them to use. Ecologists have begun to hold themselves accountable to more exacting standards in recent decades, which has made them less available and less pliable as spokespersons for the environmental movement.

Like many members of the American environmental movement, Worster is a sort of populist. On his view, all kinds of things—certain religious beliefs and rituals, for example, not to mention any number of literary texts—can be counted as "ecological" even if they have no bearing whatsoever on our scientific understanding of the natural world. This explains the great attraction of Worster's work for ecocritics, who are also populists of a sort, and who therefore would like to think that ecology is readily accessible to anyone who is able to read certain primary texts, to appreciate certain kinds of symbolic behavior, and to savor both pastoral and pristine landscapes. Especially in *Nature's Economy*, which is regarded as a classic of environmental history largely as a result of its being one of the first synoptic accounts of the subject, Worster construes the history of ecology very broadly—so broadly that he conflates it with the history of cultural movements like Romanticism, when its resemblance to those movements is much more apparent than real. Worster argues that the "Romantic approach to nature" is "fundamentally ecological" because it is "concerned with relation, interdependence, and holism."[19] In effect, Worster concedes the main point to its critics by treating ecology as if it really were no more than a "point of view," one that can be adopted more or less readily by those gifted with a modicum of imagination.

The ecologist Robert McIntosh has noted that because Worster overlooks some of the stark realities of the historical record, he grossly overstates the importance of literary natural historians like Gilbert White of Selborne and Henry David Thoreau to ecology. McIntosh suggests that "retrospective views of ecology" often produce little if any evidence that the work of writers like White and Thoreau, however intuitive those writers may have been about natural history, actually "was connected with, or led to, that of later workers. That brilliant ideas have been amply studied, elegantly expressed, and even published without having influenced the work of contemporary scientists is familiar in the history of Gregor Mendel's lonely efforts."[20] The fact that the great majority of ecologists did not and do not read either White's or Thoreau's work as being ecological, if they read it at all, and the fact that they did not and do not regard White and Thoreau as fellow workers in the field, should be decisive. Curiously, Worster doesn't take these facts into account, nor do those ecocritics who have been following his lead in constructing their own narratives about ecology, narratives in which White, Thoreau, and their ilk play a central role.[21]

While a few of the stumbling blocks strewn across the path of ecology's progress as a discipline have surely been ideological, much as Worster alleges, most of them have been—and are—all too real. They cannot be wished away, or made to vanish

by a change in attitude and outlook or "point of view," no more than the gap between literary natural history and ecology can be eliminated simply by conflating the two in a sweeping narrative of intellectual history focused on ostensibly Romantic ideas. The misgivings that ecologists first began to express in the 1960s originate in a struggle with problems grave enough to call into question, yet again, ecology's status as a science. If ecology has been a success as a science, it has been a very qualified one: research in the field continues to advance and retreat along a wavering, uncertain front. What previous generations of ecologists regarded as black-letter scientific truths, or "laws of nature," the current generation treats as so much wishful thinking. More or less out of necessity, many ecologists have become quite sophisticated about the theoretical and philosophical difficulties with which their discipline is beset. These ecologists use words like "truth" and "law" only very tentatively and somewhat apologetically, if they use them at all. They have ceased to be students of the absolute and the unchanging, and have become students of the probable and the ever-evolving.[22]

Notorious as the perils of disciplined, undisciplined, and interdisciplinary academic work are, it nonetheless is puzzling that the overstatements, misstatements, and misinterpretations I have described should have been perpetrated so often. Why assume that ecology is what the slogans of the environmental movement say it is? Why treat a writer like White or Thoreau as an ecologist, when history clearly demonstrates otherwise? In other words, why premise the value of their writing on its anticipations of what may or may not come to be counted as ecological principles, especially since such anticipations can only be, in the nature of things, vague at best? Historical and literary scholars are much too easily tempted to tell seamless stories about the things that interest them by discovering family likenesses and postulating common points of view where none exist.

Like other scientists, ecologists have to acknowledge the difficulties they face sooner rather than later, and as forthrightly as they can. They also have to find practical ways of overcoming those difficulties. Thus there is a danger that those who, like myself, are interested in ecology, but whose training is not scientific and who must cope with an entirely different set of difficulties, will gloss over or minimize the significance of the problems ecologists face in understanding the natural world. Ecocritics have seized upon ecology as an accessory and complement to their own brand of professional discourse because of their commitment to environmentalism, and because they have thought that ecology offers scope for the vibrant depiction of a natural world conceived of organically. The latter is something that literature used to offer, until theory had its way with it—or so it is said. But not all of the workings of the natural world are organic, and most of them are far from obvious. The truth, as I hope to demonstrate, is that the history of ecology has been one of discovering how much unlike an organism and just how nonobvious the natural world can be.

From Analogy to Algebra

> *The world . . . is never simple; it doesn't even provide apt metaphors.*
>
> *Stephen Jay Gould,* An Urchin in the Storm

The German morphologist Ernst Haeckel coined the term *oecologie* in 1866, but without ever doing any actual research in the field. Unfortunately—or so it seems from the environmental historian's perspective—this means that the origins of ecology cannot be traced solely to Haeckel.[23] Nor, for that matter, can they be traced to any other single theorist and researcher. The murkiness of ecology's origins is a reflection of the fact that substantive existence as a science proved very difficult for it to come by. For instead of being founded on new discoveries that opened up original avenues of research (on a so-called Copernican revolution), ecology was inspired by misgivings about reduction as a central tenet of scientific theory and methodology. It was thought that by being reductive in such a thoroughgoing way, scientists were running the risk of breaking the butterfly upon the wheel, hence of traducing the very vision of nature that gave science its grandeur and nobility as a human endeavor, not to mention its moral and philosophical sanction.

Given its origins in a reaction against an entrenched status quo, it was inevitable that a few researchers found themselves doing ecology almost before they were aware that this might be the proper name for what they were doing. Casting themselves, implicitly or explicitly, as a new breed, these ecologists-in-all-but-name insisted that important biological processes were at work at levels other than that of the individual organism, population, or species, and they proposed that these processes should be investigated *in situ*—in the field. Both by default and by design, their research agenda was at odds with the general trend of the biological sciences toward greater specialization and a narrowing focus on smaller and smaller entities easy to experiment with in a controlled setting, such entities as monkeys, rabbits, mice, fruit flies, microbes, single cells, and (eventually) strands of DNA. Ecologists were beginning to do macrobiology and fieldwork at the very moment when other scientists had become convinced both of the primacy and, more important, of the practicality and greater utility of microbiology and laboratory experiment. To other scientists, ecologists appeared to be taking a step backward, and were simply mistaken to think that they had found a new way of understanding the natural world.

The distinguished evolutionary theorist and ornithologist Ernst Mayr explains that the origins of ecology involved a departure from older ways of doing natural history through the adoption of more up-to-date assumptions about scientific method: "Natural history had to become explanatory. It continued to do what natural history had always done—observe and describe—but by applying other scientific methods to the observations (comparison, experiment, conjectures, testing of explanatory theories), it became ecology."[24] But in its early years and for many years thereafter, the new science's departure from natural history was probably more apparent than real. Despite the trappings of improved method with which it had adorned itself, ecology continued to cling to some of the bad habits that other forms of science were struggling to give up, including "observation, description, and an inductive approach."[25]

In the United States, ecology did not begin to be recognized as such until three decades after Haeckel first coined the term, which botanists were the first scientists to use. As a result, many of the earliest ecological concepts to be developed and disseminated in the United States were limited in application by their botanical bias.[26] Botanical concepts of ecology emphasized static, visually obvious features of the natural world at the expense of others. Simply by virtue of the fact that plants are stationary and are usually the first living things that we see when we enter an unfamiliar landscape, they are, quite literally as well as figuratively, much easier to grasp than animals are, both as individuals and collectively.

Early work on so-called plant communities was dominated by the idea of *succession*. According to this idea, the order in which plants colonize the newly barren ground of a disturbed site follows a standard script and is coordinated between species to a high degree. So powerfully attractive was the idea of succession that ecologists assumed its order must be determinate, which meant that if the relationships governing it could be discovered and precisely described, succession might be treated as a predictable process—and as a platform for experimentation in the field. Ecologists also assumed that succession, being determinant, was teleological: that it would continue to unfold until a dominant plant or group of plants became established, in habitats favorable to the dominance of that plant or group of plants (clearly, a certain amount of circular reasoning help to make the idea of succession seem plausible). The "ecology" of each habitat was therefore identifiable, and could be expressed in terms of the dominant vegetation, which would persist in a relatively stable state (called "homeostasis") provided that it wasn't disturbed or destroyed by drought, flood, wildfire, disease, parasitic infestation, human intervention, or a catastrophic change of climate. Until and unless one or more of these things should befall it, a habitat could be labeled a "pine forest," an "oak savanna," a "tall-grass prairie," or what have you, and managed (i.e., left to fare as best it could) accordingly. Most importantly, ecologists insisted that the value of these descriptive labels was more than pragmatic, which meant that they were not to be regarded as mere place-markers, since they denoted actual living things. A pine forest, an oak savanna, or a tall-grass prairie wasn't just a coincidence of natural history. Each of these habitats could and should be treated with all possible rigor by researchers as a single entity: as an organism, and even as a species.

One of the earliest attempts by an American botanist to describe the ecology of a particular habitat can be found in Henry Chandler Cowles's 1899 article, "The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan." Also to be found there is one of the earliest American definitions of ecology, a definition in

which the botanical bias is evident. "The province of ecology," Cowles wrote, "is to consider the mutual relations between plants and their environments." The best way "to consider the mutual relations between plants and their environments," he suggested, was to "study the order of succession of the plant societies in the development of a region" and to "endeavor to discover the laws which govern the panoramic changes." He summed up by characterizing ecology more abstractly and more philosophically as "a study in dynamics." Sand dunes are in fact among the most dynamic and changeable of landforms; as Cowles admitted, "The dune-complex is a restless maze."[27] This means that the "plant societies" of the sand dunes are also much more dynamic and changeable than vegetation seems to be elsewhere (in an old-growth forest, for example). For this reason, Cowles was tentative in his conclusions about the ecology of "plant societies," a lot more so than other botanists were at the time. He realized that panoramic changes, or gross alterations in the visual appearance of ensembles of plant species, might not have an inherently *biological* meaning. They might reflect instead such nonbiological factors as, for instance, catastrophic soil erosion brought on by floods or high winds.

Perhaps the least tentative of early plant ecologists was Frederic Clements, whose career began when he was a graduate student studying botany at the University of Nebraska in the 1890s. Clements was a leading figure in American ecology before the Second World War. Two of his ideas, *climax* and *the organismal concept*, were accepted widely by other scientists at one time, and remain part of the popular conception of ecology today (regrettably so). The two ideas are really one: according to Clements, the climax is "a complex organism inseparably connected with its climate and often continental in extent." The climax has "visual unity" because of "the life-form of the dominants, which is the concrete expression of the climate." In other words, the climax is hard to overlook. It tends to be obvious, much in the same way that mountain ranges are obvious. The climax might take the form of a great hardwood forest in which the beech tree seems to be the predominant species, or it might take the form of a boreal forest in which one or two species of conifer far outnumber other kinds of tree, in a wide belt of vegetation almost circumpolar in extent. Such climax forests constitute superorganisms, Clements argued, not only by virtue of their tremendous size and vast biomass, but also because they have developed in the same way that a single organism develops both ontogenetically (i.e., during its own life span) and phylogenetically (i.e., from its ancestor organisms).[28]

Clements didn't treat the organismal concept as an analogy, though that is what it was. Nor did he treat it as a metaphor, though that is how it tended to function in his theories. He regarded forests, grasslands, and the like, especially if they had reached the stage of climax, as organisms strictly speaking and as evolutionary units, because in his view they just *were* those things; in fact, in his view they were, to all intents and purposes, distinct species. Clements's theories appealed to other ecologists, one suspects, chiefly because they seemed to give ecology an especially firm grip on the natural world. A Clementsian ecologist did not hesitate to treat a particular forest or grassland as a separate species, rather than as a unique instance or coincidence of vegetation. To such an ecologist, isolating a single quadrat (of, say, ten square meters) in an area (of, say, ten square kilometers) where climax had been reached seemed to be an entirely reasonable procedure, rather like taking a tissue sample (ecologists have always found it hard to resist physiological analogies). Counting the species within a quadrat, multiplying by the appropriate factors, and comparing the resulting data with data generated by the study of another quadrat located in a similar area of forest or grassland nearby, possibly one disturbed by fire or abnormally intense grazing due to an overpopulation of deer, also seemed like reasonable procedures. Clementsian ecologists were sure that their methodology was both theoretically sound and pragmatically grounded, and that the results it generated were wholly reliable. For within a given climax, one quadrat was as valid a sample as another, *by definition*; and it was assumed that forests and grasslands all followed similar orders of succession.[29]

But Clements's enthusiasm for the organismal concept led him to gloss over or deny its inconsistencies, of which a few, at least, of his contemporaries were fully aware.[30] In its strongest, most metaphorical, indeed almost mystical and hence most vulnerable form, the form in which Clements actually promoted it, the analogy between the climax and the mature organism was said by his critics to be a false one.[31] It ignored the many important and quite obvious differences between mature grasslands or forests, and adult animals or plants. Grasslands and forests aren't really very similar to organisms at all, much less identical to them. But Clements was dogmatic: despite the glaring defects of the organismal concept, he built an elaborate structure of explanation centered on the idea of the climax. He also identified a number of stages of development leading up to and following the climactic stage, and devised a cumbersome Latinate vocabulary in order to keep track of them all.[32] His theory was bound to collapse of its own weight eventually.

It's worth noting that Worster, who clearly sees Clements's theory as an instance of the visionary, Romantic ecology he most admires, has explained its fate rather differently than I have here. Worster suggests that the climax concept was directly in competition not only with scientific orthodoxy (which in this case was truly on the side of righteousness) but also, and more importantly, with Frederick Jackson Turner's Frontier Thesis and the epic of nation building described by James Fenimore Cooper in his Leatherstocking novels. In Worster's view, the climax concept has something crucial in common with both Turner's and Cooper's ideas about America's growth and development. He suggests that Cooper, Turner, and Clements shared a similar intellectual disposition, and points out that all three attempted to define the basic character of historical processes in terms of the unfolding and eventual fulfillment of grand narrative designs. He also notes that all three men enjoyed thinking about the American countryside as a vast stage on which events of historic importance could take place: that there is a spatial as well as a temporal dimension to each man's thinking. But Worster argues that, all similarities

aside, Clements's views were fundamentally in conflict with those of Turner and Cooper, and therefore had to yield under pressure of national necessity:

> According to the Turner-Cooper view of national development, a mature and complex civilization must emerge out of the pathfinding exploits of a ruder culture; Clements and the mainstream of Anglo-American ecology offered a similar view of the evolution of the biotic community. But the two processes were fated to meet, it seemed, in irreconcilable conflict. One would have to give way to the other; it was not possible to have both a climax state of vegetation and a highly developed human culture on the same territory.[33]

Worster is right to note that the Leatherstocking epic, the Frontier Thesis, and the concept of the climax state are each ways of giving progressive shape to what otherwise might seem like anarchic or chaotic processes. Superficially, at least, the three are similar. That, however, is probably the merest coincidence, and Worster is mistaken to argue that the concept of the climax state was bound to be rejected, not because of its weaknesses as a scientific concept, but because it was ideologically unpalatable and could not compete with what had become a central tenet of the orthodox view of American history.

Worster treats both the superficial resemblances between the concept of the climax state and the "Turner-Cooper view of national development," and the differences between them, as more meaningful and less coincidental than they actually are. I would argue that this demonstrates the inherent weakness of the "history of ideas" approach to understanding ecology. (I think it also demonstrates the inherent weakness of any strategy that involves carving out new territories for interdisciplinary work by filling in the spaces between disciplines with spurious analyses and interpretations.) The concept of the climax state did have "to give way," but not because it was in ideological conflict with the views of Turner and Cooper; to be that, it would have had to be more in contact with them than it is likely to have been. In the event, things were much less dramatic than Worster would have us imagine: the concept of the climax state had "to give way" because of its inconsistency as a scientific concept and because of its great impracticality, neither of which were immediately apparent to Clementsian ecologists for a variety of reasons, not least among them the fact that these were still early days.[34] Clementsian ecology was not overcome on the field of ideological battle; it just petered out, through increasing lack of interest in its ideas.

The plant "community" and the "organismal" climax forest are only two examples of the charm that analogy held for the first few generations of ecologists, and perhaps it is to be expected that the key concepts of a new science will be of an essentially analogical character. Theorists and researchers know that they need to develop a distinctive approach to nature if their work is to be recognized as innovative science, and one way to begin developing such an approach is by suggesting some

original and striking analogies, preferably ones that play off one another in a more or less integrated fashion. In the late nineteenth and early twentieth century, ecologists realized that they needed to treat nature in terms and using tools other than those used in taxonomy, which emphasized the identification and description of individual species, and the collection of numerous specimens of those individual species. In principle, taxonomy was never-ending and never cumulative, at least not in a way that satisfied ecologists. They hoped to discover the broader categories in terms of which nature was organized and structured biologically, and to devise practical ways of demonstrating the functional reality of those categories experimentally. In attempting that discovery and demonstration, ecologists tended to emphasize the similarities between things, and between different orders of things, more than their differences. Analogies helped them do so.

Focusing on the similarities between natural phenomena seemed to offer early ecologists a means of extending their understanding of a few relatively well-explored aspects of natural history into new areas of research. They assumed that to extrapolate from one discipline to another (say, from botany to ecology) and from one level of biological functioning to the next (say, from the individual plant to the plant community) would be a reliable procedure because it was a reasonable one. They felt sure that the biology of individual species provided ample information about the ecological relationships obtaining between species, and between whole groups of species and their habitats. They also felt sure that these ecological relationships tended to emerge uniformly whenever and wherever plants and groups of plants evolved in company. Ecologists therefore argued that once the necessary fieldwork had been done, it would be possible to treat associations of plants much in the same way that botanists had long treated the many individual plants whose life histories were known to be influenced by factors such as climate and soil chemistry. It would be possible, for example, to manage entire forests as singular ecological entities living in a wild state, instead of selectively cultivating only a few species of trees on biologically impoverished farms and plantations. While working to extend the range and application of their research in this bootstrapping fashion, early ecologists often forgot that they were relying on the analogy of the individual organism as the key to understanding all biological relationships, including numerous relationships that were presumed to be organismal without being located, bizarrely enough, in particular organisms. And so they began to regard their analogies as more reliable than, in fact, they were.

One sees the process of reasoning by analogy at work in a fairly primitive and quite obvious way in a classic paper published in 1887, Stephen A. Forbes's "The Lake as a Microcosm." Self-consciously or not, Forbes borrows the idea of the microcosm from the theater, and applies it to what many ecologists still regard as a clearly defined, relatively easy-to-study natural system. Forbes writes that a small lake "forms a little world within itself—a microcosm within which all the elemental forms are at work and the play of life goes on in full, but on so small a scale as to

bring it easily within the mental grasp." The small lake can be treated as a microcosm because, like the ideal Classical drama, it preserves the Aristotelian unities. "All the elemental forms are at work," Forbes says, on a scale sufficiently small that the life of the lake falls "easily within the mental grasp." He uses yet another term from aesthetics to sum up the advantages of the study of lakes: "Nowhere can one see more clearly illustrated what may be called the *sensibility* of such an organic complex." And he doesn't hesitate to make an "application on a higher plane," or to point up the moral, of "the play of life" in lakes. "Out of these hard conditions, an order has been evolved which is the best conceivable without a total change in the conditions themselves; an equilibrium has been reached and is steadily maintained that actually accomplishes for all the parties involved the greatest good which the circumstances will at all permit."[35]

Forbes favors lakes as objects of ecological study because of the lessons they teach about earthly order. Equilibrium "actually accomplishes for all the parties involved the greatest good," and helps preserve the biotic *demos*. But whether or not the microcosmic expression of sensibility is an adequate concept of what transpires in the theater, it is a vague way to characterize what goes on in a lake, so vague as to be less than useful. The reach of the metaphor of sensibility exceeds the limits of the theatrical analogy's grasp. If we are unmindful of this overreaching, we may begin to take the metaphor, and the analogy, literally, and as the philosopher of science Mary Hesse has argued, by "taking a metaphor literally we turn it into a myth."[36] Any scientific hypothesis that conceals an analogy tends to devolve into a metaphor and to wind up as a myth, at which point it can be said to have come full circle: it has returned to science's point of departure.

It would be easy for us to make a great fuss about ecology's initial dependence on analogy, metaphor, and myth, and to dismiss the work of men like Forbes and Clements as literary rather than scientific in character. Something like this condemnatory approach is the route often taken by radical critics of science, whose assumption seems to be that an idea's cultural origins must determine its destiny (Worster makes the same assumption, but sees it largely as grounds for celebration).[37] However, I think it is more productive, and more properly historical, to understand the development of ecology as a struggle to divest itself of analogical, metaphorical, and mythological thinking, and of literary means of suasion (including narrative). Ecology can then be seen as an ongoing inquiry into the practical value of the analogies proposed by theorists like Forbes, Clements, and others, whose colleagues were willing to point out their errors and to remind them of the crucial differences they had overlooked. On this view, as analogies prove out practically, they in effect become less and less analogical, which means that their discursive origins also become less and less relevant (hence the tendency of historians of ideas and specialists in cultural studies to get things backward, as it were, where science is concerned).

Mary Hesse suggests something like this charitable way of viewing the case in her discussion of scientific models, which she distinguishes from poetic metaphors.

Poetic metaphors, because they are meant to be ambiguous and thus stimulating to the imagination, are "peculiarly subject to formal contradictoriness," Hesse writes. Scientific models, on the other hand, "may initially be unexpected, but it is not their chief aim to shock; they are meant to be exploited energetically and often in extreme quantitative detail and in quite novel observational domains; they are meant to be initially tightly knit by logical and causal interrelations." And should "models of the same primary system" appear to be "mutually inconsistent, this is not taken," Hesse adds, "to enhance their effectiveness but rather as a challenge to reconcile them by mutual modification or to refute one of them. Thus their truth criteria, although not rigorously formalizable, are at least much clearer than in the case of poetic metaphor."[38]

It must be admitted, however, that Hesse's analysis applies imperfectly to ecology, since she assumes that energetic exploitation of models will ensure continual scientific progress of a sort that ecology has yet to enjoy. Ecological analogies have been persistent largely because they haven't been "initially tightly knit by logical and causal interrelations," as Hesse argues scientific analogies must be in order for them to develop into reliable models. This shortcoming is one that ecologists have had to confront more than once since the days of Forbes and Clements. Frank Golley writes: "Analogical thinking is valuable to establish new hypotheses to follow in research in an area where little is known. It is less valuable when the research plan is clear."[39] In ecology the clarification of research plans has been hampered by the fact that if you scratch them, you tend to find models underneath. Scratch the models, and you come upon a layer of metaphors. Scratch the metaphors, and you discover analogies of the sort that the research plans were supposed to supplant definitely and finally.[40]

Analogies are both an asset and a liability to science, according to the philosopher of science Max Black, who writes:

> The remarkable fact that the same pattern of relationships, the same structure, can be embodied in an endless variety of different media makes a powerful and a dangerous thing of the analogue model. The risks of fallacious inference from inevitable irrelevancies and distortions in the model are now present in aggravated measure. Any would-be scientific use of an analogue model demands independent confirmation. Analogue models furnish plausible hypotheses, not proofs.

Achieving "independent confirmation" of their "analogue models" has been difficult for ecologists to do. Ecological analogies, especially those that have been popularized successfully, have had a remarkable longevity. And they have lacked what Black calls a "capacity for analogical development." This has sometimes made them indistinguishable from metaphors, which operate, according to Black, "largely with *commonplace* implications" that can be teased out by anyone who has "proverbial

knowledge." Black argues that scientific models are more demanding: "The maker of a scientific model must have prior control of a well-knit scientific theory if he is to do more than hang an attractive picture on an algebraic formula. Systematic complexity of the source of the model and capacity for analogical development are of the essence."[41]

It is precisely because Forbes's 1887 article on the lake as a microcosm relies on relatively "commonplace implications" and is uninformed by "a well-knit scientific theory" that those of us who are nonscientists are able to understand it and to profit from reading it. At the same time, there is a substantial body of more recent and much more esoteric ecological theory and research that seems to consist of little more than attempts to "hang an attractive picture on an algebraic formula," despite its being informed by a relatively "well-knit" theory. However, Black does propose a more generous way to view this apparent stalemate, and happily for us, he couches his proposal in ecologically suggestive if not in environmentally appealing terms. "Clearing intellectual jungles," he writes, "is also a respectable occupation. Perhaps every science must start with metaphor and end with algebra; and perhaps without the metaphor there would never have been any algebra."[42] With our equilibrium somewhat restored by this thought, we now are ready to review what might be called the algebraic phase of ecology.

Poking Holes in Wholes

> *Ecology traffics in differential equations, complex statistics, mathematical modeling, and computer simulation. I haven't seen a picture of an animal in the leading journal of evolutionary ecology for years.*
>
> *Stephen Jay Gould,* An Urchin in the Storm

Much of the theoretical confusion of early ecology may have stemmed from an overreliance on analogical reasoning, but it also had its source in holism. Ecologists embraced holism in reaction to the virulent strains of reductionism that, as they saw it, were infecting science, but holism was a poor alternative to reductionism in at least two respects. Methodologically, it was a muddle; philosophically, it derived from dubious sources.[43]

The most determined varieties of ecological holism were probably reflective of personal inclinations, and not the products of careful scientific reasoning. As critics liked to point out, holism had such a strong grip on the imaginations of some ecologists that it led them to overlook the sheer heterogeneity of nature and to underestimate the importance of biological diversity. Critics also liked to point out the lack of agreement among holistic ecologists on a single, unambiguous standard of unity. One ecologist's whole was likely to be another ecologist's part. This led H. A. Gleason, in his 1926 article on "The Individualist Concept of the Plant Association," to argue that concepts of unity having nothing to do with biology were being smuggled into ecology from elsewhere—chiefly, from the hyperactive imaginations of ecologists themselves. As Gleason put it, "Our various theories on the fundamental nature, definition, and classification of associations extend largely beyond the bounds of experiment and observation and represent merely abstract extrapolations of the ecologist's mind."[44]

As a corrective to the unscientific habit of proceeding from an assumption of the wholeness and integrity of plant associations instead of first discovering some evidence that they might actually possess such qualities, Gleason made a daring proposal entirely counter to the sentiments of ecologists like Clements.[45] Gleason asked, "Are we not justified in coming to the general conclusion, far removed from the prevailing opinion, that an association is not an organism, scarcely even a vegetational unit, but merely a coincidence?" He thought the answer to this question must be yes because, as he put it, "every species of plant is a law unto itself."[46] Such being the case, all attempts to construct a typology of plant associations must founder: either the heterogeneity of natural habitats undermines efforts to characterize them as of one sort or another, or natural habitats exhibiting a typical character do so coincidentally. The species living in those habitats have come to be associated with one another more or less by accident, and not as an expression or consequence of a "law of nature."[47] The "typical" character of habitats is not determined by fixed correlations of climate and plant biology, or by succession in the unacceptably teleological sense of the term, but by extremely variable local conditions, including as a leading factor the evolutionary history of individual plant species. As Gleason argued, "Every species of plant is a law unto itself." The apparent orderliness of nature is everywhere transected by vectors if not of anarchy then at least of a stubborn independence amounting to a sort of unruliness. And this means that succession is never a single linear process: its causality is multiple, as are its effects.

The logic of Gleason's argument against holism is impeccable, but holists weren't swayed by it, at least not immediately.[48] Holism would come to be associated even with the ecosystem, a concept originally intended as a corrective to the philosophies of holism and organicism that pervaded ecology in the first third of the twentieth century. A. G. Tansley, a British ecologist, first proposed the concept of the ecosystem in his 1935 paper on "The Use and Abuse of Vegetational Concepts and Terms." Tansley pointed out that the organismal concept of ecological communities was at odds with the standard scientific definition of the term "organism." "The modern biologist," he wrote, "*means* by an organism an individual animal or plant, and would usually refuse to apply the term to anything else. At the most we may be able to get the average biologist to admit that plant (or biotic) communities have *some* of the characters of organisms, and that it may be permissible to apply to them some such term as quasi-organism."[49] In effect, Tansley was urging ecologists to recognize that the organismal concept was only an analogy. It should not guide

research because it tended to color not only the interpretation but also the very gathering of ecological data in the first place. In other words, it created a bias.

Tansley also argued that the plant community isn't the fundamental ecological unit, since many inorganic ecological factors cannot be comprehended if one focuses solely on organic entities (at whatever scale). He meant that ecological research, in order for it to be as comprehensive as it claims to be, must take into account hydrological and geochemical as well as biological phenomena. Tansley wrote: "Though the organisms may claim our primary interest, when we are trying to think fundamentally we cannot separate them from their special environment, with which they form one physical system," the "ecosystem" as he suggested it should be called.[50]

The important point to grasp about this initial formulation of the ecosystem concept is that it doesn't eschew holism entirely. In fact, Tansley's ecosystem concept embraces a wider whole than the organismal concept. But its holism is more formal and less organic than that advocated by Clements and others, and it might be regarded as nothing more than an artifact of the way in which ecosystem ecologists were to organize and conduct their research. The ecosystem is a congeries of organisms and of hydrological and geochemical cycles linked by a number of different mechanisms. Many of these mechanisms are not organic in character, although they do have a tremendous impact on numerous organisms (as when soil erodes, exposing the roots of plants along with the microscopic animals that live among them). So while it greatly broadens the scope of both theory and research, the ecosystem concept also partakes of the reductionism that has come to be seen as one of the hallmarks of modern science.[51] It actually makes ecology more like other scientific disciplines, not less.[52]

The ecosystem was given more formal and, apparently, more precise definition in an influential article published posthumously by Raymond Lindeman in 1942. In "The Trophic-Dynamic Aspect of Ecology," Lindeman defined the ecosystem as "the system composed of physical-chemical-biological processes active within a space-time unit of any magnitude, i.e., the biotic community *plus* its abiotic environment."[53] Armed with this new definition of the functional unit of ecology, ecosystem ecologists from the late 1940s through the 1960s enjoyed a sense of increasing disciplinary power and success, along with increased funding of their research by public agencies.

Perhaps the most prominent of the new ecosystem ecologists was Eugene Odum, a professor at the University of Georgia who helped start the university's field station at the Savannah River Site in South Carolina.[54] Odum authored *Fundamentals of Ecology*, a standard textbook used in many undergraduate ecology classes.[55] He also proselytized for the ecosystem concept, which he interpreted broadly: his published work amply demonstrates his willingness to extend ecological modes of thinking into the provinces of sociology, social policy, and social engineering. At the height of his career, Odum took advantage of the fact that ecology had begun to attract popular interest and was beginning to have political cachet in order to promulgate views that extended well beyond questions having to do with the finer points of ecosystem dynamics.

Odum's willingness to editorialize on such issues as overpopulation and pollution reflected his confidence in modeling as a basic tool of ecological research. Although it may include visual representations at a certain primitive level, modeling should not be understood simply in terms of the creation of ecological look-alikes, as anyone who studies the illustrations in Odum's textbooks and articles, which can be very confusing, soon realizes. Many of these illustrations are elaborate diagrams full of arabesques, which variously represent such arcana as feedback loops, food webs, and the like: it's clear that they are a poor sort of visual shorthand with which to convey some extremely recondite ideas. But in fairness, they are probably meant to do no more than hint at the character of ecological relationships, which are orders of magnitude more complicated than anything that can be captured adequately on the page. Odum's illustrations are best regarded as mnemonic devices and pedagogical aids, and not as "realistic" depictions of the natural world.

Whether this is the light in which Odum regarded the illustrations in his textbooks and articles is open to question, however, since he seems to have been persuaded of the essential validity of modeling as a means of generating an accurate account of the world. Modeling, he wrote, "proceeds logically from pictures to circuit diagrams to mathematical equations." This is taking a sanguine view, but Odum was an optimist. He also suggested that modeling could proceed in the opposite direction, as it were, from reduction of the ecosystem concept to mathematical equations to expansion of it as the basis for an all-encompassing worldview (this would be the ultimate rejoinder to those critics who once dismissed ecology as a mere "point of view" and therefore a pseudoscience). Odum argued that modeling was a wonderfully empowering technique. It made it possible for ecologists to proceed, in a completely rational fashion, from pictures of the ecosystem to pictures of society. "The social science concept of different cultural units functioning together as a whole," Odum wrote, "is, of course, parallel to the ecologist's concept of the 'ecosystem.'"[56] The question to be raised is whether or not this parallelism is only a product of happenstance—of the convergent evolution of intellectual trends, or conversely, of the influence of figures like Herbert Spencer on otherwise divergent schools of thought. If it is only a product of happenstance, then we know what to say to those who argue that descriptions of ecosystems are viable as prescriptions for social change.

That society might be reorganized in accord with ecological principles was in fact a possibility that Odum, like most environmentalists, was eager to entertain. He argued that dynamics similar to those of the ecosystem operated at all levels of life, and he liked to discuss society as if it were structured and functioned like an ecosystem. "The development of ecosystems has many parallels in the developmental biology of organisms," he wrote, "and also in the development of human society." He suggested that a healthy human society, like a healthy ecosystem, would eventually

develop into a "stabilized system" of the type he still referred to as "the *climax*." But Odum also suggested that overpopulation and technological innovation had taken human society beyond the carrying capacity of its environment, to the point where the very character of the earth was being altered for the worse. And he phrased his solution to the human-engendered environmental crisis in the vocabulary of cybernetics: "It is man the geological agent, not so much as man the animal, that is too much under the influence of positive feedback, and, therefore, must be subjected to negative feedback."[57]

The charitable way to interpret "negative feedback" is to assume that it means birth control, which, I believe, is all that Odum had in mind when he used the phrase. His assertion of the necessity of applying negative feedback to "man the geological agent" shouldn't be taken as evidence of his inhumanity. It bespeaks the sense of urgency he felt about the environmental crisis, a sense of urgency widely shared in the 1960s and 70s, a time when many ecologists were led to make doomsday pronouncements they otherwise might not have made.[58] Nevertheless, the phrase "negative feedback" does suggest other, less benign means of reducing human numbers, which underscores the potential dangers of modeling one kind of system on another.[59]

Arguably, Odum's descriptions of ecology as a discipline have a figurative dimension and a Clementsian flavor at odds with his professed allegiance to the ecosystem concept, as when he characterizes ecology in terms of the study of "the gross anatomy and physiology of nature."[60] Odum's explanation of ecological succession, despite being couched in a vocabulary borrowed from physics and cybernetics, also remains essentially Clementsian. It is teleological, holistic, and organismal, and is premised on the reality of the climax. Odum defined ecological succession in terms of three parameters. The first parameter betrays the teleology of his concept of succession: "It is an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable." The second betrays its holism: "It results from modification of the physical environment by the community." And the third, its dependence on a belief in the climax: "It culminates in a stabilized ecosystem in which maximum biomass (or high information content) and symbiotic function between organisms are maintained per unit of available energy flow." That "terminal stabilized system," Odum wrote, "is known as the *climax*."[61] Because he tried to preserve the most attractive and inspiring features of the older ecology in combination with the less enchanting and more reductive features of the new (its mundane conception of energy flow and its reduction of biomass to "information content," for example), Odum's work demonstrates how stubbornly persistent analogies can be.[62]

Analogies can inspire modes of thought that don't seem very figurative at all, yet remain so at the core. In the third edition of *Fundamentals of Ecology*, Odum wrote: "The concept of the ecosystem is and should be a broad one, its main function in

ecological thought being to emphasize obligatory relationships, interdependence, and causal relationships, that is, the coupling of components to form functional units." He also described ecosystem ecology as "the formalized approach to holism."[63] Given its basis in biological relationships of interdependence, the ecosystem, Odum thought, was a good candidate for the application of techniques of modeling borrowed from the new science of systems analysis. Using those techniques would help ecologists to preserve their holism intact without lapsing into pseudoscientific speculation.

But Odum's enthusiasm for systems analysis may have been mistaken: it doesn't seem to have translated into ecological practice as smoothly as he thought it would. Robert McIntosh observes that it is hard to tell if systems analysis "is a method, philosophy, or an ideology."[64] Paul Colinvaux is more briskly dismissive of the systems or "information theory" approach, especially when it is applied to so-called food webs. He writes: "The information theory description of a food web sees each individual as a channel at a crossroads through which food freely passes, but real individuals are in fact road-blocks through which food gets with difficulty. It is this fact that makes the model not only unreal, but absurd."[65] In other words, the model fails to treat individual organisms as biological entities: it reduces them to switches in a network, each of which "behaves" in exactly the same way.

Frank Golley, one of Odum's colleagues at the University of Georgia, is unwilling to concede that the systems approach was absurd. But Golley does admit that the rhetoric of ecosystem ecology was always at odds with its practice, and that "successful applied ecosystem work followed the procedures of normal scientific work." That is, "the same process of observation, hypothesis, testing, and interpretation" followed in other biological sciences was also followed by ecosystem ecologists, including Odum himself. Golley notes that regardless of their theoretical claims, ecosystem ecologists still had to "proceed piece by piece, step by step toward a deeper understanding of the mechanisms responsible for an observed pattern."[66]

Even holistic thinkers must put their pants on one leg at a time and first thing in the morning. Such being the case, Worster is probably mistaken when he argues that holism is somehow essential or fundamental to science—to all of science, moreover, and not just to ecology. He writes: "Take away the assumption that the world is an orderly whole whose parts all work together toward a self-regulated stability, that there is an arrangement and coherence to things that can be understood, and science would cease to exist. I now see that science, and every branch of it, had to begin with some holistic ideal. It is a bedrock assumption."[67] Here Worster is once again making a philosophical declaration in the guise of an historical observation. In fact, "the assumption that the world is an orderly whole whose parts all work together toward a self-regulated stability" can be abandoned without its abandonment having any impact on the view "that there is an arrangement and coherence to things that can be understood." We don't need holism and stability in order to have arrangement and coherence. The problem with holism is that we can get along

piecemeal just fine without it, and aren't able to move beyond the piecemeal with it. It is a burdensome ideology.

Yet Worster argues that contemporary ecology, having rejected holism, "has become so imbued with historical consciousness" that it "runs the risk of total relativism."[68] But this is a very strange complaint for a historian to make; and "total relativism" is something the good relativist would have to reject as an empty phrase and a self-contradiction. Perhaps all Worster really means to say is that contemporary ecology has become more relativistic than he likes. If ecology is "the study of patterns in nature, of how those patterns come to be, how they change in space and time, why some are more fragile than others," as another environmental historian, Sharon Kingsland, has suggested, it is hard to see how it can avoid a certain degree of relativism.[69] That, it seems to me, is quite simply the price ecology must pay for its historicism, a historicism with which all of biology, after Darwin, has been saturated.

Given what I've said about it so far, the rise to prominence of ecosystem ecology in the 1960s obviously didn't mean that converts to the ecosystem concept had succeeded in bringing what had been a wayward, ill-defined science under control. The ecosystem concept failed to unify ecology, once and for all, though it did seem sounder than the organismal concept it displaced, which has come to be regarded "as quaint at best, mumbo jumbo at worst."[70] But like their organismal antecedents, ecosystem ecologists also relied on ideas borrowed from other disciplines, especially physics, systems analysis, and cybernetics, none of which have anything directly to do with biology. The "physical or engineering approach to systems," according to Golley, "tended to deemphasize the significance of biological differences." Or, he adds, to cancel it out altogether: "In the ecosystem model, species acted abstractly, like robots."[71] This suggests that ecosystem ecology may have overcompensated for the shortcomings of organismal ecology.

Perhaps the greatest weakness of the ecosystem model is owing to the fact that actual ecosystems "have bewilderingly large numbers of moving parts."[72] "Bewilderingly large numbers" are hard to account for in even the best models, and naturally it is difficult to demonstrate that anything with so many "moving parts" is as coherent and systematic a phenomenon as the ecosystem is supposed to be. "An ecosystem," Ernst Mayr observes, "does not have the integrated unity one expects from a true system."[73] Significant numbers of the living creatures found in any given habitat are likely not to be integral participants in whatever large-scale phenomena may be occurring in their habitat day after day. They are, in effect, antisocial dropouts. The natural historian Sue Hubbell writes: "Individuals within species of the profligate natural world are many, selfish, greedy, pushy, excessive, filling up all available space, taking all the resources to their own advantage, and not all of them may be 'necessary' to the function of an ecosystem. Some may be extras, spare parts, or, to use the currently fashionable word, redundant." But as Hubbell points out, the great difficulty for ecologists lies in determining which species are

the redundant ones and which are vital to the continued health of their habitats: "In our great ignorance of the life histories of even those animals we have identified and named, let alone those we have not, we are a long way from being able to pin the label 'spare part' on any of them."[74] What looks antisocial to one organism may be just another organism's way of biding its time.

So while it is distinctly more robust, in that it embraces inorganic as well as organic environmental factors, the ecosystem concept has one major defect in common with the organismal concept. It does not clearly identify an entity or a process, or a collectivity of entities and a bundle of processes, as the primary object or objects of ecological study. The ecologist R. H. Waring writes: "The ecosystem concept is dimensionally undefined. An ecosystem may be a pond, a catchment basin, or the Earth's biosphere." This lack of dimensional definition is not altogether damning: Waring thinks that the ecosystem concept has been "useful heuristically," and Joel Hagen, who calls it a "flexible abstraction," agrees.[75] But other ecologists and historians of ecology have been less sanguine. McIntosh notes that the ecosystem concept places on scientists trained as biologists the additional burden of becoming competent in aspects of physics, chemistry, geology, meteorology, and other disciplines before they can conduct the difficult interdisciplinary research that the concept entails. Ecosystem ecologists also have to master complicated new instruments that they may not have encountered during their basic training in biology, such as the apparatus of the chemistry lab. "One of the difficulties of following the development of ecosystem ecology," McIntosh writes (making a point also made by Golley), "is to match practice with the rhetoric accompanying the new ecosystem ecology in its several variants."[76] Ecosystem modeling seems to be essentially rhetorical, in that the persuasive power of model ecosystems tends to be more important than the accuracy of their details. And of course even models that do manage to be predictive, and thus seem to be very persuasive indeed, can be misleading. Frank Egerton makes a pertinent point: "As we all know from the history of Ptolemaic models of planetary motion, workable models do not guarantee that one is explaining correctly the phenomena the model describes and predicts."[77]

An even graver difficulty than those associated with modeling has long been a great bother to ecologists. It has to do with quantification. Quantification is essential to modern scientific practice, but obviously it cannot proceed without the prior recognition of entities: scientists have to have something to count before they can generate any data.[78] Unfortunately, as McIntosh points out, ecological entities—plant communities and ecosystems, for example—all too often have been described off the cuff, "on the basis of subjective judgments," without their first having been established definitively as entities by prior biological research.[79] Too many ecologists have tried to identify plant communities and ecosystems merely by getting out of doors and having a look around. They have seen the forest in terms of only a minority of its trees.

Colinvaux argues that what early ecologists "were describing with their elaborate lists" of plants was habitats, and not plant associations or communities. The lists were evidence of the fact that the habitat in which the plants on the lists were found just happened to be hospitable to those particular plants. Like strangers in a bar, they were there at the same, but they weren't really there *together*. Just as skeptics have always insisted, appearances are deceiving. Early ecologists, Colinvaux suggests, were fooled by a trick of the light, as it were, into thinking that they had discovered a pattern in nature when no pattern was there: "Distinct bands of color in a rainbow are an optical illusion, a convenience for memory and expression. The same is true about the belts of vegetation on a mountain; they do not exist as discrete zones of vegetation." It isn't that the tendency some species of plants have of gathering together in association with one another is wholly devoid of biological meaning. It's just that the meaning of such associations is other than was supposed by early ecologists. "Association," Colinvaux admits, "can be a loose form of what biologists call 'symbiosis.'" But symbiosis is comprehensible without making any specifically *ecological* assumptions, and "it encompasses few species rather than many."[80] It doesn't require the sort of large-scale and all-inclusive relationships implied by notions like association or community.

These worries and potential sources of contradiction have sometimes not been recognized at all or dismissed as unimportant by ecologists. Having decided that a forest is of a particular kind, they will set about counting its component species, usually ignoring the great majority of them in the process (since this majority will consist not only of very small plants, bugs, insects, spiders, fungi, seeds, and spores, but of any number of microorganisms as well, some of them incredibly tiny). Then they will massage the data they have gathered into shape. From roughly the 1940s onward, the most popular means of massaging data into shape has been the logistic equation, which when successfully applied generates data graphs with a characteristic *S*-shape. Statisticians seem to find this *S*-shape pleasing, though it is a flattened and rather conjectural *S*, which only emerges after the data points are plotted and then cleaned up a bit by someone with a knowing eye and a practiced hand.

The logistic equation was taught in introductory courses in ecology for many years, but a number of ecologists find its continued use problematic. For one thing, it depends on a prior judgment, often an intuitive one, of the character of a particular object of study, which might be a population of, say, either trees or animals. Data about this population are collected as if the object of study had not been defined in an ad hoc manner ("all the members of species *X* living within the quadrat *ABCD* plotted last week by our research team of first-year graduate students"). Then the logistic equation is applied to this data and depending on the quality of the resultant graphs (depending, that is, on their shapeliness), predictions about the future may or may not be made, and policies set accordingly. Bag limits on deer, game birds, or trout may be raised, lowered, or kept the same, or a forest may be sprayed with insecticide. And if the deer, the game birds, the trout, and the forest are lucky, the extrapolations from raw data made by their managers won't be too far off the mark.

As a research and management tool, the logistic equation has a signal failing, according to Daniel Botkin. Although "the logistic is supposed to be an ecological formula," he observes, "the environment of a population does not appear in it in an explicit way." The environment has been factored out of the equation, quite literally. The logistic can be perniciously reductive: it ignores the random changes to which all organic life is fated, such as, in the case of white-tailed deer and game birds, an unusually heavy crop of mast, or no mast at all, two autumns in a row. In the case of stream-bred trout, the random changes might take the form of an unchecked growth of aquatic vegetation during a mild winter and a resultant banquet of caddis and mayflies come spring; but then again it might take the form of floods and ice jams that scour a streambed and drastically reduce both aquatic vegetation and invertebrate life for a season or two. And in the case of woodland pests like southern pine beetles, the random changes might include genetic mutations making some of the beetles highly resistant to insecticides. The logistic equation ignores both the vagaries of the environment and the genetic variability and adaptability of biological entities, whether they are plants or animals. Botkin writes: "A logistic moose responds instantaneously to changes in the size of the population; there is no history, no time lags, no seasons; a logistic moose has no fat."[81] A logistic moose is therefore no proper sort of moose at all. "One of the major criticisms of mathematical-theoretical approaches in ecology," McIntosh writes, "is that they commonly rest on simplifying assumptions, often unstated, that make them tractable mathematically but nonsense biologically."[82] The charge that they have produced biological nonsense isn't one that ecologists can shrug off lightly.

Applying the logistic equation to ecological problems is appealing because it seems to fulfill the old promise of ecology to deliver something like the whole truth about nature. But to rely on this equation may be to purchase holism at too great a price. Using the logistic equation means treating animal and plant populations as if they were members of mathematical sets rather than members of species, with all the genetic variability membership in a species implies.[83] In the worst-case scenario, applying mathematical techniques to natural populations in order to give one's data about those populations a comprehensible shape means ecology without biology: without genetics and evolution, that is.

The choice between systems analysis and mathematics on the one hand and biology on the other is not a choice many ecologists would want to make in favor of systems analysis and mathematics. Ecologists have had to concede that summing all the parts of an ecosystem, even if it were possible to identify and count them all, doesn't necessarily tell one something meaningful about the whole, however elegant the math involved. They've begun to wonder whether the old maxim about the whole being greater than the sum of its parts is really all that wise a saying.

Summa Ecologica

> *Ecology is not yet ready for its Copernicus or its Kepler, much less its Newton or Einstein . . . because ecology has yet to develop even the consensus about what observations are interesting. . . . We are closer, perhaps, to a lonely priest of Ur, scanning the night skies for patterns and crudely calculating the future course of the heavens, despite gross misconceptions and uncertainties.*
>
> *R. H. Peters,* A Critique for Ecology

Because it faces unusually intense difficulties of self-definition, ecology seems to replicate on a small scale certain features of the broader debate about the unity of the sciences in general. The broader debate assumes the internal coherence of the various scientific disciplines, but in ecology's case, this assumption is unwarranted.[84] Ecology is heterogeneous: there are few ecological concepts that aren't in dispute.[85] As McIntosh suggests, the discipline's heterogeneity reflects the fact that early ecologists were fond of inventing new vocabulary and of defining their terms in an overly imperious fashion. He compares them to Humpty-Dumpty, since like Lewis Carroll's quarrelsome egg they tended to use a word "to mean just what they chose it to mean with little regard for what others said it meant. This tendency," McIntosh adds, "has not disappeared." Idiosyncratic and forceful definition of his terms may have worked for Humpty-Dumpty, but ecologists have found it necessary to pad their own definitions with uncertainty.[86]

Perhaps it is only to be expected that among the most uncertain of ecological terms are those that have been most widely popularized. Consider, for example, the term "niche." The niche is popularly understood to have a spatial reference: in their niches is where the wild things are. For those who believe in the value of finding one's niche, it is heartening to learn that it is "axiomatic that no two species regularly established in a single fauna have precisely the same niche relationships," as Joseph Grinnell observed in his classic 1917 paper on "The Niche-Relationships of the California Thrasher."[87] A niche for every species, then, and every species in its niche: thus the natural order is maintained, and likewise the social, if only metaphorically. Yet for all the apparent tidiness of the concept, and for all its metaphorical appeal, the niche has proved extremely difficult to define with precision.

And yet one might, with equal justification, say that ecologists have defined the concept of the niche to a fare-thee-well, and that the meaning of the word "niche" is in danger of vanishing in a cloud of qualification. Ecological concepts, like all scientific concepts, tend to undergo a process of rarefaction. For ecologists, the word "niche" has lost much of its intuitive sense of spatial location (they borrowed the word from architecture: niches are the nooks in a building in which statues are placed). *Niche* has become, in effect, an esoteric term: it now refers to the *n*-dimensions that a given species utilizes in the full range of its ecological interactions throughout space and time.[88] It is much more difficult nowadays to derive tidy little truisms from the niche, given how ecologists have formalized and refined the concept since Grinnell's day.

However, this seems to be one of those cases in which subtlety and formality have produced not greater precision but increased confusion and unintentionally comic results. According to the ecologists Leslie Real and Simon Levin, the niche "is a central concept of ecology, even though we do not know exactly what it means." Real and Levin report that the equally vague concepts of complexity, diversity, and stability, which also have migrated to the popular discourses of ecology and environmentalism, have generated both semantic confusion and "diametrically opposed results."[89] As Golley explains, "Simple systems may be stable, and species-rich communities may be unstable. No universal pattern holds. Nevertheless, the environmental movement of the late 1960s and 1970s used the diversity-stability hypotheses as a central tenet supporting conservation action, and it is still being taught as a common sense relation." Golley says it is possible that "ecosystems are never stable but are always in a process of change."[90] There is, in fact, some dramatic research suggesting that this is more than a possibility: tropical rainforests are perhaps the most diverse of all terrestrial habitats, and yet they are nowhere near as stable as they once were assumed to be. And one ecologist working in an old-growth forest in Oregon discovered that this forest is unstable, not only over time as he had expected but in space as well. The old-growth forest actually moves: "many of the towering trees have traveled, sprawling root system and all, several feet during their centuries-long lives."[91] Discoveries of this kind have fostered a much more skeptical but at the same time a more open-minded theoretical climate in contemporary ecology.

Colinvaux argues that stability should never have been thought of as an ecological phenomenon in the first place. He writes: "Stability and balance are not so much functions of life acting on life as they are reflections of the underlying stability of physical systems. Perhaps the greatest error recurrent in ecological thought is that which claims stability as a function of biological complexity."[92] In other words ecological stability is a product not of biological forces but of geological and climatic stability. And of course geology and climate only *seem* stable to us because of our limited ability to appreciate the vast amounts of time involved in geological and climatic change, which can have and often does have cataclysmic effects.

Ernst Mayr agrees with Colinvaux that ecological stability cannot be taken at face value, but he is dubious about the concept for a different reason: "No matter how relatively stable a community may seem to be, it actually reflects a balance between extinction and new colonization."[93] Such a balance is, in effect, a statistical artifact. It reflects evolutionary good fortune rather than the healthy diversity of the community, and evolutionary good fortune tends to be quite fleeting if not altogether ephemeral. R. C. Lewontin, a prominent evolutionary scientist and a sharp

critic of flabby thinking in science, argues that "there is nothing in our knowledge of the world to suggest there is any particular balance or harmony. The physical and biological worlds since the beginning of the earth have been in a constant state of flux and change, much of which has been far more drastic than anyone can now conceive." "*The* environment," Lewontin adds, "has never existed and there has never been balance or harmony."[94] Lewontin's approach to ecological concepts is to rarefy them with a vengeance.

Those who believe that ecology has expanded the purview of the sciences have overlooked the fact that a more tough-minded and reductive approach to nature seems to be enjoined upon ecologists sooner or later, and not because nature is simply like that—not because it is atomistic, mechanistic, and deterministic—but because a tough-minded and reductive approach to nature appears to be the most effective one. We have to get on with nature as best we can without succumbing to the allure of all-or-nothing propositions, even if that means sacrificing our hopes for unity on the altar of expediency from time to time. In science, the "diametrically opposed results" described by Real and Levin usually cannot be reconciled, except in very limited and extremely painstaking ways—as they are, for example, in quantum physics. And such reconciliation is not the work of a day; quantum physicists have had to erect a formidable edifice of theory and experiment in order to reconcile seemingly irreconcilable results, and to reduce them to something that only the gifted few and the highly trained can understand.

In ecology, the failure of stability to correlate positively with complexity and diversity, as it once was expected to do, has been a genuine disappointment, since it has made us realize how hard it is to understand complicated, diverse habitats and thus how difficult it is to figure out how to preserve them effectively. I've noticed that such disappointments are rare in the humanities, where contrary "results" or rather interpretations can be reconciled with our expectations with relatively little effort, and I think this is especially true in literary criticism. Literary critics all know how to reconcile incommensurable conclusions about particular objects of attention. It helps tremendously that the majority of these objects of attention—such things as inscription, writing, the work, the text, the intertext, textuality, intertexuality, literature, and "literariness" itself, along with media, genders, cultures, nationalities, and so on, almost *ad infinitum*—tend not to be well-defined and clearly described in the first instance. It also helps that most of these objects of attention cannot be regarded as realities, certainly not in the same way that rainforests and wetlands can be. Taking advantage of the more or less speculative nature of most of the entities that they study, literary critics may treat a colleague's interpretation of one of them as a spirited polemic seeking to change notions about what is acceptable in literary study, and will welcome it as a contribution to the field but without agreeing with it in the least. Failing this sort of canonization by default, another, more ironic sort of canonization—by exasperation, as it were—is still possible. An interpretation may be acknowledged by all parties to be completely and even glaringly wrong-headed and irresponsible. Yet it nevertheless can be treated as an amusing and instructive "strong misreading," and may become canonical despite, if not because of, its very invalidity.

There is even a sense in which the invalidity of interpretations is essential to literary criticism. The literary affection for metaphor is premised on metaphor's ability to generate "diametrically opposed" readings and incommensurable conclusions. New schools of interpretation are founded, more often than not, when a literary critic makes a few quirky, original assumptions and formulates a novel metaphor (the "homosocial" text is a good recent example; so, for that matter, is the "environmental" text). Never mind that on a first, second, and perhaps even a third inspection these assumptions and this metaphor may seem invalid, and patently so, to those who find it unjustified by textual evidence or unpersuasive on other grounds (e.g., because it's distasteful or too counterintuitive or unhistorical or what have you). This is precisely why wit still plays an important and somewhat nefarious role in literary criticism. That it both tolerates and welcomes misreadings, invalid interpretations, incommensurable conclusions, and just-so stories justifies Ernst Mayr's assertion that literary criticism "has virtually nothing in common with most of the other disciplines of the humanities and even less with science."[95]

Literary critics can agree to disagree happily (I don't mean to imply that they always or even often do). They would welcome Humpty-Dumpty to the fold as one of their own, and give him tenure, too. For ecologists, on the other hand, the fact that "a general synthesis is not currently available at any ecological level" is a cause for deep concern.[96] "Few of the major controversies in ecology, if any, have been decisively settled," according to Mayr, and the unsettled state of the discipline represents something more than just the sort of challenge that young and ambitious scientists are supposed to welcome.[97] It may be a symptom of deep confusion, or still more fundamentally, of outright impossibility.

In his book *A Critique for Ecology*, the ecologist R. H. Peters argues that the theoretical and methodological woes of ecology reflect "the vagueness of ecological constructs." "So much of the science," he writes, "is phrased so ambiguously that the meaning of most constructs is open to reinterpretation by both critic and defendant." Peters has some caustic things to say about ecologists whose work is not directed toward problem solving. He argues that by attempting to synthesize insights from a diversity of scientific fields, such ecologists promulgate tautologies rather than theories. One difference between a tautology and a theory, Peters suggests, is that "a tautology is certain whereas a theory is hypothetical, risky, and dubious."[98] Assumptions about the necessary interrelatedness of all ecological phenomena, or blanket statements like Eugene Odum's assertion that to understand the ecosystem, "the whole as well as the part must be studied," have an *a priori* quality at odds with the empirical character of scientific research.[99] They cannot be tested, since they are not predictive of anything specific. They are platitudes that have yet to be worked up or scaled back into scientific propositions—into hypotheses, that is.[100]

Peters maintains that its preoccupation with model building suggests that ecology has become "a new scholasticism, interminably debating the fine points of unobservables and formalisms." Because the terms on which they rely are not made "operational," which would require that "the range of phenomena that a concept or term represents" be specified, "many influential works in the literature do not contain testable theory, but are only propaganda for developing concepts."[101] Peters explores the flaws of a wide range of ecological concepts in his book, and much of what he has to say about them is surprisingly harsh.[102]

Consider what Peters says about the concept of *environment*, quite possibly the most popular and (therefore) the most mystified ecological concept of all. Its "vagueness," he notes, "has long been recognized by ecologists." *Environment*, Peters argues, is a nonconcept, a word without a definition and lacking a referent. In ecological practice, the environment can be defined only by "stipulating what it is not." Peters writes: "The environment is that which is not the object of investigation. Thus the environment of an entity is everything outside that entity. This sweeping definition of environment introduces a number of operational difficulties." These operational difficulties include the problem of determining where the boundary between the inside and the outside of a given entity is located. This problem will be less easily resolved for some entities than for others, and it is exacerbated by considerations of scale. Many microorganisms have permeable cell membranes and thus have extremely fluid physiological boundaries. Their relationships with things "outside" them tend to be ambient in a way that makes models based on exchanges between internal organs and the external environment less than perfectly applicable to them. Microorganisms are, in a very real and specific sense, always a part of the environment they inhabit and are "at one" with it. They are less like switches in a circuit than they are like free-floating filters that have come loose from their fittings. Using the term *environment* thus introduces a high degree of relativity and ambiguity into ecological research. Peters argues that the same can be said of related terms like *habitat* and *ecosystem*.[103] Of course many ecologists still use these terms, but fewer and fewer of them assume that when they use them they are designating specific entities. This is perhaps the chief reason the concepts attached to these terms seem less viable than they used to.

Peters has little patience for the attempts made by some ecologists to salvage vague concepts for the sake of their heuristic value. He insists that ecological theories need to be predictive, and explains that this doesn't mean that they need to be *true*: "Scientists are never entitled to conclude that successful theories are true. They can only make the modest claim that the theories which worked in the past are more likely to do so in the future than theories which failed in the past."[104] If Peters is correct, we shouldn't go seeking for the truth *of ecology* without first taking into account the limited role of truth *in ecology*.

Peters insists (and ecocriticitics who want to restore representational art to its former glory ought to take notice) that the goal of ecology, especially at a time of global environmental crisis, should not be to generate a correct picture, complete in all its details, of the workings of ecosystems, but to explore ways in which particular environmental problems can be more effectively addressed and redressed. Aside from the urgency of solving these problems, Peters argues that the more theoretical approach to ecology, while it may be more alluring intellectually, has not been very compelling otherwise: "Ecology compounds its single failings. Operational impossibilities spawn tautological discussions that replace predictive theories with historical explanations, testable hypotheses with the infinite research of mechanistic analysis, and clear goals for prediction with vague models of reality."[105] Ecology could use better techniques and methodologies, and an epistemological housecleaning, too. And it was ever thus: in ecology, the need to put Humpty-Dumpty together again, like the need to define his terms, has been perennial.[106]

One might argue that the fault of many ecological theories is their immodesty, the way in which their explanatory reach consistently exceeds the grasp of research and experiment. Such excess is usually what we mean, after all, when we use the term *heuristic* to justify our use of vague ideas. To be heuristic is to jump-start an interpretation by making a few convenient but otherwise unwarranted assumptions (as when psychoanalysts assume that the unconscious is structured and functions like a language). "'Explanatory' concepts and theories that satisfy a widely felt need for plausible, causal descriptions of nature," Peters writes, "hide the shortcomings of our theories under prose that explains away rather than explains." Ecological theory "must be judged on the evidence," he insists, and not on the "plausibility of the prose in which it is couched."[107]

One source of the plausibility of ecological prose has been the seductiveness of the analogies on which many ecological theories have been founded. Consider the analogy of the "web of life," which has become one of the pet notions of environmentalism and popular ecology. Several generations of ecologists found the idea that "every phenomenon sits in a web of interacting, multiple factors" an appealing way to characterize ecosystem dynamics, but the idea hasn't been a fruitful one. "Attempts to describe this web," Peters notes, "lead one back to a mechanistic approach to ecology and to an infinite research program." That is, one becomes preoccupied with discovering and describing the various interstices of the web in the absence of any concrete evidence of the existence of the web as a whole, and still worse, in the absence of any concrete evidence that the web *is* a whole. Peters concludes that because they tend to encourage unfocused research of this sort, "analogies are too undependable to serve as theories."[108] They keep returning ecology to somewhere very near square one.[109]

Another marker of the boundary between the humanities and the sciences is the disparity in the relative weight each assigns to similarity and difference, and hence to analogy, in constructing their accounts of the world. Historians—particularly historians of ideas, which tend to be extremely plastic—may be led to treat similarity as more vital than difference by the hardships that arise whenever one tries to

forge a coherent narrative. In a coherent narrative, similarity takes shape in the form of repetition: something early is judged by the narrator to be analogous to something late, and by focusing on this analogy a vast amount of time can be tamed and history brought to heel.

Literary critics favor similarity over difference with even greater zeal than historians, perhaps because they write with fewer constraints on the claims they allow themselves to make. Playing hunches, despite the inroads of theory, still seems to be essential to literary criticism as practiced, if not quite as professed. As practiced, literary criticism remains more or less intuitive. Thus literary critics are twice removed from science, and are likely to have a correspondingly impaired sense of difference. By virtue of their training, a point of view is all the Archimedean equipment literary critics need in order to interpret the world, including the natural world, which some of them regard as a text that they, too, are qualified to read.

Because scientists cannot overlook the difference between texts and the natural world without causing outbreaks of contagious disease, uncontrolled genetic mutations, catastrophic climate change, mass extinctions, and loss of their funding, they have to learn how to use analogies with rigor and precision, if use them they must. They also have to learn how not to confuse analogies with metaphors. In literary criticism, rigor and precision play a much less prominent role, and the distinction between analogy and metaphor is frequently ignored. Arguably, this is a serious dereliction of professional duty, since attending to the workings of rhetorical figures is something a literary critic is supposed to do *ex officio*.

One consequence of ignoring the distinction between analogy and metaphor in ecocriticism has been a gross misunderstanding of ecology, in which analogy has played a central but controversial role, and a correspondingly gross overestimation of the nearness of ecological thinking to poetic and other modes of essentially comparative thought. But it may be the peculiar fate of analogies, no matter who handles them, to become metaphors and when imaginations run amok, as they are prone to do, symbols. An analogy may begin as an illuminating comparison in which the differences between terms are preserved and clearly understood even if not explicitly stated, and end up as a metaphor, or an obfuscating equation in which the differences between terms have disappeared completely. If the new metaphor is allowed to stand, the emotional appeal of the vehicle will displace the tenor almost entirely, ultimately resulting in a symbol open to the most disparate interpretations. And all this can happen even when the original analogy is a dry one that would seem to have very little symbolic promise—as when the ecosystem concept, with its borrowings from cybernetics, is taken to imply a mysterious interconnection of one and all. Of course, some ecocritics have complained that discovering mysterious interconnections by way of analogy, metaphor, and symbol is simply what poets do, and they blame literary theory for trying to debar such discoveries. However, literary theory is an attempt to check not poetic but critical license.

Patchwork

> *How have we come to believe things about nature that are so untrue?*
>
> *Stephen Budiansky,* Nature's Keepers

In order to comprehend the intellectual difficulties that ecologists face, it helps to consider the history of their discipline not in philosophical context, as a reaction against reduction and in favor of holism, but in the context of the development of the theory of Darwinian evolution. Much of what has passed for ecological theory has been at odds with Darwin's insight into the role of natural selection in evolution.[110] This conflict is one I've hinted at before, and it tends to arise whenever ecologists try to extend their understanding of the natural world much beyond the life history of a single species or small groups of closely related species. But to say this may be to say that ecologists run afoul of Darwin just as soon as they set up shop, because the very notion of the ecological seems to be at odds with Darwinian theory. "A commitment to the evolutionary world view," Richard Levins and R. C. Lewontin write, "is a commitment to a belief in the instability and constant motion of systems in the past, present, and future; such motion is assumed to be their essential characteristic."[111] As I've tried to show, ecology has had a difficult time comprehending phenomena like instability and constant motion.

To pursue an ecological line of research, as classically described by theorists like Frederic Clements, may be to court every step of the way a contradiction of Darwin and, after the so-called and highly successful modern synthesis of the Darwinian theory of natural selection and the Mendelian theory of inheritance, of the demonstrated facts of genetics as well. For this reason, the schools of thought known as "population ecology" and "conservation biology" are now two of the more vital of ecological subdisciplines, not coincidentally because of their Darwinian perspective on ecological phenomena, a phrase that would have struck Frederick Clements and his peers as oxymoronic.[112] Stephen Jay Gould explains that population ecology embraces "the central Darwinian postulate that nature manifests no higher principle than the struggle of individual organisms to maximize their own reproductive success. Notions of community and natural harmony, however illuminating as metaphors, do not reflect nature's primary evolutionary unit, the population of individuals within a species."[113]

Ecology in the traditional sense of the term still popular with environmentalists and ecocritics, ecology that seeks to demonstrate the reality of plant and animal communities and of natural harmony, is hamstrung by its inability to pursue its goals using the most effective tools of biological research. Historically, ecology has had a pronounced tendency to leave the realm of biology altogether, in pursuit of somewhat ethereal if not entirely metaphysical entities. The inherent tensions of ecological thought are neatly demonstrated in Colinvaux's discussion of the ecosys-

tem concept, which he calls "an idea, a people-made thing" and "a way of looking at nature. It is an admission that there is no super-organismic thing out there made by some masterly designer. There are only Darwinian species."[114] On this account, the ecosystem concept is only a way of organizing one's thinking about groups of species that one otherwise treats as individuals. If so, then *ecology* is a catchall term used to describe a science more diverse in theory and method, and more free-wheeling and unconstrained, but less finely tuned and less productive of definitive results than microbiology or physics, and we seem to be right back where we started. Ecology is just a "point of view."

Yet despite what I have reported so far, and despite some of the more polemical points that I have made or have quoted others making, critics like Colinvaux, Peters, McIntosh, Egerton, Mayr, and Botkin aren't entirely negative about ecology's prospects. After all, they are ecologists themselves. Each of them suggests that ecology has certain strengths, even if it doesn't exist in a state of grace or a definite form, but has fragmented into a variety of closely allied subdisciplines. The things that ecology does well tend to involve areas of applied science like forest, wildlife, and fisheries management, or the restoration of degraded habitats to something approximating a pristine state (even if that pristine state is, for historical reasons, more or less conjectural). Ecology's success stories have grown out of research projects of relatively modest scope, the results of which have shown a gratifying tendency to rebound upon the formulation of theory, correcting, adjusting, and reshaping it in positive ways.

The fact of the matter is that ecological research is extremely difficult. The grand sweep of many ecological theories is a response to the vastness and complexity of nature: comprehending this vastness and complexity on an appropriate scale and in meaningful detail is hard to do well, assuming that it can be done at all. The intellectual and methodological challenges of ecology are further compounded by a host of very basic technical problems. Ecologists cannot take comfort from and refuge in a well-equipped laboratory purchased right off the shelf and marked "for the use of ecologists only." They often have to improvise on the spot. And in any case, it is entirely possible that the laboratory's artificiality "may simply swamp processes of ecological relevance," as Peters has suggested.[115] The laboratory tends to cancel out the very factors that we think of as ecological.

As if all this weren't handicap enough, fieldwork, which appears to be the bread and butter of ecology, can be just as problematic as lab work. The quadrat method, in which a researcher stakes out plots of a standard size in a given habitat in order to study, say, the patterns of succession of native versus alien plants or the foraging habits of feral hogs, may be invalidated by the patchiness of that habitat, particularly if an awareness of this patchiness isn't accounted for theoretically and designed into the research beforehand. But this, too, is a difficult thing to do, since patchiness and the quadrat method are inherently hard to reconcile. An environment—*any* environment, though some more than others—is patchy because plants and animals

aren't distributed in it evenly, but in a randomly variable (or *stochastic*) fashion. To risk an analogy, one bite of an apple may not have a worm in it and another bite may, but no prediction of the outcome of any one bite is possible since the distribution of worms in apples is wholly unpredictable (let us assume). Caution is advised when we bite apples, but it won't ensure that we never bite any worms inadvertently.

By the same token, habitats vary, and not just over time, as we have long realized (we call that realization "geology"). Habitats also vary from point to point and place to place: they differ, not only one from another, but internally as well. In a sense, what patchiness really means is that the idea that habitats are composed as all-encompassing "environments" is false. Patchiness, random variation, pattern, or grain—ecologists use these words interchangeably, but call it what you will, patchiness frustrates our attempts to identify and understand natural systems as, well, natural *systems*.[116] It threatens to reduce ecological research to patchwork. The irony, however, is that reducing ecology to patchwork may strengthen its claim to scientific validity in the eyes of its critics.[117] Ecology falters; its subdisciplines, all of them in varying degrees heretical, thrive.

Patchiness has made a very strong impression on contemporary ecologists, and they have begun to characterize ecosystems in a much less idealized and more neutral fashion than they used to do, in large part because they now recognize that random change is "intrinsic and natural at many scales of time and space in the biosphere," according to Botkin. To some extent, this new view of nature as prone to disturbance owes something to a general change in the scientific temperament over the last century. Chaotic phenomena like turbulence now seem much more attractive and interesting to us than they did in the past, and no longer figure in the scientific imagination as something to be explained away so that our sense of an orderly universe can be preserved. Once physicists became aware of quantum phenomena, the order of nature began to be regarded as a much more open question in general, as Botkin points out: "The profound philosophical arguments that arose from the development of quantum theory in the 1920s opened up the possibility of a very different perception of the physical universe: the universe as fundamentally stochastic to some degree."[118] Of course, one could argue that if ecology has become more like other sciences than it used to be, it is partly because other sciences have become less positivistic—and hence more like biology—than they used to be.

In recent decades, the elaboration of chaos theory has been of particular importance both for ecology and in it. The theory hasn't been imported wholesale from other disciplines, as systems analysis was, but is something to which ecologists have made original contributions. This doesn't mean, however, that ecologists now feel stymied by a world at last admitted to be fundamentally indeterminate and wholly chaotic, and that they have conceded the main point to the harshest, most antinomian critics of science. That the world is fundamentally indeterminate and wholly chaotic, a swirling vortex of sheer disorder from which order only arises provisionally—that the appearance of order is only an illusion—isn't what chaos theory ar-

gues.[119] And yet the fact that ecologists have embraced a less determinate view of nature does mean that they have had to distance themselves from the rosier varieties of environmental thought, to resist their own positivistic impulses, and to refrain from open-ended theoretical speculation, or at the least to speculate more parsimoniously than they once did.

After more than one hundred years of research, ecology is not yet a fully mature science, but is still discovering its subject matter and elaborating its key concepts and basic methods. Golley's wistful description of ecosystem ecology in the mid-1960s still resonates, and might be applied with some justice to the discipline as a whole today. He writes: "The condition of ecosystem studies at this time might be characterized by Claude Levi-Strauss's term *bricolage*, which refers to the construction of an object or a theory from a variety of unrelated, found materials. The *bricoleur* arranges these and creates something new and unexpected from the disparate materials."[120] Ecology continues to be a makeshift affair. No doubt this is precisely why it seems attractive to the kind of scientist who enjoys poking around outdoors and tinkering with things to see how they work.

Disturbing Nature

> *In most ecosystems the interval between disturbances—fire, frost, flood, windstorm—is almost always less than the life span of an individual member of the dominant species. So much for balance.*
>
> *Stephen Budiansky,* Nature's Keepers

In his 1899 article on "The Ecological Relations of the Vegetation of the Sand Dunes of Lake Michigan," Henry Chandler Cowles seems to anticipate the theoretical bashfulness and cautiousness of many present-day ecologists when he discusses the patchiness of plant societies and notes that ecological terms are semantically ample for good reason. Cowles writes: "The term patch or zone has a value like that of variety in taxonomy. Authors disagree, here as everywhere, upon the content and values of the terms employed; this disagreement is but an expression of the fact that there are few if any sharp lines in nature." He adds that in field biology, terminology "is largely arbitrary and adopted merely as a matter of convenience." The question a contemporary ecologist must ask, however, and must ask more forcefully than Cowles could have done, is how much convenience there is in terminology as arbitrary as some ecological terminology seems to be. A contemporary ecologist would have to note that the homely comparison Cowles makes of the sand dune complex to "a river with its side currents and eddies at many points, but with the main current in one direction" is no longer a comforting thought, in light of the things we have learned about the chaotic nature of the turbulence that accompanies a river's

"main current in one direction."[121] Are the phenomena of ecological interest out in the channel with the unidirectional flow of the main current, or are they tucked away in the contrary side currents and whirling eddies? Or are they to be discovered in the complex interaction of the river's many and braided currents with the surrounding geography of its watershed as a whole, shaped as that watershed has been by the larger forces of nature, and perhaps by human hands as well?

These seem to be increasingly difficult questions to answer, even as their urgency grows. The environmental crisis is frustratingly manifold. "We are hybridizing the planet," the science writer Jonathan Weiner warns. "We may be creating conditions in which evolution is running at its maximum rate." Insects reproduce so often that our use of insecticides has acted on them as a novel form of selection pressure. In a number of cases, this has had the effect of improving the breed, so to speak, in a very short time. According to Weiner, "every postmodern, well-equipped house fly" is now the bearer of a "mutant gene" making it immune to pesticides by limiting its uptake of them from the environment. The creation of postmodern insect pests reflects the perverse dynamics of our treatment of nature: "We bring strangers together to make strange bedfellows, and we remake the beds they lie in, all at once."[122]

But Weiner's point about human hybridization of the natural environment may be made in too dramatic a fashion, at least in one respect. Far from being solely a postmodern phenomenon, hybridization is nothing new. "The man with the axe is an integral part of nature," the natural historian Marston Bates once observed, "and the consequences of his activities make an interesting and important, though dismal, field of study."[123] The man with the ax is not a wholly different figure from the man with the insecticide sprayer strapped to his back or hitched to the rear of his tractor. Both men are engaged in a process of rearrangement, restructuring, and redefinition of the natural world and the creatures in it.

An awareness of the long-term human manipulation of the environment ought to be fundamental to ecology, Stephen Budiansky argues: "After ten thousand years of breaking the soil, after a hundred thousand years of setting fire to the forests and the plains, after a million years of chasing game, human influence is woven through even what to our eyes are the most pristine landscapes." He suggests that ecologists have done a poor job of taking into account the less than pristine condition of nature. In fact, the central claim of Budiansky's book *Nature's Keepers* is that ecologists have been charmed, just like the rest of us, by the idea of an Edenic natural world. "The entire modern conception of nature," he writes, "depends upon denying her checkered past." Realizing that this has been the case for too long, some restoration ecologists have set about their work in a new way in recent years, taking into greater account than they used to the long-term human presence in and its effects upon the landscapes they attempt to restore. "The artificial," Budiansky suggests, "is more natural than the natural."[124] Humans play a central role, for example, in the ecology of fire: many habitats long thought to be entirely natural are now recognized as the products of deliberate and not always carefully controlled fires set by humans. Fire,

in other words, can be an important management tool (albeit one that needs to wielded very carefully nowadays, considering the density of human populations in or near many tracts of otherwise wild land and the buildup of immense stockpiles of fuel thanks to the longstanding practice of fire suppression by forestry and other agencies).

Budiansky's arguments derive in part from the school of thought known as "the ecology of natural disturbance." But he is impatient with academic ecology ("a perusal of the present-day scientific literature in ecology reveals an almost neurotic degree of guilt and self-doubt"), despite his enthusiasm for many of the conclusions reached by the revisionist thinking characteristic of the discipline since the early 1970s. What Budiansky does admire is the hands-on attempts of restoration ecologists and managers of wild lands less interested in refinements of theory than in repair and maintenance of damaged habitats: "Restoration experiments are a way to figure out how natural ecosystems work; they are also a way to figure out what went wrong in natural systems that are no longer working properly."[125] Some of these experiments involve nothing more elaborate than conducting controlled burns, and then waiting to see what happens next.

Given the alarming situation described by Weiner, and the undermining of what long has been thought to be ecological wisdom and the subsequent faltering of the discipline described by Budiansky, it is no wonder that a critically engaged ecologist like R. H. Peters should make the claim that "the problems that ecology should solve are not being solved. They are worsening, growing more imminent, more monstrous."[126] Yet very little of the anxiety of ecologists over the travails of their discipline has been communicated to the wider audience interested in ecology and in environmental issues. Many members of this audience still engage in freewheeling speculation of the sort ecologists are now trying to avoid, though not always successfully: "Armchair, and bar stool, ecology continues to be alive and well, despite its bad press."[127]

In the next two chapters, I will discuss the armchair and (for all I know) barstool views of ecology held by those who, for political reasons, are suspicious of science, and conversely, the views of ecology held by those who, for aesthetic reasons, are charmed by what they regard as its scientific sanction, its truth. Neither party seems to realize how keenly aware ecologists are of the shortcomings of their own work. Those who are wary of ecology simply because it is a science do not realize how much intense scrutiny the field has given its own imperfections, but then they are too suspicious to give the testimony of scientists the benefit of doubt. Those who celebrate ecology as a latter-day revelation of truth do not recognize its shortcomings, either, because they put too much trust in what the bumper stickers say. They also fail to give the testimony of scientists the benefit to be had from doubt, preferring instead to take the truth of ecology for granted.

3

The Science Wars, Ecology, and the Left

Take away the world around the battles, keep only conflicts or debates, thick with humanity and purified of things, and you obtain stage theater, most of our narratives and philosophies, history, and all of social science: the interesting spectacle they call cultural. Does anyone ever say where *the master and slave fight it out?*

Michel Serres, The Natural Contract

On the Late Unpleasantness in Science Studies

The major battles of the so-called Science Wars have been fought over the past three decades, give or take a few years. However, it is likely that the roots of this conflict actually lie at least five centuries in the past, in the bitter disagreements about the nature of reality that arose during the Renaissance, when the authority of the Church began to be questioned, both directly and indirectly, by scientists (as they were only much later to be known).[1] In the 1980s, these old disagreements, albeit in altered forms and long after they appeared to have been resolved in favor of science, began to attract the interest and stoke the ire of a new breed of cultural authority. Because those who belong to this new breed are steeped in both the humanist and the posthumanist traditions of transcendental thought (as the strategists who define their battle lines insist they should be), they have no vested interest in the maintenance of the status quo, to which they are as a rule very much opposed, unlike the churchmen of a half-millennium ago. In fact the dispositions of the new breed of cultural authority are strikingly contrarian and anti-authoritarian. This makes them especially eager to provoke and participate in a fresh reassessment of science on behalf of culture and society. After all, that the tables have been turned in science's favor in the modern era is undeniable: science has become a powerful institution in its own right and plays a central role in determining the character of our lives, both culturally and socially.

To put the point made near the end of the previous paragraph in other words, the contemporary critique of science is not conservative but radical, and it fully intends to be that way. I realize that the epithet "radical" may sound abusive, at least

Notes

Preface

1. Aldo Leopold, "Thinking Like a Mountain," in *Sand County Almanac; And Sketches Here and There* (New York: Oxford University Press, 1987), 129.
2. Dominic Head, "The (Im)possibility of Ecocriticism," in *Writing the Environment: Ecocriticism and Literature*, ed. Richard Kerridge and Neil Sammells (London: Zed Books, 1998), 38.
3. Heise writes that from a comparatist's perspective, ecocriticism "is not in principle more closely linked to American than to any other national or regional literature," and that it "has nothing specifically to do with *nature* writing" or with "nature *writing*." See Ursula K. Heise, "Forum on Literatures of the Environment," *PMLA* 114,5 (October 1999): 1097.
4. Richard White, "Discovering Nature in North America," *The Journal of American History*, 79,3 (December 1992): 874.
5. Roland Barthes, "From Work to Text," in *Image Music Text*, trans. Stephen Heath (New York: Hill and Wang, 1977), 155. Italics in original.
6. Jonathan Bate, "Poetry and Biodiversity," in *Writing the Environment*, 65.
7. Friedrich Nietzsche, "Against Mediators," in *On the Geneaology of Morals* and *Ecce Homo*, ed. and trans. Walter Kaufmann (New York: Vintage Books, 1967), 193.
8. Ian Hacking, *The Social Construction of What?* (Cambridge: Harvard University Press, 1999), vii, 35, 49.
9. David Bloor, *Knowledge and Social Imagery* (London: Routledge & Kegan Paul, 1976), 93.
10. William Cronon, "Introduction: In Search of Nature," in *Uncommon Ground: Toward Reinventing Nature*, ed. William Cronon (New York: W. W. Norton, 1995), 25–26.

Chapter 1

1. For overviews of the field and a representative sample of essays in ecocriticism, see *Earthly Words: Essays on Contemporary American Nature and Environmental Writers*,

ed. John Cooley (Ann Arbor: The University of Michigan Press, 1994); *The Ecocriticism Reader: Landmarks in Literary Ecology*, ed. Cheryll Glotfelty and Harold Fromm (Athens: University of Georgia Press, 1996); the selected papers from the first conference held by the Association for the Study of Literature and Environment in 1995, published as *Reading the Earth; New Directions in the Study of Literature and the Environment*, ed. Michael Branch, et al. (Moscow, Idaho: University of Idaho Press, 1998); *Writing the Environment: Ecocriticism & Literature*, ed. Richard Kerridge and Neil Sammells (London: Zed Books, 1998); the special issue on ecocriticism published in the summer of 1999 by the journal *New Literary History*; and the contributions to a "Forum on Literatures of the Environment," *PMLA* 114.5 (October 1999): 1089–1104.

2. Frank Stewart, *A Natural History of Nature Writing* (Washington: Island Press, 1995), 222, 221. Unlike other ecocritics, Stewart invokes his moment of epiphany retrospectively, at the end of his book.
3. Stewart, *A Natural History of Nature Writing*, 229.
4. Patrick Murphy, *Farther Afield in the Study of Nature-Oriented Literature* (Charlottesville: University Press of Virginia, 2000), x.
5. See SueEllen Campbell, "The Land and Language of Desire: Where Deep Ecology and Post-Structuralism Meet," in *The Ecocriticism Reader*, 124–36.
6. Lawrence Buell, *The Environmental Imagination: Thoreau, Nature Writing, and the Formation of American Culture* (Cambridge: Harvard University Press, 1995), 10.
7. Buell, *The Environmental Imagination*, 5.
8. Buell, *The Environmental Imagination*, 102. The seal's point of view is one that Barry Lopez tries to imagine in his book *Arctic Dreams*, in a passage to which Buell is alluding.
9. I should note that American ecocritics are not alone in their assumption that realism is somehow a crucial issue ecologically and environmentally. "The real, material ecological crisis," according to the British ecocritic Richard Kerridge, "is also a cultural crisis, a crisis of representation." He also suggests that ecological crisis is caused by "a failure of narrative" ("Introduction," in *Writing the Environment*, 4).
10. Umberto Eco, "On the Crisis of Representation," in *Travels in Hyperreality*, trans. William Weaver (New York: Harcourt Brace Jovanovich, 1986), 126–27.
11. Roland Barthes, "Myth Today," in *Mythologies*, trans. Annette Lavers (New York: Hill and Wang, 1972), 126, 109, 142, 152–53. Italics in original.
12. Roland Barthes, "The Death of the Author," in *Image Music Text*, trans. Stephen Heath (New York: Hill and Wang, 1977), 142. Italics in original.
13. Barthes, "From Work to Text," in *Image Music Text*, 156–57, 157.
14. Buell, *The Environmental Imagination*, 5.
15. In an essay critical of versions of ecocriticism like Buell's, Bonnie Costello writes: "A rhetorically oriented criticism is aware of the text (and indeed all mediating forms) less as a statement about reality than as a series of motivated strategies and structures that communicates to an audience or makes something happen imaginatively. A rhetorical criticism does not necessarily lead to a thesis about the primacy of the imagination, mind, or culture, as ecocriticism has charged" ("'What to Make of a Diminished Thing': Modern Nature and Poetic Response," *American Literary History* [Winter 1997]: 574).
16. Barry Lopez, "Landscape and Narrative," in *Crossing Open Ground* (New York: Vintage Books, 1989), 64, 65.

17. Daniel Dennett, *Kinds of Minds: Toward an Understanding of Consciousness* (New York: Basic Books, 1996), 89, 82.
18. Lopez, "Landscape and Narrative," 64.
19. As an epigraph to the third chapter of *The Environmental Imagination*, Buell quotes almost at full length the passage from "Landscape and Narrative" that I have quoted only a small portion of here, and refers to the essay in largely positive terms thereafter. But see page 103, where Buell does complain that Lopez's description of the interior landscape is too mystical. For a skeptical reading of Lopez's essay that nonetheless finds some merit in the idea of the two landscapes, see William Howarth, "Some Principles of Ecocriticism," in *The Ecocriticism Reader*, 69–71; and for more on ecocritical evaluations of Lopez's work, see my discussion of nature writing in chapter five.
20. Lopez, "Landscape and Narrative," 64.
21. Lopez, "Landscape and Narrative," 63, 71.
22. Sue Hubbell, *Waiting for Aphrodite: Journeys into the Time Before Bones* (New York: Houghton Mifflin, 1999), 160.
23. Buell, *The Environmental Imagination*, 86.
24. Eric Todd Smith, "Dropping the Subject: Reflections on the Motives for an Ecological Criticism," in *Reading the Earth*, 30, 34, 35.
25. Dennett, *Kinds of Minds*, 93.
26. Smith suggests that ecocritics have resisted the idea that we do not have to "consider our language to have failed when it doesn't deliver the essence of a 'referent,'" because they have wanted to "preserve literature as a pure salve (either natural or metaphysical) for the alienated human soul" ("Dropping the Subject," 38).
27. Buell, *The Environmental Imagination*, 84.
28. Buell, *The Environmental Imagination*, 85, 86, 90.
29. Buell, *The Environmental Imagination*, 31. For some other attempts to define ecocriticism and nature writing, too, as pastoral, see Glen A. Love, "*Et in Arcadia Ego*: Pastoral Theory Meets Ecocriticism," *Western American Literature* 27.3 (Fall 1992): 195–207; John Cooley, "Introduction: American Nature Writing and the Pastoral Tradition," in *Earthly Words*, 1–15; and Don Scheese, *Nature Writing: The Pastoral Impulse in America* (New York: Twayne Publishers, 1996).
30. Paul Alpers writes: "Modern studies tend to use 'pastoral' with ungoverned inclusiveness." "It sometimes seems," he observes, "as if there are as many versions of pastoral as there are critics and scholars who write about it," and he cites Buell's work on "new world pastoral" as a case in point. See Alpers's book *What is Pastoral?* (Chicago: University of Chicago Press, 1996), ix, 8.
31. Buell, *The Environmental Imagination*, 54. Buell is motivated in large part by his desire to address what he sees as the shortcomings of Leo Marx's classic 1964 study of "new world pastoral," *The Machine in the Garden*, and to further revise Marx's own revision of his arguments in an essay published in 1986, in which Marx suggests that contemporary pastoralism "may be particularly well suited to the ideological needs of a large, educated, relatively affluent, mobile, yet morally and spiritually troubled segment of the white middle class"—a suitability that would seem to compromise the pastoral both culturally and politically. See "Pastoralism in America," in *Ideology and Classic American Literature*, ed. Sacvan Bercovitch and Myra Jehlen (Cambridge: Cambridge University Press, 1986), 40.
32. William Empson, *Some Versions of Pastoral* (Norfolk, Conn.: New Directions Books, 1960), 6, 23.

33. Marx, "Pastoralism in America," 54.
34. Bonnie Costello argues that while it is true that the pastoral impulse "persists in the literary imagination," the pastoral is far from being the only viable means contemporary poets have of addressing the natural world. "Fictions of nature as a primal Other or even a numinous presence are receding as poets turn to the indissoluble mixture of gray and green in which we live," she writes. She suggests that "modern poets interested in the mediations of language and culture that inform our relation to the natural world," poets like Robert Frost and Wallace Stevens, or poets "versed in the languages of history and science" like Amy Clampitt and A. R. Ammons, "have more to tell us about the possibilities for our relation to nature than do the latter-day Romanticists, primitivists, and 'poets of place' and mystical presence who are usually celebrated by ecologically oriented critics" ("'What to Make of a Diminished Thing'": 571, 572.)
35. I also should note another fact of some importance here, one the pastoral will have a hard time coping with: environmental historians now argue that human degradation of the environment is due as much, if not more, to the ancient and ongoing development of agriculture as it is to more recent human innovations like heavy industry. Alfred W. Crosby writes: "Agriculture, a Neolithic development, has been altering the biosphere for a lot longer than the industrial revolution, and, one could argue, continues to make greater changes" ("An Enthusiastic Second," *The Journal of American History* 76,4 [March 1990]: 1107).
36. Buell, *The Environmental Imagination*, 54–55. Glen Love notes that the pastoral mode "reflects the same sort of anthropocentric assumptions which are in such dire need of reassessment" and that "the terms by which pastoral's contrastive worlds are defined, do, from an ecological viewpoint, distort the true essence of each." He concludes: "We need to redefine pastoral in terms of the new and more complex understanding of nature" ("Revaluing Nature: Toward an Ecological Criticism," *Western American Literature* 25,3 (Fall 1990): 207). But redefinition of the pastoral so that it allows for greater recognition of ecological (and social) complexity will amount to retaining the term "pastoral" while emptying out the concept, and is bound to create confusion.
37. Since I can never remember the definition of metonymy, it seems only fair to give the reader some assistance here: metonymy is the figure of speech that uses the name of a thing as a substitute for the name of another thing of which it is a part, or with which it is associated.
38. Alpers, *What is Pastoral?*, 338.
39. See my discussion of the concept of niche in the next chapter, where the appropriate scientific authorities are cited.
40. A point indirectly suggested by Leo Marx: "Potential invaders of all sectors of the environment, the forces represented by the new technology necessarily blur (if they do not erase) the immemorial boundary lines between city, countryside, and wilderness. By threatening to take dominion everywhere, they intensify—at times to the point of apocalyptic stridency—the dissonance that pastoralism always had generated at the junction of civilization and nature" ("Pastoralism in America," 58). In this connection, see my essay "Don DeLillo's Postmodern Pastoral," in *Reading the Earth*, 235–46.
41. Eco, "Travels in Hyperreality," in *Travels in Hyperreality*, 49.
42. The hyperreal as described by Eco is not unlike myth as described by Barthes, in that the issue of where and how things lie is raised by both hyperreality and mythology. Barthes writes: "The ubiquity of the signifier in myth exactly reproduces the physique of the *alibi* (which is, as one realizes, a spatial term): in the alibi too, there is a place which is full and one which is empty." He adds: "Myth is a *value*, truth is no guarantee for it; nothing prevents it from being a perpetual alibi: it is enough that its signifier has two sides for it always to have an 'elsewhere' at its disposal" ("Myth Today," 123; italics in original).
43. Eco, "Travels in Hyperreality," 52.
44. The San Diego Zoo's Web site is located at www.sandiegozoo.org.
45. Guy Debord, *The Society of the Spectacle* (Detroit: Black & Red, 1970), #9. Italics in original.
46. Jean Baudrillard, *Simulations*, trans. Paul Foss, Paul Patton, and Philip Beitchman (New York: Semiotext(e), 1983), 140. Baudrillard's description of the "hyperrealism of simulation" deserves to be quoted here in full: "This is a completely imaginary contact-world of sensorial mimetics and tactile mysticism; it is essentially an entire ecology that is grafted on this universe of operational simulation, multistimulation and multiresponse."
47. Buell, *The Environmental Imagination*, 113. On the opposition of natural and virtual realities, Katherine Hayles comments: "When the virtual is opposed to the natural, the emphasis falls on the redemptive potential of the natural world." But, she adds, "when the virtual and the natural are aligned, new opportunities for analysis present themselves" (N. Katherine Hayles, "The Illusion of Autonomy and the Fact of Recursivity: Virtual Ecologies, Entertainment, and *Infinite Jest*," *New Literary History* 30,3 [Summer 1999]: 677). Hayles's argument is pointed in an entirely different direction, but the thought that "new opportunities for analysis" present themselves "when the virtual and the natural are aligned" has long been one of the great hopes of ecological research, where, unfortunately, the techniques of computer simulation have proved to be less than wholly enabling. See my discussion of ecosystem modeling in the next chapter.
48. Of course Baudrillard would counter Buell's argument (as Buell notes) by suggesting that environmental literature and ecocriticism are infected with "the nostalgia for a natural referent of the sign" (*Simulations*, 86).
49. Eco, "Travels in Hyperreality," 13, 30–31, 4, 7.
50. "Must we say what we see?" is a question I take up again in chapter four: see the section with that question as its heading. The question is also an allusion to Stanley Cavell's *Must We Mean What We Say?: A Book of Essays* (Cambridge: Cambridge University Press, 1976).
51. Jean-Francois Lyotard, *The Postmodern Condition: A Report on Knowledge*, trans. Geoff Bennington and Brian Massumi (Minneapolis: University of Minnesota Press, 1984), 51.
52. Jean Baudrillard, *Simulations*, 115.
53. Linda Hutcheon, *The Politics of Postmodernism* (London: Routledge, 1989), 2.
54. Fredric Jameson, "Postmodernism, or The Cultural Logic of Late Capitalism," *New Left Review* 146 (July–August 1984): 78.
55. Fredric Jameson, *Postmodernism, or The Cultural Logic of Late Capitalism* (Durham, N.C.: Duke University Press, 1991), 35, ix, 1. Jameson offers a more qualified judgment, and a more turgid one, on the fate of nature later in his book. Nature, he writes, "has systematically been eclipsed from the object world and the social relations of a society whose tendential domination over its Other (the non-

human or the formerly natural) is more complete than at any other moment in human history" (170).

56. Jameson, in taking the view of nature that he does, also has in mind Heidegger's concept of nature as the "standing-reserve," which might be described as an epistemological and ontological version of the economic category of the capitalist mode of production deployed by Marxism. "Everything is ordered to stand by, to be immediately on hand, indeed to stand there just so that it may be on call for a further ordering," Heidegger argues, and he then suggests that its being made a part of the standing-reserve means that nature is taken into culture once and for all time: "Whatever stands by in the sense of standing-reserve no longer stands over against us as object." See "The Question Concerning Technology," in Martin Heidegger, *Basic Writings*, ed. David Farrell Krell (New York: Harper & Row, 1977), 298.
57. Jameson, *Postmodernism*, 231–32, 67–68.
58. "What seems to have happened," according to Arran E. Gare, "is that the triumph of Western civilization has revealed the hollowness of its premises" (*Postmodernism and the Environmental Crisis* [London: Routledge, 1995], 5).
59. Debord, *Society of the Spectacle*, #175. Jameson agrees with Debord, stating that "place in the United States today no longer exists, or, more precisely, it exists at a much feebler level," and that small towns, each of them "once a separate point on the map," have become only "an imperceptible thickening in a continuum of identical products and standardized spaces from coast to coast" (*Postmodernism*, 127, 281). David Harvey confirms that this is a typically postmodern view. "Postmodernism cultivates," he writes, "a conception of the urban fabric as necessarily fragmented, a 'palimpsest' of past forms superimposed upon each other, and a 'collage' of current uses, many of which may be ephemeral" (*The Condition of Postmodernity; An Enquiry into the Origins of Cultural Change* [Oxford: Blackwell Publishers, 1989], 66).
60. William Cronon, "Modes of Prophecy and Production: Placing Nature in History," *The Journal of American History* 76.4 (March 1990): 1124, 1126, 1130.
61. Michel Serres, *The Natural Contract*, trans. Elizabeth MacArthur and William Paulson (Ann Arbor: The University of Michigan Press, 1995), 43.
62. Michael E. Soulé, a biologist critical of postmodernist attitudes toward nature and natural science, writes: "To claim that *Homo sapiens* has produced or invented the forest ignores the basic taxonomic integrity of biogeographic units: species today still have geographic distributions determined largely by ecological tolerances and geological history and climate, rather than by human activities" ("The Social Siege of Nature," in *Reinventing Nature? Responses to Postmodern Deconstruction*, ed. Michael E. Soulé and Gary Lease [Washington, D.C: Island Press, 1995], 157).
63. Eco is very strongly influenced by the writing of Charles Sanders Peirce, one of the founding figures of American pragmatism and, as it happens, also one of the originators of semiotics.
64. William James, *Pragmatism and The Meaning of Truth* (Cambridge: Harvard University Press, 1978), 124.
65. Paul Feyerabend, *Against Method; Outline of an Anarchistic Theory of Knowledge* (London: NLB, 1975), 230.
66. Bruno Latour, *We Have Never Been Modern*, trans. Catherine Porter (Cambridge: Harvard University Press, 1993), 2, 1, 6.
67. Latour, *We Have Never Been Modern*, 47.

68. Latour, *We Have Never Been Modern*, 50, 64. Michel Serres' thinking about nature and culture has a great deal in common with Latour's. Serres argues, "We have made politics and economics into their own disciplines so as to define power." But now the question facing us, he says, is "how are we to think of fragility?" (*The Natural Contract*, 41). Cronon also makes a point similar to Latour's, with specific reference to the peculiar difficulties of his own discipline of environmental history: "Nature, political economy, and belief—these, in varying mixes, have been the chief fascinations of environmental historians' work, and our greatest challenge has been to figure out how best to integrate the three." Cronon adds that this challenge has proved difficult to meet: "We have either had studies of ecology and economy, or studies of ideas of nature; too rarely have we had the three together" ("Modes of Prophecy and Production": 1123).
69. Barthes, "Lesson in Writing," in *Image Music Text*, 171.
70. The allusion is to Thomas Nagel, *The View From Nowhere* (Oxford: Oxford University Press, 1986).
71. As Paul R. Gross and Norman Levitt point out, "The mentality of postmodernism has an emphatically totalizing component, even as it pretends to denounce the totalizing propensities of whatever it wishes to attack" (*Higher Superstition; The Academic Left and Its Quarrels with Science* [Baltimore: The Johns Hopkins University Press, 1994], 89).
72. Of course "nature" tends to be a difficult, complicated term no matter who uses it. Raymond Williams calls it "perhaps the most complex word in the language" (*Keywords; A Vocabulary of Culture and Society*, Revised Edition [New York: Oxford University Press, 1983], 219).
73. In a chapter "On Being," Eco writes: "Here is what we mean by the word *Being*: Something." See his book *Kant and the Platypus; Essays on Language and Cognition*, trans. Alastair McEwan (New York: Harcourt Brace, 2000), 12.
74. With both postmodernism and poststructuralism in mind, Christopher Norris writes: "What these movements have in common is a deep suspicion of any theory that claims a vantage-point of knowledge or truth, a self-assured position of 'scientific' method from which to criticise the various forms of 'ideological' false-seeming or common-sense perception" (*What's Wrong with Postmodernism; Critical Theory and the Ends of Philosophy* [Baltimore: The Johns Hopkins University Press, 1990], 28). The 1960s, when a ground note of pessimism entered into the chorus of intellectual life, was the watershed moment for poststructuralism and postmodernism. According to Luc Ferry and Alain Renaut, in the sixties philosophy was "becoming a strangely problematic activity," one "condemned for its very survival to the eternal celebration of its own death" (*French Philosophy of the Sixties; An Essay on Antihumanism*, trans. Mary Schnackenberg Cattoni [Amherst: University of Massachusetts Press, 1990], 6).
75. Richard Rorty, *Essays on Heidegger and Others; Philosophical Papers Volume 2* (Cambridge: Cambridge University Press, 1991), 176.
76. Latour, *We Have Never Been Modern*, 46.
77. Max Black, *Models and Metaphors; Studies in Language and Philosophy* (Ithaca: Cornell University Press, 1962), 16.
78. Baudrillard, *Simulations*, 31.
79. Latour, *We Have Never Been Modern*, 75, 47. Compare John Dewey's assessment of our situation to Latour's: "The *world* is precarious and perilous. It is as easily accessible and striking evidence of this fact that primitive experience is cited. The

voice is that of early man; but the hand is that of nature, the nature in which we still live. It was not fear of the gods that created the gods." He adds: "When all is said and done, the fundamentally hazardous character of the world is not seriously modified, much less eliminated" (*Experience and Nature* [New York: Dover Publications, 1958], 42 [italics in original], 44).

80. Serres argues that the global environmental crisis should serve us as a powerful reminder of our culture's continuity with nature: "The natural world will never again be our property, either private or common, but our symbiont" (*The Natural Contract*, 44). Of course, those who come to this insight from the perspective of literature and philosophy, as Serres has done, are much more apt to see the symbiosis of culture and nature as something new than are those whose perspective is shaped more by natural history. David Rains Wallace writes: "Civilization would not have evolved without the preceding evolution of cereal grains from wild grasses. That agriculture was developed by cultural instead of natural selection doesn't make the plants less important. They may be sown and harvested by us, but they still do the real work of turning soil, water, and sunlight into food." He concludes: "Civilization is a grassland symbiont, fully dependent on the condensed food energy of grain" (*The Klamath Knot; Explorations of Myth and Evolution* [San Francisco: Sierra Club Books, 1983], 113, 128).
81. Latour, *We Have Never Been Modern*, 3, 7, 87. It should be clear that Latour is not putting the concept of "nature-culture" forward as some sort of compromise position, or as a way of skating lightly over the cracks caused by the dualism of nature and culture. He would agree with Neil Evernden that this dualism "cannot actually be resolved, because it never existed," though he would reject Evernden's suggestion that the unreality of the dualism means "that there is no 'nature,' and there never has been," since one could make the same assertion about culture and society equally well on the same grounds (*The Social Creation of Nature* [Baltimore: The Johns Hopkins University Press, 1992], 99).
82. Richard Rorty, *Objectivity, Relativism, and Truth: Philosophical Papers Volume 1* (Cambridge: Cambridge University Press, 1991), 36.
83. Dewey, *Experience and Nature*, 310.
84. Some readers may wonder how the disparaging remarks about social construction that I made in the preface of this book square with my enthusiasm for soft, squishy, and dubious facts, and for Latour's concept of nature-culture, facts and a concept that have about them the tang of constructionist thinking. But to regard the facts as soft, squishy, and dubious and to accept the concept of nature-culture strikes me as one way of embracing a version not of social construction but of scientific realism.
85. Eco, "On Being," 54–55. Italics in original.
86. In his essay "Dropping the Subject," Smith also notes that ecocriticism tends to take the distinction between nature and culture as a given, and appeals to Latour and Donna Haraway in support of his argument. Jonathan Levin, in his contribution to the *PMLA* forum on ecocriticism cited in note 1 above, makes a similar case: "Nature and culture are entangled in complex and inherently elusive ways. To acknowledge this is not to abandon the project of thinking rigorously about their relation but is rather to set that project on an alternative track, one less devoted to resolving once and for all a long-standing sociophilosophical problem than to entering the space of the problem in new ways" ("Forum on Literatures of the Environment": 1098).

87. Latour, *We Have Never Been Modern*, 10.
88. Campbell, "The Land and Language of Desire," 128, 129, 132–33. John Cooley makes a point similar to Campbell's: "The parallels between intertextuality and ecological concepts of biotic community interactions are numerous," he writes. "Neither texts nor biotic communities are closed systems" ("Afterward: Toward an Ecocriticism," in *Earthly Words*, 253). The question, of course, is whether texts and biotic communities are "systems" at all.
89. Campbell's attempt to treat the deer as nodes in an environmental network is a nonmathematical version of the use of the logistic equation in scientific ecological research, an approach to wildlife biology that some ecologists believe to be a failure. See my discussion of this subject in chapter two.
90. Ludwig Wittgenstein, *Culture and Value*, ed. G. H. von Wright and Heikke Nyman, trans. Peter Winch (Chicago: The University of Chicago Press, 1980), 41e.
91. On the subject of Esperanto, see Wittgenstein, *Culture and Value*, 52e.
92. Richard Rorty, *Philosophy and Social Hope* (New York: Penguin Books, 1999), 64.
93. Wittgenstein, *Culture and Value*, 50e. Italics in original.
94. "A *picture* held us captive. And we could not get outside it, for it lay in our language and language seemed to repeat it to us inexorably." Proposition 115 in Ludwig Wittgenstein, *Philosophical Investigations*, trans. G. E. M. Anscombe, (New York: MacMillan Publishing, 1958), 48e. Italics in original.
95. Donald Worster, *The Wealth of Nations; Environmental History and the Ecological Imagination* (Oxford: Oxford University Press, 1993), 180. Italics in original.
96. Rorty, *Philosophy and Social Hope*, 140.
97. Feyerabend, *Against Method*, 17 (italics in original), 194. I would distinguish the "anarchic" approach to ecocriticism from what Buell describes as the "eclecticism of critical practice" in order to justify or "sanction" his borrowing and use of the term "pastoral" in "an elastic sense" (*The Environmental Imagination*, 439n4). More is at stake in these matters than word choice: thus Feyerabend's emphasis on "rags of argument." Ecocritics would be wise, I think, to heed Barthes's warning about eclecticism. In his essay on "Neither-Nor Criticism," he writes: "A literary judgment is always determined by the whole of which it is a part, and the very absence of a system—especially when it becomes a profession of faith—stems from a very definite system" (*Mythologies*, 82).
98. Joel Kovel, "Dispatches from the Science Wars," *Social Text* 46–47 (1996): 173–74. Like Latour, Kovel suggests that our intellectual culture is ill-prepared to cope with the environmental crisis: "Denial and apocalypticism, as well as cynical withdrawal or indifference, are all ways of relieving anxiety; here they can have potentially fatal consequences." "If extrapolations of the present ecological crisis are true," he adds, "if only the findings about sperm counts are true, not to mention better-known calamities such as global warming, rampant species-loss, destruction of topsoils, and deforestation—then we are facing something for which human society is utterly unprepared" (170–71).

Chapter 2

1. See chapters two, three, and four in Thomas S. Kuhn, *The Structure of Scientific Revolutions*, Second Edition (Chicago: The University of Chicago Press, 1962, 1970).

2. Robert P. McIntosh, *The Background of Ecology: Concept and Theory* (Cambridge: Cambridge University Press, 1985), 1.
3. The environmental historian Peter Bowler writes: "In biology the relationship between the laboratory and the field disciplines has often been one of tension and recrimination" (*The Norton History of the Environmental Sciences* [New York: W. W. Norton, 1993], 429).
4. According to the philosopher of science Peter Galison, "To the molecular biologists the dream of a complete discipline includes the explanation of ontogenetic and phylogenetic development from primitive relations of genetic material. To the macrobiologists such reductiveness will never capture the systemic aspects of complex organisms, let alone the ecological systems in which they live and reproduce" ("Introduction: The Concept of Disunity," in *The Disunity of Science: Boundaries, Contexts, and Power*, ed. Peter Galison and David J. Stump [Stanford: Stanford University Press, 1996], 2).
5. Jon Luoma suggests that ecologists are not as disruptive of scientific unity as they might be: "Even scientists who are trained as ecologists are tugged toward the small, the easily definable, the easily quantifiable, the *non*complex, the reductive," owing to the practical constraints placed on their research. However, Luoma does quote an ecologist who thinks that the tendency to work on a small scale is a regrettable by-product of "physics envy." See *The Hidden Forest: The Biography of an Ecosystem* (New York: Henry Holt, 1999), 10.
6. According to Stephen Budiansky, "Understanding the workings of ecological systems may be a more difficult problem, theoretically speaking, than those a chemist or physicist encounters" (*Nature's Keepers; The New Science of Nature Management* [New York: The Free Press, 1995], 160).
7. Neil Evernden points out that we have assumed that ecology "will help us to feel our way into a healthier relationship with the world by revealing to us the 'natural harmonies' that are essential to our survival and happiness," and that this assumption "is not particularly attuned to the literature of ecology." He adds that the popular, oracular version of ecology is "a more 'convenient' ecology" tailored to the needs of "a program for social action" (*The Social Creation of Nature* [Baltimore: Johns Hopkins University Press, 1992], 7–8). Evernden means that the distortion of popular ecological rhetoric reflects the vicissitudes of the environmental movement; in other words, it can be explained politically. Of course, ecologists must share some of the blame for helping to foster the misunderstanding of their science that many of them now deplore. For an account of the popular misunderstanding of ecology, particularly on the part of conservationists and environmentalists, which confirms many of the points I make in this chapter, see the ecologist Michael B. Barbour's essay "Ecological Fragmentation in the Fifties," in *Uncommon Ground: Toward Reinventing Nature*, ed. William Cronon (New York: W. W. Norton, 1995), 233–55.
8. McIntosh notes that during the 1960s, "although ecologists had long asserted that ecological science was significant in offering insight about, and to, human societies, they were ill prepared to cope with the abrupt seizure of the name and its extension to include all aspects of environmental concern, often leaving behind ecological concepts and canons of evidence which had developed over the decades" (*The Background of Ecology*, 1).
9. Andrew Brennan, *Thinking About Nature* (Athens: The University of Georgia Press, 1988), 7.

10. Donald Worster, *Nature's Economy: A History of Ecological Ideas*, Second Edition (Cambridge: Cambridge University Press, 1994).
11. Donald Worster, *The Wealth of Nature; Environmental History and the Ecological Imagination* (Oxford: Oxford University Press, 1993), 165–66.
12. On this issue, see the forum on environmental history published in *The Journal of American History* 76,4 (March 1990), which includes an essay by Worster written in response to the contributions of other prominent environmental historians, some of whom are critical of his work.
13. In fact a different historiographic approach to ecology is readily available. Bowler describes this approach in the following terms: "Recent historical studies stress the importance of scientific disciplines and research programmes. The emergence of a science of ecology depended not so much on changing assumptions about Nature"—as Worster, dedicated as he is to intellectual history, would have it—"as upon the creation of a community (or communities) of researchers who saw the study of natural relationships as their primary goal." Bowler adds: "Ecology was a second-generation response to the problem of creating a scientific biology," and not a continuation of earlier and more traditional ways of thinking about the natural world (*The Norton History of the Environmental Sciences*, 363, 364).
14. Worster, *The Wealth of Nature*, 51.
15. See in particular Worster's essays on "The Shaky Ground of Sustainable Development" and "The Ecology of Order and Chaos" in *The Wealth of Nature*, 142–55 and 156–70, in which he takes recent ecology to task for its "permissiveness," a rhetorical maneuver which suggests that his understanding of current trends in ecology is limited. Worster's treatment of the ecologists Daniel Botkin and Paul Colinvaux (see *The Wealth of Nature*, 149–153 and 166), especially his insinuation that they lack conviction because they have questioned some of the environmental movement's broadest and least supportable claims, seems particularly unfair to me based on my own reading of their work.
16. Worster, *The Wealth of Nature*, 169. McIntosh describes ecology as "an eclectic science that frustrates writers of ecological history" ("Ecology Since 1900," in *History of American Ecology*, 356). I do not think, however, that he has in mind the kind of frustration Worster sometimes expresses.
17. Richard White, "Environmental History, Ecology, and Meaning," *The Journal of American History* 76,4 (March 1990): 1111, 1112. Stephen Pyne agrees with White. He says Worster "appeals to the laws of ecology to construct a nature that is external to humans and that provides a moral template against which to measure human behavior. This grants him, as author, a privileged, omniscient position with which to view the spectacle" ("Firestick History," *The Journal of American History* 76,4 [March 1990]: 1139). Worster has responded to Pyne by charging him with being overly modernist, and by rattling off a litany of the bad things that can be identified with modernism: "The foremost philosophical challenge of this age, in my view, is to escape the state of nihilism, relativism, and confusion that modernistic history, and modernistic everything else, have left us in" ("Seeing Beyond Culture," *The Journal of American History* 76,4 [March 1990]: 1146). Ecocriticism sometimes yields to the same temptation to dismiss as nihilist, relativist, and confused the many challenges that contemporary culture poses to its most dearly held views.
18. White, "Environmental History, Ecology, and Meaning," 1114–15.
19. Worster, *Nature's Economy*, 58.

20. McIntosh, *The Background of Ecology*, 22. "Ecologists sorely need a guide to understanding the background of their science," McIntosh admits, "but it is unfortunate if the science of ecology is conflated with diverse historical concerns with the relation between humanity and the environment and if things that have simply 'gone before' are linked as if they are in a direct line of development to ecology" (17). He notes with frustration that Worster is willing to include, on very slender evidence, even so unlikely a candidate as John Wesley, the founder of Methodism, in his pantheon of early ecologists.
21. Bowler approaches the history of ecology in a way much more likely to please McIntosh and his colleagues. Bowler writes: "It was certainly possible to study what would now be called ecological relationships before the founding of scientific ecology. But the natural theologians' assumption that God had designed a harmonious order of Nature was hardly a suitable basis upon which to build a modern science" (*The Norton History of the Environmental Sciences*, 363).
22. Ernst Mayr has suggested that ecology, "among all biological disciplines, is the most heterogeneous and most comprehensive." However, it seems ecology is the exception that proves to be the rule. What is true about it is also true of biology as a whole, where, Mayr suggests, "pluralism, probabilism, and purely qualitative as well as historical phenomena abound, while strictly universal laws are virtually absent." "Probabilistic theories," according to Mayr, "rarely give the kind of certainty one is aiming for when using the word 'law.'" See *This is Biology; The Science of the Living World* (Cambridge: Harvard University Press, 1997), 207, 48–49, 62.
23. As McIntosh notes, Haeckel "provided a name but little substance" for ecology (*The Background of Ecology*, 23). And according to Bowler, "Haeckel's holistic philosophy would inspire a later generation of environmentalists, but he had been trained as a morphologist and sought other ways of displaying the unity of Nature" (*The Norton History of the Environmental Sciences*, 338). Unlike McIntosh and Bowler, Anna Bramwell makes a great deal of Haeckel's work in support of her contention that ecology "was formulated in Germany," but she grossly overestimates Haeckel's importance to the nascent science owing to her interest in his political activities. See *Ecology in the 20th Century: A History* (New Haven: Yale University Press, 1989) 10; on Haeckel, see page 39 and subsequent pages, especially page 53.
24. Mayr, *This is Biology*, 208.
25. McIntosh, *The Background of Ecology*, 4.
26. The first American book to incorporate "ecology" in its title was *Flower Ecology*, published in 1893 by Louis H. Pammel, a professor of botany at Iowa State College. Most of the important early ecologists were, like Pammel, botanists by training. See Frank N. Egerton, "The History of Ecology: Achievements and Opportunities, Part One," *Journal of the History of Biology*, 16,2 (Summer 1983): 277.
27. Henry Chandler Cowles, "The Ecological Relations of the Vegetation on the Sand-Dunes of Lake Michigan," in *Foundations of Ecology: Classic Papers with Commentaries*, ed. Leslie A. Real and James H. Brown (Chicago: The University of Chicago Press, 1991), 28, 38.
28. "Like other but simpler organisms, each climax not only has its own growth and development in terms of primary and secondary succession, but it has also evolved out of a preceding climax. In other words, it possesses an ontogeny and phylogeny that can be quantitatively and experimentally studied, much as with the individuals and species of plants and animals" (Frederic E. Clements, "Nature and the Structure of the Climax," in *Foundations of Ecology*, 62, 63, 64).

29. In practice, quadrats tend to be much smaller than I have suggested, and hence are likely to be even less representative. Luoma cites a 1993 study by the ecologist Robert May in which it was demonstrated that a majority of the experiments surveyed were focused on an area of less than ten square meters, while "fully 44 percent covered an area of less than one square meter—about the size of a coffee table" (*The Hidden Forest*, 10).
30. As McIntosh reports, Clements's critics "pointed out the anomaly of an adult organism which had multiple embryonic stages from different starting points and lacked a genetic basis, but superorganisms are not easily killed by mere logic" (*The Background of Ecology*, 81).
31. "There has always been," according to Ernst Mayr, "a somewhat mystical overtone to the description of plant communities as superorganisms" (*This is Biology*, 221).
32. According to McIntosh, Clements's love of vocabulary was evident throughout his career, beginning in 1905 with his first publication of importance, a book entitled *Research Methods in Ecology*: "In this volume he evidenced the tendency that was to earn for ecology the pejorative definition 'that part of biology which has been totally abandoned to terminology.' Its glossary contained the classical definition of *geotome* (complete with Greek derivation): 'An instrument for obtaining soil samples'—that is, a shovel" ("Ecology Since 1900," in *History of American Ecology*, 354).
33. Worster, *Nature's Economy*, 219.
34. In effect, and perhaps without realizing it, Clementsian ecologists were holdovers from an earlier period of scientific thought, when those convinced of the priority and, indeed, the sufficiency of the *a priori*—and of theory—scoffed at "mere empirics." This circumstance was not without its ironies. According to Frank B. Golley, "Concepts of the complex organism or the superorganism are idealist concepts that are not researchable using ecological methods of analysis" (*A History of the Ecosystem Concept in Ecology* [New Haven: Yale University Press, 1993], 27).
35. Stephen Forbes, "The Lake as a Microcosm," in *Foundations of Ecology*, 14, 27.
36. Mary B. Hesse, *Models and Analogies in Science* (Notre Dame: University of Notre Dame Press, 1966), 167. Ernst Mayr observes that in science, "analogies are almost invariably misleading: they fail to be isomorphic with the real situation," which suggests that the devolution of analogy into metaphor and myth is inevitable, no matter how conscious of the dangers of analogy a scientist may be (*This is Biology*, 278n6).
37. I discuss the assumptions of radical critics of science about ecology, and about science in general, in chapter three.
38. Hesse, *Models and Analogies in Science*, 169.
39. Golley, *A History of the Ecosystem Concept*, 29.
40. In a discussion of sixteenth-century science, Michel Foucault suggests that its "reversibility" and "polyvalency" are the factors that "endow analogy with a universal field of application" and make it almost irresistible and all but ineradicable. Foucault also links the privileging of similarity over difference, which seems essential to the creation of analogy, to the development of "that only too well-known category, the microcosm," a category revived by late nineteenth-century ecology, as Forbes's article on lakes demonstrates. See *The Order of Things; An Archaeology of the Human Sciences* (New York: Vintage Books, 1973), 22, 30.

41. Max Black, *Models and Metaphors: Studies in Language and Philosophy* (Ithaca: Cornell University Press, 1962), 223, 239.
42. Black, *Models and Metaphors*, 242.
43. Clements, for instance, is said to have been a devoted follower of Herbert Spencer, whose sociological writings inspired the ecologist to develop his own ideas about the plant community as a superorganism. See Bowler, *The Norton History of the Environmental Sciences*, 375.
44. H. A. Gleason, "The Individualistic Concept of the Plant Association," in *Foundations of Ecology*, 100.
45. In 1916 Clements had published a large volume entitled *Plant Succession*, in which he offered "one grand theory" unifying the concepts of community and succession, precisely the sort of theory that Gleason was to attack ten years later as the product of wishful thinking. Egerton provides a description of *Plant Succession* in "The History of Ecology": 278.
46. Gleason, "The Individualist Concept of the Plant Association," 107, 117.
47. Coincidence and accident can be fortuitous, of course, as in cases of the symbiosis and mutual dependency of coevolved species of plants, fungi, and bacteria.
48. See Bowler, *The Norton History of the Environmental Sciences*, 524–25. Something very like Gleason's individualistic concept is now the accepted view of succession, as described by Mayr: "One abandoned pasture in New England may be taken over by white pine and gray birch, another nearby pasture may first be invaded by junipers, bird cherries, and maples. Succession is influenced by many factors: the nature of the soil, exposure to sun and wind, regularity of precipitation, chance colonizations, and many other random processes" (*This is Biology*, 220).
49. A. G. Tansley, "The Use and Abuse of Vegetational Concepts and Terms," in *Foundations of Ecology*, 324.
50. Tansley, "The Use and Abuse of Vegetational Concepts and Terms," 299.
51. Popularizers of the ecosystem concept often failed to realize that it, too, was essentially reductive. Golley notes, for example, that environmentalists embraced the ecosystem concept during the 1960s "as a way to maintain their faith in holism" (*A History of the Ecosystem Concept*, 3).
52. Tansley's article appears to have marked the beginning of a process of retrenchment among ecologists who were less suspicious of reduction in science and dissatisfied with Clementsian holism. "Clements's organic view of vegetation," according to Daniel Botkin, was "completely dismissed in the United States" by the 1940s (*Discordant Harmonies: A New Ecology for the Twenty-First Century* [New York: Oxford University Press, 1990], 98). Joel Hagen reports that Clements's views are "anathema to most ecologists" today (*An Entangled Bank: The Origins of Ecosystem Ecology* [New Brunswick, N.J.: Rutgers University Press, 1992], 13), and Sharon Kingsland points out that abandonment of the organic concept paid immediate dividends: "The shift from a biological to a physical model for ecology also opened the way to a mathematical analysis of the system" ("Defining Ecology as a Science," in *Foundations of Ecology*, 6). Mathematical analysis, of course, is the *sine qua non* of modern science.
53. Raymond L. Lindeman, "The Trophic-Dynamic Aspect of Ecology," in *Foundations of Ecology*, 400.
54. The Savannah River Site (SRS) is one of the largest plutonium-producing facilities in the United States. Like many nuclear preserves, it is surrounded by an extensive buffer zone of forest and abandoned farmland. This has led to its becoming a sanctuary for wildlife (both plant and animal), and has made it a prime location for ecological research.
55. Such was Odum's influence that in 1973 one ecologist joked, "Until recently, the appropriate unit of measure of ecology texts was the *odum*." The author of this witticism is quoted in Martin LaBar, "Odum in Brief, 2nd Edition," *Ecology* 58,2 (March 1977): 460.
56. Eugene P. Odum, *Ecology: The Link Between the Natural and the Social Sciences*, Second Edition (New York: Holt, Rinehart and Winston, 1975), 102, 222.
57. Eugene P. Odum, *Fundamentals of Ecology*, Third Edition (Philadelphia: W. B. Saunders, 1971), 251, 36. Italics in original.
58. The dawning awareness of environmental crisis in the 1960s and 70s helped create an atmosphere in which confusion about the character of ecology itself could flourish: according to McIntosh, "it was frequently confounded with any concern for, or ideology about, the environment" (*The Background of Ecology*, 6). In fact, the history of ecology should be viewed separately from the history of environmentalism. "The outsider might be tempted to assume that scientific ecology was inspired by the growth of environmentalism in the late nineteenth century," Bowler writes. "Yet serious studies of the interactions between animals, plants and their physical environments were often initiated by scientists who hoped to modify the natural balance in order to allow sustainable exploitation" (*The Norton History of the Environmental Sciences*, 362).
59. The vulnerability of some of ecology's positions with regard to the human population explosion is a favorite topic of radical critics of science like Andrew Ross; see my discussion of his ideas about "social ecology" in chapter three.
60. Odum, *Ecology: The Link Between the Natural and the Social Sciences*, 14.
61. Odum, *Fundamentals of Ecology*, 251.
62. Golley notes that early on in the development of the concept, "ecologists tended to misuse the term *ecosystem* as a more modern expression for the community concept or Clementsian complex organism and thus maintained the confusion that Tansley was trying to overcome" (*A History of the Ecosystem Concept*, 34, italics in original).
63. Odum, *Fundamentals of Ecology*, 9, 276.
64. McIntosh, *The Background of Ecology*, 232.
65. Paul Colinvaux, *Why Big Fierce Animals Are Rare: An Ecological Perspective* (Princeton: Princeton University Press, 1978), 206.
66. Golley, *A History of the Ecosystem Concept*, 165.
67. Worster, *The Wealth of Nature*, 174.
68. Worster, *The Wealth of Nature*, 174.
69. Sharon E. Kingsland, *Modeling Nature: Episodes in the History of Population Ecology*, Second Edition (Chicago: The University of Chicago Press, 1985, 1995), 1.
70. Budiansky, *Nature's Keepers*, 17.
71. Golley, *A History of the Ecosystem Concept*, 80, 106.
72. Colinvaux, *Why Big Fierce Animals Are Rare*, 6.
73. Mayr, *This is Biology*, 222.
74. Sue Hubbell, *Waiting for Aphrodite; Journeys into the Time Before Bones* (New York: Houghton Mifflin, 1999), 96–97, 98.
75. R. H. Waring, "Ecosystems: Fluxes of Matter and Energy," in *Ecological Concepts; The Contribution of Ecology to an Understanding of the Natural World*, ed. J. M. Cherrett (Oxford: Blackwell Scientific Publications, 1989), 18, 17; Hagen, *An En-*

tangled Bank, 127. In a review of Golley's book on the ecosystem concept, T. R. Seastedt writes: "The arbitrary boundaries of ecosystems have always plagued the usefulness of the concept, but systems with 'real' boundaries (lakes, watersheds, etc.) seem to be the subjects of better ecosystem science. Whether we now know how to study ecosystems is debatable" ("The History and Status of Ecosystem Science," *Ecology* 75,8 [December 1994]: 2466).

76. McIntosh, *The Background of Ecology*, 203.
77. Egerton, "The History of Ecology": 292. On the history of false theories that nonetheless prove useful and fruitful, see Umberto Eco, "The Force of Falsity," *Serendipities: Language and Lunacy*, trans. William Weaver (New York: Harcourt Brace, 1999).
78. A parallel though not equivalent problem in literary criticism has to do with the recognition of texts as distinct not only from referents but also from narratives, characters, settings, and the like, with all the attendant differences in methodology and attitude that these distinctions entail and encourage.
79. McIntosh, *The Background of Ecology*, 133. McIntosh adds that it may be impossible to obtain "precise measurements of biological characteristics of communities or ecosystems" (135), should one be able to identify those communities or ecosystems as such in the first place.
80. Colinvaux, *Why Big Fierce Animals Are Rare*, 68, 71, 72.
81. Botkin, *Discordant Harmonies*, 36, 37. Ernst Mayr points out that logistic approaches to ecological research treat the individuals of a given species as members of a class, thereby draining the biology from ecology. "The members of a class usually lack the individuality that is so characteristic of the organic world, where each individual is unique; each stage in the life cycle is unique; each population is unique; each species and higher category is unique; each interindividual contact is unique; each natural association of species is unique; and each evolutionary event is unique." Mayr also points out that "the concept of species as a class" has received "virtually universal rejection" from evolutionary biologists. See *Toward a New Philosophy of Biology: Observations of an Evolutionist* (Cambridge: Harvard University Press, 1988), 34, 342.
82. McIntosh, "Ecology Since 1900," in *History of American Ecology*, 367. Budiansky makes a point similar to Botkin's and McIntosh's when he notes that one reason "the species-area curve tends to exaggerate so wildly is that it ignores the texture of habitats. Species are not distributed randomly but in patches. Reducing all of a forest's multiplicity of habitats to a single mathematical variable representing 'area' is a biological absurdity" (*Nature's Keepers*, 167). Max Black has noted that mathematical analysis, however empowering it may seem to be, is in fact a problem for all the sciences because it requires "drastic simplifications" that "entail a serious risk of confusing accuracy of the mathematics with strength of empirical verification in the original field" (*Models and Metaphors*, 225).
83. Ernst Mayr writes: "The population concept adopted by most mathematical population ecologists was basically typological, in that it neglected the genetic variation among the individuals of a population. Their 'populations' were not populations in any genetic or evolutionary sense but were what mathematicians refer to as sets." Mayr suggests that the "crucial aspect of the population concept to have emerged in evolutionary biology" is a new emphasis on "the genetic uniqueness of the composing individuals. This kind of 'population thinking' is in sharp contrast with the typological thinking of essentialism. In ecology the genetic uniqueness of a population is usually ignored" (*This is Biology*, 211).
84. "Ecology is such a heterogeneous science that arguments about methods, approaches, and definitions of central terms are nearly impossible to avoid" (Kingsland, "Defining Ecology as a Science," in *Foundations of Ecology*, 12).
85. "The key terms of ecology—terms like 'community,' 'niche,' 'predator,' 'resource,' 'system,' 'competition,' 'parasite,' 'detritivore' and so on—do not have one clear level of application" (Brennan, *Thinking About Nature*, 97).
86. "Few phrases are as ubiquitous in community ecology as 'more or less,' usually introduced in defense of one or another system for defining and classifying communities and in providing sufficient elasticity, not to say lubricity, to make it difficult to grasp and attack assertions about communities" (McIntosh, *The Background of Ecology*, 80, 119).
87. Joseph Grinnell, "The Niche-Relationships of the California Thrasher," in *Foundations of Ecology*, 124.
88. In 1957, G. E. Hutchinson redefined the niche as "an *n*-dimension hypervolume," "every point in which corresponds to a state of the environment which would permit the species S_1 to exist indefinitely" ("Concluding Remarks," in *Foundations of Ecology*, 226). Paul Colinvaux follows Hutchinson's lead, but defines the niche much more colloquially: "The niche is an animal's (or a plant's) profession," he says, and not its address (*Why Big Fierce Animals Are Rare*, 11). For an excellent and very brief discussion of the niche concept, see Stephen Jay Gould, *An Urchin in the Storm; Essays about Books and Ideas* (New York: W. W. Norton, 1987), 184–86.
89. Leslie A. Real and Simon Levin, "The Role of Theory in the Rise of Modern Ecology," in *Foundations of Ecology*, 180, 188.
90. Golley, *A History of the Ecosystem Concept*, 100.
91. Luoma, *The Hidden Forest*, 27.
92. Colinvaux, *Why Big Fierce Animals Are Rare*, 237.
93. Mayr, *This is Biology*, 222.
94. R. C. Lewontin, *Biology as Ideology: The Doctrine of DNA* (New York: HarperCollins, 1991), 118, 119.
95. Mayr, *This is Biology*, 37. On the issue of validity and invalidity in interpretation, see the essays collected in *Questions of Evidence; Proof, Practice, and Persuasion across the Disciplines*, ed. James Chandler, Arnold I. Davidson, and Harry Harootunian (Chicago: University of Chicago Press, 1994).
96. Joel G. Kingsolver and Robert T. Paine, "Conversational Biology and Ecological Debate," in *Foundations of Ecology*, 315.
97. Mayr, *This is Biology*, 224.
98. R. H. Peters, *A Critique for Ecology* (Cambridge: Cambridge University Press, 1991), 4, 40.
99. Odum, *Ecology: The Link Between the Natural and the Social Sciences*, 39.
100. Readers familiar with the philosophy of science will recognize the Popperian slant of Peters's arguments.
101. Peters, *A Critique for Ecology*, 101, 77, 78.
102. See Naomi Cappuccino's review of *A Critique for Ecology*, "What Might Be Wrong With Ecology," *Ecology* 74,6 (Sept. 1993): 1907–08. Cappuccino welcomes the book as a valuable attempt to clear the air, something much needed by "a science that often asks fuzzy questions and engages in endless, aimless polemics" (1907). She

does point out that Peters "often overstates his case" (1907), but thinks that his overstatements can be excused due to his desire to be critical.

103. Peters, *A Critique for Ecology*, 89, 91.
104. Peters, *A Critique for Ecology*, 105.
105. Peters, *A Critique for Ecology*, 273.
106. According to Kingsland, "Ecology had hardly emerged when already ecologists were concerned with the problem of how best to impose a unified theoretical structure on the facts of nature" (*Modeling Nature*, 23).
107. Peters, *A Critique for Ecology*, 105–06, 137.
108. Peters, *A Critique for Ecology*, 135, 215.
109. Even consciously delimited uses of analogy seem problematic in ecological research, as J. H. Lawton, writing about studies of so-called food webs, reports: "Confronted with limited data of highly variable quality, hardly any of which is really good, food web studies face either hand-wringing paralysis, or cautious efforts to see what can be discovered in the existing information." Lawton thinks "some of the patterns" ecologists have been regarding as food webs "may eventually prove to be artefacts of poor information." See J. H. Lawton, "Food Webs," in *Ecological Concepts*, 45.
110. Bowler notes that in the nineteenth century, "ecology was presented as an extension of physiology into the study of the organism's reaction to its environment," not as an offshoot of Darwinism, to which some leading ecologists were, in fact, hostile. "The late nineteenth century saw an 'eclipse of Darwinism' in which the supporters of natural selection were marginalized even within scientific biology" (*The Norton History of the Environmental Sciences*, 308, 327).
111. Richard Levins and Richard Lewontin, *The Dialectical Biologist* (Cambridge: Harvard University Press, 1985), 11.
112. Bowler reports that as late as the 1930s, holists like Clements "were vehemently opposed to the Darwinian selection theory, and tended to favour Lamarckism" (*The Norton History of the Environmental Sciences*, 523).
113. Gould, *An Urchin in the Storm*, 183.
114. Colinvaux, *Why Big Fierce Animals Are Rare*, 73.
115. Peters, *A Critique for Ecology*, 137.
116. According to McIntosh, patchiness may be the one thing that more than anything else has hampered the development of contemporary ecology: "The problem of spatial distribution of organisms and particularly the problem of pattern, remains the key to modern ecological studies and theories, frustrating both empiricists and theorists" (*The Background of Ecology*, 53).
117. "Critics have attacked what they see as an overemphasis upon constancy, balance, and gradual change in traditional ecosystem ecology. In its place, they would erect a new ecology that emphasizes indeterminism, instability, and constant change. Ecosystems, so critics claim, may be perpetually out of balance" (Hagen, *An Entangled Bank*, 194).
118. Botkin, *Discordant Harmonies*, 9, 124.
119. As Worster correctly points out, "the new ecology of chaos" is not "a total surrender to the idea of disorder, or to a philosophy of complete indeterminism, or to some obscurantist repudiation of science itself" (*Nature's Economy*, 411).
120. Golley, *A History of Ecosystem Ecology*, 109. Egerton suggests that the existence of vigorous debates between ecologists subscribing to incommensurable theories "arouses visions of a Kuhnian preparadigm stage of science." He adds: "Yet selecting which paradigms will become generally accepted is not our business. There is at least a possibility that schools of ecology with mutually exclusive perspectives will persist side by side for an indeterminate period in ecology, just as they do in the social sciences" ("The History of Ecology": 267). Some ecologists may find Egerton's comparison of the state of their discipline to that prevailing in the social sciences disturbing, since "social science" is widely regarded as a synonym for "pseudoscience." But he and Golley have given voice to what seems to be the consensus among theorists and critics of ecology today.
121. Cowles, "The Ecological Relations of the Vegetation of the Sand Dunes of Lake Michigan," in *Foundations of Ecology*, 36–37, 40–41.
122. Jonathan Weiner, *The Beak of the Finch* (New York: Random House, 1994), 242, 244, 255, 244.
123. Marston Bates, *The Nature of Natural History* (Princeton: Princeton University Press, 1950), 116.
124. Budiansky, *Nature's Keepers*, 5, 16.
125. Budiansky, *Nature's Keepers*, 163–64, 238.
126. Peters, *A Critique for Ecology*, 10.
127. Kingsolver and Price, "Conversational Biology and Ecological Debate," in *Foundations of Ecology*, 309.

Chapter 3

1. The word "scientist" was not coined until sometime in the early nineteenth century.
2. This description of Sokal was attributed to Stanley Aronowitz by Janny Scott in her article, "Postmodern Gravity Deconstructed, Slyly," *The New York Times* (May 18, 1996). For an overview of the Sokal affair, see *The Sokal Hoax: The Sham That Shook the Academy* (Lincoln: University of Nebraska Press, 2000), which contains essays, editorials, and other commentary collected by the editors of *Lingua Franca*, the journal that broke the Sokal story in the first place.
3. Alan Sokal, "What the *Social Text* Affair Does and Does Not Mean," in *A House Built on Sand: Exposing Postmodernist Myths about Science*, ed. Noretta Koertge (New York: Oxford University Press, 1998), 11.
4. Paul Shepard, "Establishment and Radicals on the Environmental Crisis," *Ecology* 51,5 (September 1970): 942.
5. Philip Kitcher, "A Plea for Science Studies," in *A House Built on Sand*, 38.
6. David J. Hess, *Science Studies: An Advanced Introduction* (New York: New York University Press, 1997), 1.
7. Hess, *Science Studies*, 35.
8. Steve Woolgar, *Science: The Very Idea* (New York: Routledge, 1993), 21, 73, 89, 31, 35.
9. Steve Fuller, *Philosophy of Science and Its Discontents*, Second Edition (New York: The Guilford Press, 1993), 8. Fuller embraces what is known as an *asymmetric* version of science studies: "I am a scientific realist with regard to the discourse of the social sciences. By that I mean that the best explanation for the history of all of our knowledge enterprises is provided by the best social scientific theories. However, I am an antirealist about the discourse of the natural sciences, to the extent that I accept the validity of social constructivist accounts of natural scientific practices" (xiv).
10. Paisley Livingston, "Why Realism Matters: Literary Knowledge and the Philosophy of Science," in *Realism and Representation: Essays on the Problem of Realism in*