

JULIANNE LUTZ NEWTON

# ALDO LEOPOLD'S ODYSSEY



REDISCOVERING THE AUTHOR OF  
A SAND COUNTY ALMANAC

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# A New Kind of Conservation

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*We were sawing firewood when we picked up an elm log and gave a cry of amazement. It was a full year since we had chopped down the trunk . . . and yet this elm log had still not given up! A fresh green shoot had sprouted from it with a promise of a thick leafy branch, or even a whole new elm tree.*

*We placed the log on the sawing horse, as though on an executioner's block, but we could not bring ourselves to bite into it with our saw. How could we? That log cherished life as dearly as we did; indeed its urge to live was even stronger than ours.*

Alexandr Solzhenitsyn, "The Elm Log"

By the time Leopold wrote "The Farmer as a Conservationist" and "A Biotic View of Land," his important essays from 1939, he was ready to face again the question he had struggled with since 1913: what was conservation's object? He was also ready to speak directly about land use in moral terms, a matter he had first broached in 1923.

Leopold addressed both of these issues repeatedly in his final years. On the moral question his late writings exuded finality and confidence. He had reached bedrock, or so he sensed. In the case of an overall conservation goal, his late writings were focused in their content but less certain in tone. His most extended pieces on what he



termed “land health” remained in his desk drawer “cooler,” apparently in his view unready for publication (three would appear in print many years later, in 1991 and 1999).<sup>1</sup> When he died, in April 1948, Leopold had not offered his colleagues anything resembling the full exposition on land health he had hoped to give. Still, he had introduced the concept in numerous published writings and summarized its main elements in three essays in *A Sand County Almanac*, published posthumously.<sup>2</sup> Human needs and values came into play, as did ecological understanding.

Leopold’s writings leave no doubt about the importance to him of land health as a concept (the term itself was of less significance). They demonstrate also how his now famous “land ethic,” the term he increasingly used as a shorthand way to talk about a moral relationship to land, was directly tied to it. Land health became conservation’s vision, and his land ethic, a guide to help people find their ways there.

#### FUNDAMENTAL LESSONS

Leopold’s conservation focus was on the land as a whole—not just wilderness but entire landscapes, including those with people in them. Nor did he lose sight of the nation’s democratic vision, even as he worried that human numbers were too high for the land to sustain.<sup>3</sup> The humans who occupied his landscape visions were themselves part of the cycle of life that he conceived of as a land pyramid, which functioned and evolved over time according to the principles of his common concept of land. Soils were the foundation of the pyramid of life, with native plants, insects, fish, birds, and mammals in their characteristic numbers and kinds building upward in interconnecting layers to the largest and fewest in number, the carnivorous predators, at the pinnacle. Energy flowed upward through the food chains of the pyramids and back down to the soil, ready to be reused in promoting a richness of life. For Leopold, life—“a rich variety” of native plants and animals and the “exuberant” landscapes of which they were members—was inherently good.<sup>4</sup>

The science of ecology supplied the chief means for understanding the land’s interconnections. It was ecology, Leopold said, that accounted for “the outstanding discovery of the 20th century”: the immense complexity of the collective interactions and organizations

of nature.<sup>5</sup> No part of nature was independent of the other parts, *Homo sapiens* included.<sup>6</sup> When the land was studied over time, the forces of evolution could be seen to provide a motive power. Over geologic time, to Leopold's understanding, the general trend was for floras and faunas to become more elaborate and diverse<sup>7</sup> as the emergence of new species outran the extinction of old ones.

In the land's evolutionary drama humans were kin and "fellow-voyagers with other creatures in the odyssey of evolution."<sup>8</sup> Evolution and ecology were two ways of studying the odyssey of life. Evolution revealed the flow of life over time, whereas ecology cut against the flow at a right angle,<sup>9</sup> exposing life at a given moment. Ecology revealed the land pyramids with their fountains of energy flowing upward and downward through webs of dependence. Evolutionary science revealed that these pyramids tended over time to increase in dimension and complexity as life-forms became more diverse. "Ecology," wrote Leopold, "is a science that attempts this feat of thinking in a plane perpendicular to Darwin":

A rock decays and forms the soil. In the soil grows an oak, which bears an acorn, which feeds a squirrel, which feeds an Indian, who ultimately lays him down to his last sleep in the great tomb of man — to grow another oak. . . . Ecology calls this sequence of stages in the transmission of energy a food chain, but it can be more accurately envisioned as a pipe line. It is a fixed route or channel, established by evolution. . . . Thus we see each animal and each plant is the "intersection" of many pipe lines; the whole system is cross-connected. Nor is food the only thing transmitted from one species to another. . . . [C]hains of plants and animals are not merely "food chains," but chains of dependency for a maze of services and competitions, of piracies and cooperations. This maze is complex; no efficiency engineer could blueprint the biotic organization of a single acre. It has grown more complex with time.<sup>10</sup>

Land was "a slowly augmented revolving fund of life," Leopold said in "The Land Pyramid."<sup>11</sup> The more diverse the flora and fauna became over time, the more complex, vast, and well organized their interactions became, thus promoting, he believed, the retention of nutrient energy in the system and the endurance and life-promoting capacity of the whole. It was not just nonhuman nature, Leopold

knew, that was subject to the forces of evolution. Humans, too, were being pushed along by it, in ways that they understood little better than did other evolving life-forms.

The practice of conservation, in Leopold's view, was not about promoting some parts of nature—natural resources—at the expense of other parts, given nature's interconnections. It was about promoting the functioning and endurance of the whole. As Leopold had put it earlier, "there is only one soil, one flora, one fauna, one people, and hence only one conservation problem."<sup>12</sup> "If the components of land," he explained in a 1944 essay, "have a collective as well as a separate welfare,"

then conservation must deal with them collectively as well as separately. Land-use cannot be good if it conserves one component and injures another. Thus a farmer who conserves his soil but drains his marsh, grazes his woodlot, and extinguishes the native fauna and flora is not practicing conservation in the ecological sense. He is merely conserving one component of land at the expense of another.<sup>13</sup>

Resource exhaustion was an important consideration, Leopold knew; human life depended upon continued production of the elements that sustained them. But land often failed because its mechanisms were disrupted, well before its human-desired products were used up.<sup>14</sup> Moreover, given nature's complexity it was often impossible to predict degradation until it was too late, until soils started eroding and species disappeared, perhaps forever. Grazing in one place could cause soils miles downriver to wash away; a monocultural tree plantation could ruin soil fertility, diminish plant and animal species, and increase diseases and pests as timber production slowly declined. Conservation needed to consider the condition of the integrated natural whole, humans included, in terms of its collective functioning and organization.

#### A CULMINATING CONCEPT

Leopold's preferred ways of thinking about nature as a whole were as a community and, more loosely, as an organism or as a living, biotic mechanism. These concepts struck him as more apt than any other, and they put a face on land. "We can be ethical," Leopold explained

in "The Land Pyramid," "only in relation to something we can see, feel, understand, love, or otherwise have faith in."<sup>15</sup> It was impossible to love a collection of natural resources thought about in strictly economic terms. The land pyramid itself was a descriptively rich scientific concept of land, and Leopold made frequent use of it. But the land pyramid image had something of a factory aspect, its parts functioning like the parts of a machine. It lacked the full connotation of a system that was brimming with life forces and able to replenish and develop itself over time. Machines also lacked inherent moral value; it was often prudent to care for them, but not morally obligatory. Far better were the images of community and organism, with their living, self-directed, morally valuable connotations. These concepts put a living face on the land pyramid. Thinking about land in this way, Leopold believed, encouraged people to consider their actions toward land as a whole as well as toward its members, in both moral and prudential terms.

When land was conceived of as a community (or, even more, as an organism) it made sense to consider its well-being in terms of health and sickness. Both organisms and communities had parts working together as wholes and could be variously healthy (i.e., objectively normal) or deranged or ill (i.e., objectively abnormal). Leopold was hardly the first to speak of nature in terms of its health. Such language had figured prominently, for instance, in the important Governors Conference held in 1908.<sup>16</sup> Health connoted a desirable state; it was a condition productive of life, and life itself was inherently good.<sup>17</sup> The goal of conservation, then, focused as it should be on the whole rather than the parts, was appropriately considered in terms of the health of the land community, or land health.

By the early 1920s Leopold was talking publicly about land's good condition in terms of its overall health or normality. He increasingly made reference to land sickness and to ecological health in talks and writings during the 1930s, his meaning becoming more detailed as his ecological concept of land developed. It was only around 1940, however, that Leopold embraced the term "land health" (or, as an adjective and sometimes as compound noun, "land-health") with regularity, as a term of choice, to capture his emerging overarching conservation idea.<sup>18</sup>

Based on decades of synthetic intellectual work—bringing together ecological knowledge and practical wisdom—Leopold’s land health concept became his culminating vision of enduring prosperity and ecological harmony among humans and the entire community of life.<sup>19</sup> Land health became for Leopold a yardstick for evaluating the ways people lived on land. It became, in other words, the much-needed standard for judging conservation’s “effect on the forest,” which he had called for in 1913.<sup>20</sup> It provided the on-the-ground “conservation standard” or “ultimate goal” that Leopold had sought in his 1922 “Standards of Conservation.”<sup>21</sup> It was the moral standard that he had called for in “The Conservation Ethic” in 1933.<sup>22</sup> It was the framework for building a “workable criterion of good vs. bad land use” that he had struggled to identify in his 1934 “Conservation Economics.”<sup>23</sup> Land health was conservation’s sought-after “collective purpose,” which Leopold talked about as such in the early 1940s.<sup>24</sup> Land health provided the touchstone for a needed “shift of values,” as he put it in *A Sand County Almanac*—a way of “reappraising things unnatural, tame, and confined in terms of things natural, wild, and free.”<sup>25</sup> The condition of land health became the responsibility of people with an ecological conscience, Leopold believed. It was the expression of Leopold’s famous land ethic well practiced on the land itself.<sup>26</sup>

For years Leopold had considered the land’s healthful physical condition in terms of its functioning. In his 1923 *Watershed Handbook* he observed, for instance, that land in good or normal condition had “[self]-healing power” after being “injured.”<sup>27</sup> He carried this understanding<sup>28</sup> into his final work. Land health, Leopold explained in the final pages of *A Sand County Almanac*, “is the capacity of the land for self-renewal.”<sup>29</sup> As his concept of land developed through the 1930s, Leopold’s understanding of the “self-healing” or regenerative processes of land became more directly linked with the composition and organization of land’s native elements: diverse forests in Germany were ecologically healthier than spruce monocultures, he recognized in 1936; the Mexican side of the Sierra Madre Occidental, with its wildflowers and trout, Leopold recognized in 1937, was healthier than America’s eroding lands just across the border, which were “spangled with snakeweed”; and the midwestern farmer who



grew tamaracks and lady's slippers alongside cows and corn, to Leopold's 1939 thinking, promoted healthier landscapes than did the conventional slick-and-clean farmer who grew only cows and corn.<sup>30</sup> Land health, he wrote in 1941 — bringing together scientific evidence with his more sweeping observations of land — was expressed in “the cooperation of the interdependent parts: soil, water, plants, animals, and people”; it implied “collective self-renewal and collective self-maintenance.”<sup>31</sup> And again, three years later:

The land consists of soil, water, plants, and animals, but health is more than a sufficiency of these components. It is a state of vigorous self-renewal in each of them, and in all collectively. Such collective functioning of interdependent parts for the maintenance of the whole is characteristic of an organism. In this sense land is an organism, and conservation deals with its functional integrity, or health.<sup>32</sup>

The land health concept had become, by the early 1940s, the centerpiece of Leopold's thinking about conservation, building directly upon his common concept of land and his holistic moral vision. In nearly every major essay from 1941 on, Leopold brought in the idea of land health if it was at all relevant to the topic at hand, whether he spoke about wildlife, wilderness, conservation education, or philosophy. Land health was a condition of land in which wild nature was given free play apart from human trammeling. It was also a condition, to Leopold's mind, of human-inhabited land that had kept its regenerative capacities.

#### ODYSSEY

Leopold's concept of land health arose directly out of his carefully crafted concept of land — the nutrient-cycling biotic pyramid<sup>33</sup> — which he had continued to develop after its 1939 unveiling. Nutrients rose upward through food webs — from soil at the base of the pyramid to plants and animals, with large carnivores at the pinnacle — and they spilled back down into the soil through organisms' wastage and death. In the soil, nutrients from such spillage and from rock decomposition remained until picked up by some other organism, the start of another upward trip. Moving animals, too, Leopold had observed, carried nutrients from place to place, while forces of gravity and water

worked to transport nutrients downward across a landscape—from hills and mountains, eventually into the sea.

Land was a kind of circulatory system, Leopold observed. There was a constant tension in the land between the pull of gravity on nutrients and the resistance of plants and animals sucking nutrients from the soil, eating and being eaten, temporarily impounding the nutrients in their bodies. These processes of ever-present pull and intermittent resistance created what Leopold described as a continuous rolling movement of nutrients downhill. The speed of this downhill roll was linked to the complexity of the land community and to the soil fertility: the more complex the community, Leopold believed, the longer the nutrients could be kept within it. As the whole trend of evolution had been to make food chains longer and more complex, as he understood matters, the general effect had been to slow the speed of the downhill motion, holding nutrients within the system. When the downhill pull on nutrients was no faster than the speed at which the landscape system gained them from decay of rocks—land had continuity and was healthy. When nutrients washed away faster than they were gained, on the other hand, the land began to show signs of sickness.<sup>34</sup>

Modern humans were reversing long-term ecological and evolutionary trends, and therein lay the main source of land sickness, in Leopold's view. When modern agriculture and other industrial land uses came on the scene, domesticated plants and animals were substituted for native ones and the complexity of food webs was often drastically reduced.<sup>35</sup> Downhill nutrient roll became faster and faster as fewer (and shorter-lived) species were present to keep nutrients circulating within the community, soil, organic matter, and fertility declined, and all manner of disorganizations and maladjustments in the land pyramid began to occur. It was that simple, and yet that complicated, for the dynamic land pyramid was endlessly intricate. Human activities inevitably affected it and could easily disrupt it. Moreover, disruptions in one place could show up as signs of sickness in a distant place. Keeping the land healthy was no easy task.

Nowhere did Leopold tell the story of land health in contrast with land sickness more vividly and lyrically than in his essay "Odyssey"—the dramatic representation of his "common concept

of land" and his most succinct statement of what ecological conservation was all about.<sup>36</sup> The essay was a prose poem about Wisconsin's land-use history: about the transformation of native prairie to the wheat epoch and then to the intensive dairying epoch, and about the effects these changes had on the land. The first part of Leopold's story recounted the journey of nutrient atom "X" through the circulatory system of the prairie, before the wheat epoch and before the era of slick-and-clean farming. In the second half of the story, nutrient atom "Y" journeyed through the same landscape after the arrival of industrial farming. Like X, nutrient atom Y was released from a limestone ledge and sucked up by a root, which had nosed into a crack in the rock. But because so many species had been removed from the land—everything from prairie flowers to passenger pigeons to predators—Y's journey through the food chain was much speedier than X's—its route from soil through biota back to soil took one year, not a decade or century. Nutrient Y also made far fewer trips through the food chain before being washed downhill and lost to the land community.

An oxteam turned the prairie sod, and Y began a succession of dizzy annual trips through a new grass called wheat. The old prairie lived by the diversity of its plants and animals, all of which were useful because the sum total of their co-operations and competitions achieved continuity. But the wheat farmer was a builder of categories; to him only wheat and oxen were useful. He saw the useless pigeons settle in clouds upon his wheat, and shortly cleared the skies of them. He saw the chinch bugs take over the stealing job, and fumed because here was a useless thing too small to kill. He failed to see the downward wash of over-wheated loam, laid bare in spring against the pelting rains. When soil-wash and chinch bugs finally put an end to wheat farming, Y and his like had already traveled far down the watershed.

When the empire of wheat collapsed, the settler took a leaf from the old prairie book: he impounded his fertility in livestock, he augmented it with nitrogen-pumping alfalfa, and he tapped the lower layers of the loam with deep-rooted corn.

But he used his alfalfa, and every other new weapon against wash, not only to hold his old plowings, but also to exploit new ones which, in turn, needed holding.

So, despite alfalfa, the black loam grew gradually thinner.<sup>37</sup>

On X's prairie landscape, "for every atom lost to the sea, the prairie pulls another out of the decaying rocks."<sup>38</sup> The system's nutrient losses were offset by its gains. On Y's landscape, nutrient atoms were being lost more quickly than they could be sucked out of rocks. The system was losing fertility, sapping the land's "capacity for self-renewal." In a 1943 unpublished draft, "Land as a Circulatory System," Leopold commented, "Conservation is a matter of the size of the deficit in the circulatory system. Land is healthy when its nutrient deficit is met by 'new earnings.'"<sup>39</sup>

Conservation, in short, thus was about keeping nutrients within ecological systems, cycling through long food chains and repeating their cycles enduringly before being washed to the sea. Lands were degraded when and to the extent that human changes in the land disrupted this process. In a landscape the most obvious sign of nutrient loss took the form of direct soil erosion. The loss of fertility—soil's ability to "receive, store, and return energy" and to produce life—provided another sure indication. But even without such direct evidence it was possible to know that land was sick. Nutrient cycling was altered when species were removed and new ones added.<sup>40</sup> Changes in hydrologic systems could disrupt nutrient cycling as well, while signaling that nutrient cycles had already been disrupted. Then there were, for Leopold, the telltale signs—overbrowsed deer ranges, damaged forests, irrupting insect and rodent populations—that often appeared particularly when predators at the top of the land pyramid were removed.

From his early days in the Southwest Leopold had been in the habit of identifying and cataloguing the signs that lands might be deranged or sick. Soil erosion and flash floods provided the most stark evidence. His first list of symptoms appeared in his 1923 *Watershed Handbook*,<sup>41</sup> derived by his comparison of current conditions of the land with those of its "normal" past. The problem, he could see already, was not merely that too much grass had been eaten or too many trees cut. It was that the foundation upon which grass and trees grew was disappearing. The matter involved the degradation of the land's "self-healing power." Siltage problems, abnormal floods, gullies, loss of soil fertility and plant and animal productivity: these were the signs that land's regenerative capacity had declined. In ensuing years Leopold returned to his list of symptoms, refining it and adding

to it.<sup>42</sup> In 1946 he drafted a comprehensive list.<sup>43</sup> In his essay “Wilderness for Science,” which would appear in *A Sand County Almanac*, Leopold summarized the symptoms again, now categorizing them according to what he considered the land’s four fundamental parts or organs: soils, waters, plants, and animals—loss of soil fertility and soil erosion; abnormal floods and water shortages; “the disappearance of plant and animal species without visible cause despite efforts to protect them; and the irruption of others [other species] as pests despite efforts to control them.”<sup>44</sup>

Leopold’s definition of healthy land and his signs of sickness were based on his assumption of the goodness of life and hence the goodness of basic diversity, fertility and self-renewal. His judgment was thus not a matter of science alone. Evolution had something to do with it; to preserve fertility and the complexity of food pyramids was



*Leopold approvingly labeled this photograph “Picturebook Country”—  
a landscape found along Route 33 in Vernon County, Wisconsin.*

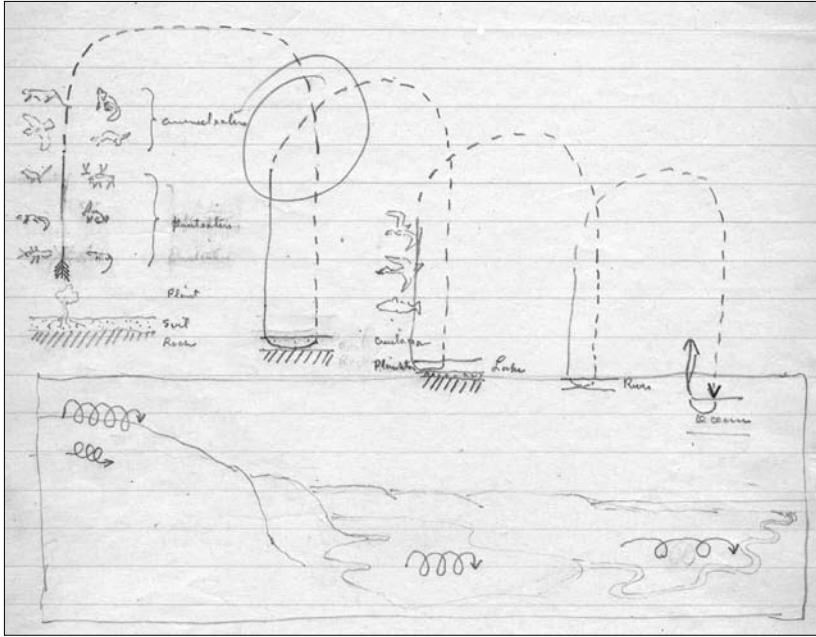
to move with rather than against evolution's long-term trends. The writings of Piotr Ouspensky, Arthur Twining Hadley, José Ortega y Gasset, and many others had contributed to his thinking about the importance and moral goodness of healthy communities. The parts were linked to the welfare of the whole, and the whole depended in the long run on the maintenance of the land's nutrient cycles. A healthy system was not one that was static. It was a dynamic one that retained its local fertility, slowly building on it. When fertility remained and nutrient cycles were flowing through a diverse community, plant life could flourish. When plant life flourished, so, too, did animal life. When the land as a whole was healthy, it was a good place for people to live.

#### A NEW SCIENCE

Despite his confidence in listing signs of sickness and proposing definitions of health, Leopold knew that there was much to learn about the whole matter. Research was called for, and he was anxious to promote it. What was needed was a new science of land health.<sup>45</sup> The science would probe the health of lands in various terrains and climates, finding out more about the land's regenerative capacities. The science would identify symptoms of unhealthy land, diagnose the causes of land derangements, and prescribe remedies for land illness.

In the summer of 1943 Leopold had begun work on a new conservation-oriented textbook, but illness of his own and work demands kept him from completing it.<sup>46</sup> As his text *Game Management* had ten years earlier, this work, he hoped, would help lay the groundwork for a new kind of conservation science—this new science of land health. Draft notes for an introduction explained what he had in mind for the text's orientation: "Ecological conservation," or the science of land health, Leopold wrote, was "a *positive* proposal" for conservation. Rather than focusing on the threat of deficit in various natural resources, as conservationists had done in the past, the new conservation science would look at the whole "biotic stream" and attempt to learn "the attributes or properties of the whole [land] mechanism: as it was; as it is; as it might be."<sup>47</sup> It would be an attempt to find out more about the "collective functioning of





*Leopold used this diagram to explain to students his concept of the land's nutrient cycling. From left (uphill) to right (downhill), nutrients spiral from the soil upward through the food chain—plants, insects, herbivores, carnivores—and back down again to the soil. In a diverse community the downhill movement of nutrients is gradual; the community can keep nutrients cycling within it for a long time, holding out against the force of gravity. When species are removed from a community, however, nutrient cycles are shortened and downhill nutrient flow is quickened as gravity gains the upper hand.*

[the land's] interdependent parts for the maintenance of the whole"<sup>48</sup> and how humans could promote it.

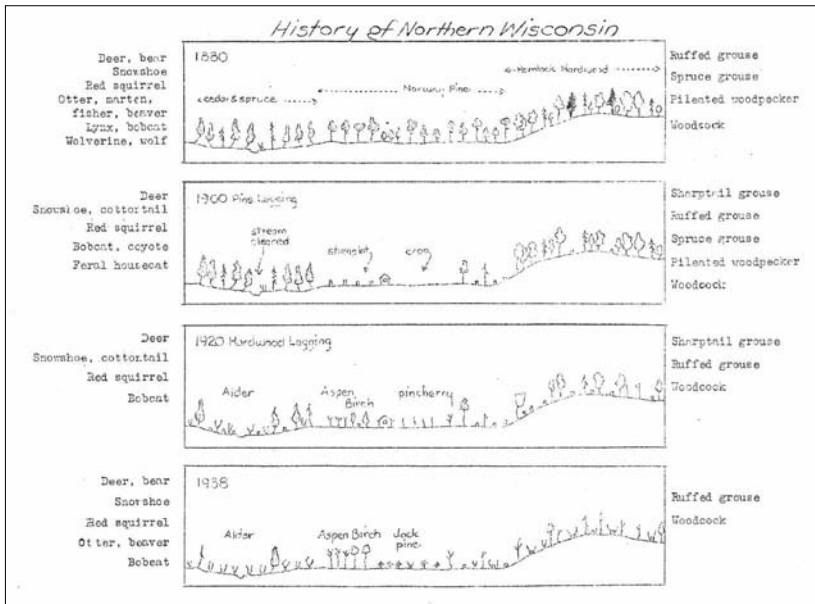
In the draft for chapter I, "Land as a Circulatory System," Leopold set out, as he put it, to "enlarge the conventional concept of a landscape" and to describe the land's "capacity for self-renewal."<sup>49</sup> As in "Odyssey," he portrayed the land in terms of a biotic pyramid and energy flows. Here Leopold likened the land to the vessels and organs in an organism; the landscape system was best understood as "nutrients in motion": "The plant-animal community, then, is a kind of circulatory system for nutrients, and food-chains are the channels of flow."<sup>50</sup>

Leopold also planned to discuss the general effects of modern land

use on the organization and functioning of land and the ecological readjustments that had taken place as a result. "Regarded collectively, the adjustments in flora and fauna consequent to civilization are prolonged, radical, and complex," Leopold wrote:

The conservationist knows them as facts, but previous attempts to explain those facts have been unsatisfactory, because our ecology was too rudimentary to cope with them. Attempts to guide these adjustments (conservation) have been largely unsuccessful for the same reason.<sup>51</sup>

His new ecology text was to be "an attempt to explain and guide these adjustments in the light of recent advances in ecological knowledge."<sup>52</sup> In the following chapter he planned to develop "what happens to wild animals and plants when they are no longer needed as links in the human food-chain."<sup>53</sup> In later sections Leopold intended to "describe the workings of land by following the known history of a series of landscapes or communities."<sup>54</sup> For illustration he apparently intended to describe a series of case studies that he and his



*Leopold used this diagram in his wildlife ecology class to show land-use history and changes in species over time in northern Wisconsin since European-American settlement.*

wildlife students at the University of Wisconsin used for class assignments.<sup>55</sup> These case studies traced the histories over time of particular places, differing widely in size: a ragweed patch, a roadside, a fencerow, a marsh, the vast landscape of northern Wisconsin, and others. What had these areas been like when European settlers arrived, and what were they like over the decades as humans developed the land? What were the possible ecological mechanisms behind the changes that took place? Leopold also asked his students to project land conditions into the future—fodder for further observation and hypothesis testing.<sup>56</sup>

The big conservation question for people everywhere had to do with human changes to the land. How far could people go in altering it, and in what ways, before they compromised its capacity for self-renewal? For the new science of ecological conservation or land health, it was a central challenge. Related to that were more specific questions: What plant and animal species were needed to keep the land's regenerative abilities? How many species could the land lose, and which ones, before its health declined? Which would be needed to restore sick land to health?

By the 1940s Leopold had developed several approaches to use in addressing these questions. One approach was to pay close attention to lands that humans had altered little, if at all. Areas in native wilderness condition provided a standard by which to measure how much humans had changed land, particularly when a nearby area still in untrammelled condition was similar to a human-altered area except for the human change—the undeveloped Mexican and developed American sides of the Sierra Madre Occidental in the Southwest being such an example.<sup>57</sup> A second approach, one that Leopold habitually used in studying land health was to go back in time, comparing current conditions in a given place with conditions in the same place before significant human change, to the extent that historical conditions could be surmised. For Leopold the past, like a wilderness area, could be “a laboratory.”<sup>58</sup> What had lands looked like and how had they functioned before industrial man arrived? Human-caused changes in the land, particularly in nutrient cycling, might be abnormal if they were noticeably out of character with past conditions.<sup>59</sup> To reconstruct historical conditions Leopold frequently used the

records of trappers, explorers, and early agrarian settlers. The land itself also provided evidence. The tools of observation, which he had used since his early efforts to sort out the grass-timber-fire-grazing-erosion story in Arizona and New Mexico, were many: tree-ring studies, evidence of vegetative succession, fire scarring, archaeological remains, geologic observations, and pollen analyses.

A third approach, Leopold concluded, was to pay particular attention to lands that people had long occupied yet that had maintained their overall health despite alterations. These lands could provide special local and general insights into a land's ability to withstand human-caused change. Further knowledge could come by contrasting healthy, human-inhabited lands with lands that humans had used in similar ways but that had not endured as well. A prime target for study was northwestern Europe,<sup>60</sup> where water systems and soil fertility had apparently remained largely normal despite centuries of human occupation, as he had observed in parts of Germany.

Leopold's historical work had begun in the Southwest with his study of normal and abnormal erosion. From his travels for the game survey in the late 1920s and early 1930s Leopold gained a sense of how farming had affected the Midwest, again by studying the land and consulting as many historical records as he could find. Particularly helpful was his work in Iowa on quail, which gave him insight into the land's functioning as a whole. The "golden age" for quail and men had occurred between 1860 and 1890, he noted. Before then natural prairie conditions had provided plenty of cover but scant food. Earlier settlers had improved conditions for quail by adding food in the form of nourishing seed crops and better cover in the form of hedgerows. But after 1890 agricultural methods became increasingly intense, reducing both food and cover. So rapidly did quail decline that even with a hunting ban the bird's recovery was uncertain.<sup>61</sup>

In Wisconsin, too, in the marshlands along the state's rivers, Leopold identified a "golden age" or "optimum conditions" for both game and humans. The "Arcadian age"<sup>62</sup> for many wildlife populations came after European settlers arrived.<sup>63</sup> Only after the new agriculturists began burning openings in the tamaracks for hay meadows did ideal conditions for many kinds of animals arise. "The open haymeadows," wrote Leopold,

separated by stringers of grass, oak, and popple, and by occasional remnants of tamarack, were better crane, duck, and sharptail range than the primeval bogs. The grain and weeds on the farms abutting the marsh acted as feeding stations for prairie chickens, which soon became so abundant as to take a considerable part of any grain left in the fields. These were the golden days of wildlife abundance. Fires burned parts of the marsh every winter, but the water table was so high that the horses had to wear "clogs" at mowing times, hence no fire ever "bit" deep enough to do any lasting harm.<sup>64</sup>

The Arcadian age, though, soon gave way as "the March of Empire"<sup>65</sup> arrived in the marsh, bringing its drainage dredges and machine mind. Deep ditches lowered water tables and dried out the land. During times of drought, fires burned the peat until most of it was gone. For a time many plants and animals thrived on the nutrients released by fires, but the ashes soon leached or blew away. Plant species disappeared, and many animals disappeared, too. Aspens, able to survive the new conditions, took over but provided poor conditions for many species. The land had found a new equilibrium, but at a lower level of energy, plant and animal productivity, and biological diversity. It would be a generation or longer before new soils could build and an army of plant and animal species could return.<sup>66</sup> The downfall of the marsh could be seen in the loss of soils, the loss of species, the emerging dominance of just a few plant species, and the land's inability to produce things needful to humans.<sup>67</sup>

Supplementing these studies was a more detailed look at land change in Wisconsin. Here Leopold was able to draw upon the latest advance in historical ecology—pollen analysis,<sup>68</sup> which used microscopy to identify the plants and animals that had coexisted in past ages.<sup>69</sup> The primary lessons that Leopold learned from these paleontological studies were revealing. Before 1840 it appeared that Wisconsin's lands had slowly increased in species diversity and complexity. For thousands of years native floral and faunal communities had remained generally "intact." After 1840 many species began to disappear and communities became deranged.<sup>70</sup> This reversal of trends, Leopold believed, was a symptom of sickening land.<sup>71</sup>

For a lecture on land health within the southwestern Wisconsin

region, first given in 1943 and repeated in tightened form the following year, Leopold probed the region's history, seeking insights into human land-use options.<sup>72</sup> He divided the region's land-use history into four overlapping epochs and then evaluated each in terms of whether or not downhill losses of nutrients during the era tended to exceed natural gains from decaying rocks. During the first era—the fur epoch, 1680–1832—furbearing mammals had withstood heavy exploitation, but there were few signs that the land itself had become deranged. Some furbearers, particularly the beaver, had “bounced back” when excessive trapping pressure was relieved. Some, like the otter, were reduced to persistently lower densities than before the trapping. Some became extinct (e.g., martin, fisher, wolverine), but extinctions were a direct result of trapping pressure, not of any indirect organic cause. Buffalo and elk endured for a time under heavy exploitation before disappearing, again because of hunting pressure rather than any derangement in the land. As Leopold put it in 1944, southwestern Wisconsin had “lost some fingers” during the fur epoch but was not sick.<sup>73</sup>

The fire epoch, 1750–1850, overlapped with the fur epoch and was characterized by deliberate annual burning of prairies by the “Winnebago (Ho-Chunk)” Indians, who had driven out the Sioux by 1750. Burned and unburned areas in the region obviously differed in the plant and animal species that inhabited them; to various degrees burned forests changed into prairie. But as in the fur epoch the land had not been deranged. There was “[n]o evidence,” Leopold wrote,

that Winnebago fires hurt either soil, fauna, or flora (except as they replaced forest flora with prairie flora). As to soil, the old prairies are our richest farm lands. As to fauna, we have already seen how “tough” the fur mammals were to resist the exploitations of the fur trade, both with and without fire. As to flora, the forest “bounced back” when the fire pressure was removed. All these facts indicate that there was no organic derangement which could be called sickness.<sup>74</sup>

A far different story unfolded during the ensuing wheat epoch, 1832–1878. Small farms expanded in size and were planted in wheat year after year. Timber was taken down for fencing. In a brief span



the prairies and oak openings of southern Wisconsin were transformed into fields of billowing grain. Much of this was exported, carrying away many of the land's nutrients, thus creating a fast-leaking nutrient-cycling deficit. The ecological effects were drastic. Early signs of trouble came in the irruption of the native chinch bug as a pest and in the widely spreading wheat diseases rust and smut. Declining crop yields provided evidence that soils were being exhausted. Then came wheat gullies and sheet erosion on slopes. When the wheat boom subsided—as it did, as a result of competition from farmers on land farther west—pests and erosion subsided as well. A general healing began to take place.<sup>75</sup>

From these three epochs Leopold drew several conclusions. Plowing and the export of nutrients with the wheat crop did organic damage to land, whereas fire and the decimation of some mammals had not. The damage caused by nutrient export diminished when large-scale wheat export ceased, even though farming and plowing continued. Leopold's conclusion: when erosion was not a problem a nutrient deficit was more dangerous than plowing as such.<sup>76</sup> The wheat epoch, in summary, had left scars on the land, but changes in farm practices had halted the disease process enough for the land to begin healing.

Then came the dairy epoch, in the end the worst, to Leopold's understanding. Cows gradually replaced wheat, and at first all went well, even beautifully. Manure replaced a good portion of the nutrients exported via butter, cheese, milk, and meat. Pastures and hay lands on flatlands were resistant to erosion. Soils in general retained the humus built up by centuries of wilderness vegetation. Trout streams ran clear, deep, narrow, and full, seldom overflowing. Even the steepest fields and pastures had few gullies.<sup>77</sup> But soon, owing to economic pressures, more cows were added and more machines arrived. Marshes were drained and woods were cleared from sloping lands. Cows in woodlots inhibited tree reproduction, killing the sprouting stumps and compacting soil. The resulting conditions encouraged pests and diseases. Hillsides began to erode, gullies formed anew, and the intensified flooding of rivers carried away more soil. Wildlife declined radically.

Southwestern Wisconsin land history allowed Leopold to draw

important if tentative conclusions: "the land-health which withstood animal exploitation and fire broke down under continuous wheat, healed under general farming, then broke down again under [intensive] cow pressure."<sup>78</sup> The lesions of the wheat era had been reopened; the land's health again declined. As sickness progressed more soils, plants, and animals were lost, pests and diseases became more prevalent, and watercourses were flooded and silted. And the land's fundamental capacity for self-healing had declined. To effect a cure society had to address the root land-use causes.

The lessons from southwestern Wisconsin, like those from the Southwest, Iowa, and the Wisconsin marshlands, suggested that humans could live on land in ways consistent with its continued health. But if they were not sensitive to the land as a whole they could degrade it, and economic forces, which made adding more cows and planting more crops profitable in the short run, too readily pushed them to do so.

Leopold's lessons from regions of America were supplemented by important data from Europe, some that he collected personally, much that he got secondhand. While in Germany in 1935, Leopold had witnessed obvious signs of forest "soil-sickness"<sup>79</sup> taking place after the German bout with "spruce mania," which had ripple effects throughout forestry. Solid spruce plantings had led to podsolization, which led to poor vegetative reproduction in the understory, to artificial feeding of deer, to deer overpopulation and overbrowsing, and to the loss of native flora and fauna. It was in the mid-1930s, around the time he was talking about German forest soils, that Leopold began regularly using the term "sickness" in relation to land. The opposite of soil sickness, Leopold said then, was "ecological health," which Germans were hoping to restore by encouraging a return to permanent mixed forests.<sup>80</sup> Leopold was impressed by the German readjustment.<sup>81</sup> In addition to a cultural willingness to make such changes, Leopold believed that the endurance of German civilization was due to the climate, flexibility, and strength of the land itself. Northwestern Europe seemed to be "resistant to abuse" and "to possess extraordinary recuperative capacity, i.e., capacity, when disturbed, to establish new and stable equilibria between soil, plants, and animals."<sup>82</sup> "European civilization," Leopold concluded,

developed on a landscape extraordinarily resistant to disorganization, i.e., one which endures very rough usage and severe modification without derangement of function. Thus the oak forests of England became closely grazed sheep downs without losing their soil. The fauna and flora shifted, but did not disintegrate.<sup>83</sup>

Because lands varied significantly in their ability to withstand human land use,<sup>84</sup> land users had to be attentive to the particular capabilities and limitations of their locales.<sup>85</sup> The signs and principles of health and the symptoms of illness might be fundamentally universal; the land-use practices to maintain health clearly were not.

Yet another geographic region that drew Leopold's attention for studying land health was the Sierra Madre Occidental region of Mexico, which had impressed him so favorably during his two visits along the Gavilan in the late 1930s. It was a splendid example of a whole landscape particularly because it offered such a stark comparison with American lands just to the north.<sup>86</sup> "[O]ur southwestern mountains," Leopold wrote in 1937, "are now badly gutted by erosion, whereas the Sierra Madre range across the line still retains the virgin stability of its soils and all the natural beauty that goes with that enviable condition."<sup>87</sup> Despite every kind of well-meaning and scientific conservation effort, the American side was "so badly damaged that only tourists and others ecologically color-blind, can look upon them without a feeling of sadness and regret,"<sup>88</sup> whereas the Mexican side, even without national parks or national forests, presented a most lovely "picture of ecological health."<sup>89</sup> "It was here," Leopold reported, "that I first clearly realized that land is an organism, that all my life I had seen only sick land, whereas here was a biota still in perfect aboriginal health."<sup>90</sup> The entire Mexican region, Leopold believed, cried out for protection, and Americans ought to get involved. "The preservation and study of the Sierra Madre wilderness, by an international experiment station, as a norm for the cure of sick land on both sides of the border, would be a good-neighbor enterprise well worthy of consideration."<sup>91</sup>

#### SHREWD GUESSES

As Leopold thought about land health through the 1940s and looked over the relatively meager evidence collected about it, he was

impressed as much by his ignorance as by any knowledge that he had obtained. Nature was extraordinarily complex, not just around the world but also in any given place. The science of land health, in contrast, was in its infancy. It would take many years for the science to gain maturity. In the meantime, land-use decisions were proceeding briskly and conservation programs were being framed. It was simply not possible to delay all action until science could mature.

"The land mechanism is too complex to be understood," Leopold observed in 1944, "and probably always will be. We are forced to make the best guess we can from circumstantial evidence."<sup>92</sup> Ecologists had no choice but to offer their predictions about how lands worked and how people could use them while still keeping them in normal condition. To make best guesses, ecologists needed to supplement their knowledge in some way by taking into account their ignorance. The time was not ripe, Leopold wrote in "The Land-Health Concept and Conservation," for ecologists to speak with confidence. Still, it was essential for them to present their "shrewd guess[es]" about keeping land healthy. When lands were resilient, mistakes might be corrected.<sup>93</sup> When lands were more sensitive, caution was even more essential.

It was no easy task to come up with workable, practical yardsticks by which to measure land health. To propose land health as an overall conservation goal was to call for a new type of conservation, aimed at the integrated whole of nature rather than the parts singly. The new conservation would need to stress prevention of problems, while calling for remediation if they arose. In his first major writing about land health, the essay "Biotic Land-Use," Leopold offered his own best guess about ways of measuring the land's health.<sup>94</sup> He prefaced his observation by noting two basic characteristics of "new" land—land not yet dominated by humans. The first characteristic was what he called stability: "Undisturbed communities change their composition and their internal economy only in geological time," he observed. "Within the time-scale of human affairs, they are stable."<sup>95</sup> The second characteristic, he wrote, was diversity: "The biotic community is diverse in composition, complex in organization, and tends to become more so."<sup>96</sup>

These two characteristics of new land, added to Leopold's existing

understanding of nature and culture, led him to offer readers two "yardsticks" that might be used to produce crude measures of a landscape's condition. The first was as obvious as it was essential: soil fertility. "That the maintenance of at least the original fertility is essential to land-health is now a truism, and needs no further discussion."<sup>97</sup> The best way to judge the land's condition was to look at its soil, in terms of what was normal for a given landscape and climate. The second yardstick, related to the first, had to do with the land's "diversity of fauna and flora."<sup>98</sup> The more a landscape retained its original fauna and flora, the more likely it was to be healthy.

As Leopold thought about these yardsticks—as he thought about land health—his mind focused on the soil and on the biotic circulatory system that kept it intact. Soil fertility was the foundational element of land health. This was the base measure of land's condition. Land was healthy when it retained over long periods of time its ability to cycle nutrients efficiently and continuously. When land could accomplish this feat it was, in Leopold's vocabulary, stable. "Stability," Leopold explained in "Biotic Land-Use," "is the continuity of this organized circulatory system. Land is stable when its food chains are so organized as to be able to circulate the same food an indefinite number of times."<sup>99</sup> Erosion, floods, pest irruptions, species loss, and other land symptoms without directly visible cause were expressions of instability. They provided evidence of breakdowns in the circulatory system; they emerged because of simplification and derangement of the land pyramid, or degradation of the land's capacity to sustain and renew itself over time.

Land stability as Leopold defined it appeared to be connected to the maintenance of the land pyramid, and thus to the many native species of plants and animals that lived in an area. Undeveloped land, as he had noted, tended toward diversity in composition and complexity in organization,<sup>100</sup> whereas the arrival of industrial civilization typically led to the reverse—the loss of many native species and to organizational simplification and land problems. From his many studies Leopold came to believe that the loss of species was both a cause and an effect of declining land health.<sup>101</sup>

To get at this issue Leopold returned to his land pyramid and to the principles upon which it was based. "Stability implies," Leopold

stated, "not only characteristic kinds, but also characteristic numbers of each species in the food chains."<sup>102</sup> This idea was not new; it had been a premise of food web analysis for years. So far as Leopold could tell it was sound. Particular species might come and go in a land community, but the function of a departing species in the pyramid had to be taken over by another species or the system as a whole would suffer, with nutrient cycles becoming shorter. "The circumstantial evidence" provided by history, Leopold stressed, "is that stability and diversity in the native community were associated for 20,000 years, and presumably depended on each other."<sup>103</sup> The connection here was not entirely clear; some lands remained healthy despite significant changes in species composition. Still, plentiful evidence supported the typical existence of a strong positive connection. Both stability and diversity in many places were "now partly lost, presumably because the original community [had] been partly lost and greatly altered."<sup>104</sup> This observation led logically to another: "Presumably the greater the losses and alterations, the greater the risk of impairments and disorganizations."<sup>105</sup>

The apparent link between stability (as thus defined) and diversity was not one that Leopold thought he could prove, despite the historical correlation; indeed, he believed, it never would be proven, and, in fact, debates about it would continue within the ecological community.<sup>106</sup> Evidence Leopold knew about from his studies of the land, however, tended to support the connection between diversity and stability. Parts of northwestern Europe demonstrated the only cases known to Leopold in which a material loss of diversity had not resulted in major derangements in the land pyramid and depleted soil fertility.<sup>107</sup> All other lands that had lost substantial diversity, to Leopold's knowledge, had displayed serious symptoms of sickness. In terms of the land mechanism itself, the land's circulatory system was dependent upon its complexity and organization. "The question in hand," he wrote in "Biotic Land-Use," "is whether other parts of the globe can remain stable without the deliberate retention of diversity. All I can say is that I doubt it."<sup>108</sup>

"Diversity" as Leopold used the term meant simply the variety of native plants and animals that resided in a given place. As he continued working on land health he began to find it helpful to use a word



that captured more precisely the kind of diversity that he deemed important. The term he seized upon was "integrity." An early use of the term came in a 1939 lecture, "Basis of Conservation Education." In the lecture he explained the fallacy underlying the old kind of conservation, which viewed as sufficient the coordination of single resource-use practices:

[The] fallacy in this is to regard any plant or animal as a "separate" thing. There are plenty of parts of your industrial plant "of no economic importance." Do you tear them out? No—not if they are parts of the organism. In conservation we don't yet realize that every living thing is part of the organism. To the conservationist, the spar of a dying tamarack [in a drained marshland] is not merely a dead tree—it is the symbol of a countryside which is losing its wholeness, its integrity as an organism.<sup>109</sup>

As Leopold put it, integrity had to do with the parts of nature, but it meant more particularly the parts of nature that were necessary for land to keep its stability and its health. But what parts were necessary? If land maintained its integrity when it kept the parts that it had possessed before humans changed the land, given human ignorance, it was wise to keep all of them.<sup>110</sup> As a prudential matter, this was the integrity that ought to be maintained. Integrity, then, had for Leopold two overlapping meanings, which came together by means of his rule of caution in using land: it meant the species needed to keep land stable, and it meant the full range of native plants and animals that had inhabited a place before industrial civilization arrived. A third implication was that all member species of the land community had value as such and were entitled to continuance as a matter of "biotic right,"<sup>111</sup> and, "at least in spots," their right to "continued existence in a natural state."<sup>112</sup>

One of Leopold's most extended treatments of integrity would appear in his final major writing on land health, "The Land-Health Concept and Conservation." "It is necessary to suppose," he concluded from all the evidence, "that a high degree of interdependence exists between the capacity for self-renewal and the integrity of the native communities."<sup>113</sup> Leopold admitted that it might not be worth debating the removal of some species from some landscapes, which was perhaps necessary for civilization—for example, the extirpation

of buffalo and pigeons from settled regions of the corn belt—and which did not necessarily preclude some habitable degree of land health. But in other cases—for example, the extirpation of wolves across most of the West and the Great Lakes states, leading to deer irruptions—the removal of species could have more ecologically drastic effects. Likewise, exotic species, which often spread to the detriment of native species, could cause serious land maladjustments and generally were undesirable. It was thus important to take the likely relationship between integrity and stability as well as human ignorance seriously and to be careful about altering communities unduly:

We must assume, therefore, that some causal connection exists between the integrity of the native communities and their ability for self-renewal. To assume otherwise is to assume that we understand the biotic mechanisms. The absurdity of such an assumption hardly needs comment, especially to ecologists.<sup>114</sup>

As Leopold wrote about land health he continually searched for better ways to express his ideas.<sup>115</sup> In “Conservation: In Whole or in Part?” he offered a definition for the new conservation and land health, phrased in terms of “collective functioning” and “functional integrity”:

The land consists of soil, water, plants, and animals, but health is more than a sufficiency of these components. It is a state of vigorous self-renewal in each of them, and in all collectively. Such collective functioning of interdependent parts for the maintenance of the whole is characteristic of an organism. In this sense land is an organism, and conservation deals with its functional integrity, or health.<sup>116</sup>

In both “A Biotic View of Land” from 1939 and its condensed version incorporated in “The Land Ethic,” Leopold used the words “complexity” and “structure” to talk about “normal circulation” through the pyramidal land community:

The velocity and character of the upward flow of energy depend on the complex structure of the plant and animal community, much as the upward flow of sap in a tree depends on its cellular organization. Without this complexity, normal circulation presumably would not occur. Structure means the characteristic numbers, as well as the characteristic kinds and functions, of the component species. This

interdependence between the complex structure of the land and its smooth functioning as an energy unit is one of its basic attributes.<sup>117</sup>

In retrospect Leopold might have been wiser to employ less variety in his terms, just as he might wisely have used his metaphors with greater care. Nonetheless, one can see through the words to the ideas that he meant to capture. Land health was the goal of conservation. Land health depended on soil that received nutrients at least at the rate it released them and on the normal structure and functioning of the land pyramid. The land pyramid, in turn, depended upon the self-organization of its full complement of native species. It was wise to keep nature's parts. It was wise to use the land gently, avoiding violent changes whenever possible. It made sense to remember the gradual pace at which nature worked, particularly the forces of evolution, and attempt to work in concert with them. Evolutionary changes were "slow and local."<sup>118</sup> Industrial changes, by contrast, often occurred with "unprecedented violence, rapidity, and scope."<sup>119</sup> "We are remodeling the Alhambra with a steam-shovel," Leopold observed in the closing paragraph of his section "The Outlook" in *A Sand County Almanac*. "We shall hardly relinquish the shovel, which after all has many good points, but we are in need of gentler and more objective criteria for its successful use."<sup>120</sup>

In his final major writing on land health Leopold included as a possible "requisite" or rule of thumb for sound land use that people attempt to foster land beauty. Much as did the other terms he used, "beauty" had for Leopold a particular and rich meaning. The land's beauty, Leopold said, was not separable from its usefulness; utility and beauty went side by side. Both utility and beauty in turn depended upon the health of the land as a whole.

The biota is beautiful collectively and in all its parts, but only a few of its parts are useful in the sense of yielding a profit to the private landowner. Healthy land is the only permanently profitable land, but if the biota must be whole to be healthy, and if most of its parts yield no salable products, then we cannot justify ecological conservation on economic grounds alone. To attempt to do so is sure to yield a lop-sided, and probably unhealthy, biotic organization.<sup>121</sup>

Beauty, then, was an attribute of lands that were healthy, particularly lands that retained their native integrity. Beauty was not a mere

subjective choice of the viewer; it was an objective ecological attribute of lands that could endure. It was a characteristic that arose when the parts of nature were linked harmoniously into a whole promoting the land's stability and long-term flourishing—its “capacity for self-renewal.” Beauty could not be separated from ecological functioning, from the land's enduring productivity, and from the prosperity of human civilization:

The divorcement of things practical from things beautiful, and the relegation of either to specialized groups or institutions, has always been lethal to social progress, and now it threatens the land-base on which the social structure rests. . . . Tomorrow we shall find out that no land unnecessarily mutilated is useful (if, indeed, it is still there). The true problem of agriculture and all other land-use, is to achieve both utility and beauty, and thus permanence.<sup>122</sup>

Year by year Leopold probed more deeply the conservation predicament of the age, gaining greater wisdom about it. The more he progressed, however, the more he distanced himself from his generation, even from many other conservation professionals. He had traveled far enough that his words, he suspected, were making less and less sense to other people. All around him, conservation work as most other people understood it had to do almost entirely with particular resources and specific technologies to address merely the symptoms of land misuse. As farm fields deteriorated fertilizers were added, or at most a leguminous rotation was added to a cropping system, with little to no thought of the wild plants and animals that had built the soil to begin with. Poisons were spread to deal with agricultural pests, with no search for the organic causes of the irruptions or invasions. Foresters who faced declining yields looked for new tree species to plant, paying little attention to the disturbed microflora of the soil. Flood-control dams for flooding, check dams and terraces for erosion control: none of them touched the true causes or proposed any lasting cure. Wildlife refuges and fish hatcheries did not address the reasons behind widespread declines in game and fish populations. Such treatments, wrote Leopold, were not cures. They were merely “local alleviations of biotic pain.”<sup>123</sup>



*Leopold inspects the tamarack seedlings he and his family planted at the Shack sometime in the mid-1940s. For decades farmers in Wisconsin had been destroying tamaracks—burning and chopping them down and draining the bogs in which they grew—to gain more land for crops and pastures. Partly through Leopold's influence, a few farmers enthusiastically planted young tamaracks and restored their marshes and bogs, reintroducing sphagnum moss, lady's slippers, and other characteristic wildflowers.*

#### YET THE TREES GROW

Leopold's mature thinking about conservation would do more than take him further from the world as he knew it, further even from his conservation and research colleagues. What became clear to him was that nothing short of fundamental cultural change was needed for lands to keep or regain their health. More powerfully than before, he recognized how the industrial-economic-individualist mind, so dominant in his age, was leading the nation in precisely the opposite direction. The conservation movement, now several decades old, had done little to improve land-use practices. And the destructive technologies coming along, symbolized for Leopold by DDT and the atomic bomb, were terrifying in what they portended.<sup>124</sup> Industrialism as a mode of living, economic determinism as a cultural ideology, and individualism as an ethical doctrine were gradually destroying the land. In the long run they would very likely destroy the people as well.

As the United States' entry into a second world war approached, Leopold drafted in late 1941 a somber commentary on the modern cultural landscape, "Yet the Trees Grow."<sup>125</sup> Never published, it stayed in his desk drawer, an expression of his inner thoughts, not of his outer persona. It bore witness to Leopold's mournful perception of the inherent conflict between the industrial and ecological minds and of the far greater power that the industrial one presently possessed. On came the slick-and-clean farming, Leopold wrote; on came the plant and animal pest irruptions and the new chemical poisons; away blew the soils and, with them, the native floras and faunas and human homesteads; on came more roads and ever larger machines; on came advertisers and assembly-line trinkets; on came war and weapons of terror. The juggernaut of industrial civilization was having its way.

Yet even then the life forces and seasons of nature continued to exert themselves. The oaks continued to make wood, responding not to human follies but to the fundamental forces of nature.

Empires spread over the continents, destroying soils, the floras and faunas, and each other. Yet the trees grow.

Philosophies spread over the empires, teaching the good life with tank and bomb. Machines crawl over the empires, hauling goods. Goods are plowed under, or burned. Goods are hawked over the ether, and along the lanes where Whitman smelled locust blossoms morning and evening. Quarrels over goods are planted thick as trees along the rivers of America. . . . Yet the trees grow.<sup>126</sup>

Walt Whitman's dream had been that the west-flowing settlers might "plant companionship as thick as trees along all the rivers of America."<sup>127</sup> Looking back at America's actual record, knowing as well as anyone what had come to pass, Leopold could not help but be saddened. The trees, rivers, prairies, wild creatures—all had been too often viewed as obstacles on the road to progress, or as raw material whose primary reason to exist was to be transformed into commodities and consumed. Companionship as Americans understood it had little to do with nature and far more to do with disposable manufactured "goods," the production and exchange of which bred competition, strife, and destruction. And yet the trees grew.

This was a somber side of Leopold's imagination, a vivid portrait

of a world gone gravely awry. Here growing within the nation was an undiagnosed cultural disease, lying face-up on the land while its root causes lay in the hard-to-reach deep within the minds and hearts of people. In essay after essay, particularly in part II of his *Sand County Almanac*, Leopold would plumb the sources of his sorrow, his profound, aching sense of loss. He would mention some of his losses specifically, in terms of the plants, animals, and places that he held so dear. And in speaking of them he would offer a vision of what was taking place overall and of what seemed to lie ahead. It was wildness itself that was under assault, wildness itself that was on the verge of being crushed. For Leopold, for the Wisconsin in which he lived, the crane was a symbol of that "wildness incarnate,"<sup>128</sup> a representation of the land's persistent inner force and its time-tested wisdom. To fear for the crane was to fear for much more, as we read earlier:

Some day, perhaps in the very process of our benefactions, perhaps in the fullness of geologic time, the last crane will trumpet his farewell and spiral skyward from the great marsh. High out of the clouds will fall the sound of hunting horns, the baying of the phantom pack, the tinkle of little bells, and then a silence never to be broken, unless perchance in some far pasture of the Milky Way.<sup>129</sup>

In the silence never to be broken wildness would be gone, and with it the world that Leopold so cherished.

#### RIGHTNESS

In his literary masterwork, written for all citizens, especially the landowner, Leopold took his concept of land health and transformed it into a moral duty.<sup>130</sup> It was a moral duty placed not only on society as a whole but also on the individual as a member of society. As Leopold stated plainly, it reflected an "individual responsibility for the health of the land"<sup>131</sup> and an ecological conscience toward the community.

Leopold's proposed ethic admonished the individual to "[e]xamine each [land-related] question in terms of what is ethically and aesthetically right, as well as what is economically expedient." "A thing is right," Leopold said in his now famous summation, "when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."<sup>132</sup> This was the core of

Leopold's land ethic. It was the distillation of his guidance, for those who could interpret it, on right and wrong living on the land.

The "biotic community" as such, not any concept of human needs or of resource flows, was what this land ethic sought to promote. It was a holistic vision linked to the entire community of life, people included. By "stability," as we have seen, Leopold meant the capacity of the land to cycle nutrients efficiently and continuously because its biotic pyramid was intact and its food circuits were open. By "integrity" Leopold meant that the land possessed all the parts needed to maintain its stability. Given biotic rights and human ignorance about what it took to maintain stability, integrity in practical terms meant keeping the biotic parts that the land had possessed before humans changed it, or as many of them as possible. As for "beauty," it was, in Leopold's view, an attribute of lands that possessed stability and integrity. Integrity, stability, and beauty: they were three ways of describing one object—healthy land—in terms of its interrelated parts, its nutrient cycling, and its pleasing appearance to the eye, ear, and soul.

With these key words Leopold gave his land ethic both an ecological and a moral orientation, linked to his concept of land and to the overall goal of land health. Leopold also situated his ethic in an evolutionary context. Evolution had no ultimate goal, nor was it morally based or purpose driven, but it had apparently produced historical trends toward increasingly diverse, and complexly organized biotic communities. Humans as fellow objects of evolutionary processes might expect to be included with other species on that trajectory. In any event, historically the extension of human ethics had so far embraced relationships between individuals and between individuals and society. Perhaps, Leopold thought, if he was "read[ing] the evidence correctly," a next possibility would be a biological extension of ethical behavior to the relationship between humans and land.<sup>133</sup> From past trends Leopold thought it at least possible—particularly if people preserved and interacted with some of the natural environment out of which they had been shaped—that the human species might evolve toward increasingly intuitive cooperative interactions with the land community.<sup>134</sup>

In recent generations particularly, though, humans had embraced



modes of living that cut against nature's enduring ways, in evolutionary as well as ecological terms. They had exercised their unique powers to reason and make deliberate choices in ways that seemingly hampered their own and others' long-term welfare. In the final section of "The Land Ethic" Leopold sketched the chief ways in which humans were cutting against evolution's trends. "Perhaps the most serious obstacle impeding the evolution of a land ethic," he wrote, "is the fact that our educational and economic system is headed away from, rather than toward, an intense consciousness of land."<sup>135</sup> This was the obstacle that affected the vast majority of people, those who no longer made their living on the land. "Almost equally serious" as an obstacle to evolution was "the attitude of the farmer, for whom the land is still an adversary."<sup>136</sup> This was the leading obstacle for landowners who did possess a consciousness of land but who did not perceive it ecologically.

"One of the requisites" for the removal of both obstacles was the development of "an understanding of ecology"<sup>137</sup>—a matter of the right kind of education, including face-to-face interactions with nature. For ordinary citizens Leopold suggested that ecological knowledge and direct experience with land would foster the kind of "intense consciousness"<sup>138</sup> of land that landowners presently lacked; it would help promote "a vital relation to it" and ongoing awakenings in people that would enable them to see, know, understand, love, and respect the land. For farmers and other land managers, an ecological comprehension of nature would help them shift from an oversimplified, resource-oriented view of land to seeing it as an integrated whole.

If a land ethic was only "an evolutionary possibility," it was nevertheless an "ecological necessity."<sup>139</sup> Until such a time as it might become instinctual, caring for the land, Leopold urged, required people to consciously "improve themselves" in the sense of improving their ecological comprehension of land, improving their "social conduct,"<sup>140</sup> and learning and practicing an "ethics of community life" extended to soils, waters, plants, and animals as well as people.<sup>141</sup> "I have no illusions about the speed or accuracy with which an ecological conscience can become functional," Leopold wrote in 1947.

It has required 19 centuries to define decent man-to-man conduct and the process is only half done; it may take as long to evolve a code of decency for man-to-land conduct. In such matters we should not worry too much about anything except the direction in which we travel. The direction is clear, and the first step is to *throw your weight around* on matters of right and wrong in land-use. Cease being intimidated by the argument that a right action is impossible because it does not yield maximum profits, or that a wrong action is to be condoned because it pays. That philosophy is dead in human relations, and its funeral in land-relations is overdue.<sup>142</sup>

In the short term, Leopold suggested, a land ethic might help people broaden their ideals and bring themselves into line with nature's forces. Until that distant day when harmonious living with land became ingrained, the land ethic could provide an interim land-use guide. It could serve as a placeholder or outward standard, "a kind of community instinct in-the-making,"<sup>143</sup> providing a practical guide for confronting the tangle of ecological situations so complex and intricate that no human mind could determine how to act.<sup>144</sup>

In hoping to cut through that complex tangle to clearer understanding, Leopold phrased his land ethic in general terms, connecting it with a comprehensible mental image of dynamic land grounded in the most up-to-date ecological research. Leopold's guiding land ethic and the goal of land health could be applied to the use and conditions of all lands. On the other hand, no two land parcels were alike. Even at the smallest scale lands were unique. Some were more resilient than others because of climate or other factors. On some lands the organization of the land pyramid appeared to be more flexible and able to adjust to change without becoming deranged. A particular action on one landscape might be right while the same action elsewhere might be wrong.

In the end Leopold was able to address with his land ethic nearly the full range of tasks that had drawn his attention during his professional life. It pointed toward the overall goal of conservation—land health—offering the prospect of redressing the fragmentation that so afflicted the conservation cause. It provided the means to protect the public interest in private land, an issue for Leopold from his first days

in the Southwest. It offered a remedy for the excessive individualism of the day. It provided the ecological base for a new understanding of private landownership, giving content to the individual's duty, as he put it, "to manage his land in the interest of the community, as well as in his own interest."<sup>145</sup> And it addressed, finally, the need to respect the moral value that he believed infused the natural world, the "biotic right"<sup>146</sup> of species and biological communities to exist as long as evolutionary forces allowed. A land ethic "affirmed the right of community members to exist, and, at least in spots," as mentioned earlier, "to exist in a natural state."<sup>147</sup> Even creatures with no conceivable value to humans were members of the biotic community and entitled as such to a chance to endure.

"All history," Leopold wrote as he closed his final writing on wilderness, "consists of successive excursions from a single starting-point, to which man returns again and again to organize yet another search for a durable scale of values."<sup>148</sup> For Leopold this search for values began and ended with the land. The land itself provided the guiding lessons, available to all who would open themselves to them. The land—"things natural, wild, and free"—provided a standard for reappraising things "unnatural, tame, and confined," for reappraising progress and the meaning of "the good life."<sup>149</sup>

Aldo Leopold died of a heart attack on April 21, 1948, while helping a neighbor in Sauk County fight an accidental grass fire. He had suffered health problems over the previous two years but was nonetheless at the height of his professional powers. His death caught him in mid-stride. As outgoing president of the Ecological Society of America, Leopold looked forward to the customary address that he would deliver that September. He apparently planned a major talk on land health, viewed from the perspective of wilderness. In his desk lay a stack of unfinished manuscripts, mostly having to do with land health and with the conservation challenge that Leopold deemed most important: getting private landowners to use their lands better. Included in Leopold's files was the first chapter of his planned textbook on ecology. Attached to it were the detailed ecological case studies that he had put together for use in his wildlife ecology class and planned to develop for his ecology text. Just a week earlier

Leopold had received word from Oxford University Press of its desire to publish his collection of essays, so there was revising and editing that would need doing. His graduate students were in the thick of important research projects. Returning soldiers meant overflowing undergraduate classes and thus fresh educational possibilities. For the land itself pressures toward an ever more industrialized way of life were forming darker clouds on the horizon.

In the meantime, though, spring was in full swing at the Shack. There was planting to do, and there were phenology notes to record. Overhead were the migratory birds; underfoot there was “draba, the smallest flower that blows.” And then, as in Aprils past, there was the “drama of the sky dance”—the nightly entertainment of the male woodcock, offered to those who lived by the land and not merely on it. For ages humans had watched the woodcock in joy, yet its ways remained largely its own. People could pose their questions, as Leopold and his family did. But many answers would remain elusive. They would linger within the timeless mists, as did so many of nature’s ways, veiled amid the “mysteries of the deepening dusk.”<sup>150</sup>

The evening before his death, Leopold recorded a final dusk-time “sky-dance” in his journal: “Woodcock 7:10 p.m.”

# Notes

Frequently cited works are identified by the following abbreviations:

AL	Aldo Leopold
ALSW	D. E. Brown and N. B. Carmony, eds., <i>Aldo Leopold's Southwest</i> (Albuquerque: University of New Mexico Press, 1990).
FHL	J. B. Callicott and E. T. Freyfogle, eds., <i>Aldo Leopold: For the Health of the Land; Previously Unpublished Essays and Other Writings</i> (Washington, DC: Island Press, Shearwater Books, 1999).
LP	Leopold Papers (series number followed by box number), University of Wisconsin–Madison Archives.
RAMC	R. A. McCabe Collection of the Writings of Aldo Leopold, University of Wisconsin–Madison Libraries.
RMG	S. L. Flader and J. B. Callicott, eds., <i>The River of the Mother of God and Other Essays by Aldo Leopold</i> (Madison: University of Wisconsin Press, 1991).
RR	L. Leopold, ed., <i>Round River: From the Journals of Aldo Leopold, Author of "A Sand County Almanac"</i> (New York: Oxford University Press, 1993).
SCA	A. Leopold, <i>A Sand County Almanac and Sketches Here and There</i> (New York: Oxford University Press, 1987).
USFS	USDA Forest Service
UW	University of Wisconsin–Madison
UWDWE	University of Wisconsin Department of Wildlife Ecology

For a full listing of Aldo Leopold's publications, the reader is referred to the following:

S. L. Flader and J. B. Callicott, eds., *The River of the Mother of God and Other Essays by Aldo Leopold* (Madison: University of Wisconsin Press, 1991).

C. D. Meine, *Aldo Leopold: His Life and Work* (Madison: University of Wisconsin Press, 1988).

117. AL, "Illinois Bus Ride," SCA, pp. 117–119.
118. AL, "Good Oak," SCA, p. 6.
119. AL, "Prairie Birthday," SCA, pp. 44–50.
120. AL, "A Mighty Fortress," SCA, pp. 73–77.
121. AL, "Clandeboyce," SCA, pp. 158–164.
122. AL, "Home Range," SCA, pp. 78–80.
123. AL, "Sky Dance," SCA, pp. 30–33.
124. AL, "65290," SCA, pp. 87–94.
125. Albert Hochbaum, letter to AL, 11 March 1944, LP 10-2, 3. Hochbaum also urged Leopold to reveal that his "way of thinking is not that of an inspired genius, but that of any other ordinary fellow trying to put two and two together. Because you have added up your sums better than most of [us], it is important that you let fall a hint that in the process of reaching the end result of your thinking you have sometimes followed trails like anyone else that lead you up the wrong alleys. That is why I suggested the wolf business." This note was part of the discussion that led Leopold to write "Thinking Like a Mountain" (SCA, pp. 129–133).
126. AL, "Thinking Like a Mountain," SCA, p. 130.
127. See Flader, *Thinking Like a Mountain*. Leopold's understanding of the deer-predator-mountain relationships evolved over time. See, too, AL's "confession," in his "Foreword," unpublished revision of 31 July 1947, LP 10-6, 16 (4), and in Callicott, *Companion to "A Sand County Almanac,"* pp. 281–290.

#### *Chapter 11: A New Kind of Conservation*

1. AL, "Conservation: In Whole or in Part?" RMG, pp. 310–319; AL, "Biotic Land-Use," FHL, pp. 198–207; AL, "The Land-Health Concept and Conservation," FHL, pp. 218–226.
2. AL, "Odyssey," SCA, pp. 104–108; AL, "Wilderness for Science," SCA, pp. 194–198; AL, "The Land Pyramid," SCA, pp. 214–220. Susan Flader, in *Thinking Like a Mountain: Aldo Leopold and the Evolution of an Ecological Attitude toward Deer, Wolves, and Forests* (Madison: University of Wisconsin Press, 1994), traces Leopold's thinking about deer ecology to the concept of land health (including pp. 172, 268–269) and links its substance with Leopold's land ethic (p. 270). Flader also notes the direct links between Leopold's land ethic and land health in "Aldo Leopold and the Evolution of a Land Ethic," in *Aldo Leopold: The Man and His Legacy*, edited by T. Tanner (Ankeny, IA: Soil Conservation Society of America, 1987), p. 21. J. Baird Callicott emphasizes the importance of land health to Leopold's thinking in "Standards of Conservation: Then and Now," *Conservation Biology* 4 (1990): 229–232, and "Whither Conservation Ethics?" *Conservation Biology* 4 (1990): 15–20. Eric Freyfogle draws attention to the centrality of Leopold's land health concept in "A Sand County Almanac at 50: Leopold in the New Century," *Environmental Law Reporter* 30 (2000): 10058–10068. Curt Meine also traces the evolution of Leopold's land health idea in *Correction Lines: Essays on Land, Leopold, and Conservation* (Washington, DC: Island Press, 2004), chap. 5. See also J. B. Callicott and E. T. Freyfogle, eds., *Aldo Leopold: For the Health of the Land; Previously*

- Unpublished Essays and Other Writings* (Washington, DC: Island Press, Shearwater Books, 1999). For discussions of health as metaphor and its usefulness for conservation, see J. B. Callicott, "Aldo Leopold's Concept of Ecosystem Health" and "The Value of Ecosystem Health," in *Beyond the Land Ethic: More Essays in Environmental Philosophy* (Albany: State University of New York Press, 1999), pp. 333–364.
3. AL, "Ecology and Politics," RMG, p. 284; AL, "The Land-Health Concept and Conservation," FHL, p. 225.
  4. AL, "Wilderness," RMG, p. 229; AL, "The Farm Wildlife Program: A Self-Scrutiny," unfinished, n.d., p. 1, UWDWE, vol. 2, pp. 362–370; AL, "Ecology and Economics in Land Use," unfinished, unpublished, ca. 1940s, p. 1, LP 10-6, 17; AL, "Substitutes for a Land Ethic," SCA, pp. 210–211.
  5. AL, "A Survey of Conservation," RR, p. 146.
  6. AL, "The Arboretum and the University," *Parks and Recreation* 18, no. 2 (October 1934): 59–60; also in RMG, p. 209, and AL, "The Community Concept," SCA, p. 204.
  7. AL, "A Biotic View of Land," RMG, pp. 268, 269; AL, "The Round River," p. 162; AL, "Conservation: In Whole or in Part," RMG, p. 312; AL, "The Land Pyramid," SCA, p. 216.
  8. AL, "On a Monument to the Pigeon," SCA, p. 109.
  9. AL, "The Round River: A Parable," RR, p. 159.
  10. Ibid., pp. 159–162.
  11. AL, "The Land Pyramid," SCA, p. 216; also in AL, "A Biotic View of Land," RMG, p. 269.
  12. AL, "Land Pathology," RMG, p. 213.
  13. AL, "Conservation: In Whole or in Part?" RMG, p. 316.
  14. AL, "The Farmer as a Conservationist," FHL, p. 162. See also AL, "The Role of Wildlife in a Liberal Education," *Transactions of the 7th North American Wildlife Conference* (8–10 April 1942): 485–489; also in RMG, p. 303.
  15. AL, "The Land Pyramid," SCA, p. 214.
  16. Even back at least to Plato and Moses. See R. A. Long, "Forest Conservation," in *Proceedings of a Conference of the Governors of the United States, 1908, White House, May 13–15* (Washington, DC: Government Printing Office, 1909), pp. 87–88: "The effect and influence of forests on the climate, health, and water conditions of the country is evidenced by the chronicles of the Mosaic, the Roman and the Greek writers, and many of their far-seeing priests prevented the destruction of the forests. . . . Plato writes that the consequence of deforestation is the 'sickening of the country.'"
  17. The foundation for Leopold's conservation ideas, upon which grew the concepts of land health and the land ethic, can be summarized as "the positive conviction that cohabitation of the land by wild and the tame things is good." He believed in "the fundamental goodness of men living on land with plants and animals." AL, "Farm Wildlife Program," p. 1.
  18. Leopold's first major writing directly on land health dated from October 1940, his initial draft of a paper titled "Biotic Land-Use" (draft attached to AL, letter to Rudolf Bennett, 22 October 1940, LP 10-1, 1). Sometime around

- 1942 he expanded the essay, but he still left it unpublished (it was published in 1999 in FHL, pp. 198–205). Leopold's first major published work on land health was the piece he contributed in 1941 to a symposium on hydrobiology: "Soil health and water health are not two problems, but one," he asserted. AL, "Lakes in Relation to Terrestrial Life Patterns," in J. G. Needham et al., *A Symposium on Hydrobiology* (Madison: University of Wisconsin Press, 1941), pp. 17–22. Also appearing in 1941, discussing land health, was a piece on wilderness as "a base-datum of normality, a picture of how healthy land maintains itself as an organism." AL, "Wilderness as a Land Laboratory," *Living Wilderness* 6 (July 1941): 3; also in RMG, p. 288, and appearing almost in full as part of "Wilderness for Science," SCA, pp. 194–198. Important, brief discussions of land health appeared in two 1942 essays, AL, "Land-Use and Democracy," *Audubon* 44, no. 5 (September–October 1942): 218, also in RMG, p. 300; and AL, "The Role of Wildlife in a Liberal Education," RMG, p. 303. Most significant from 1942 was an essay describing land health in story form: AL, "Odyssey," *Audubon* 44, no. 3:133–135; also in SCA, pp. 104–108. In later essays Leopold again used the land health concept in brief, important ways. See AL, "The Outlook for Farm Wildlife," *Transactions of the 10th North American Wildlife Conference*, 26–28 February 1945, pp. 165–168, also in FHL, p. 217; and AL, "The Ecological Conscience," *Bulletin of the Garden Club of America*, September 1947, pp. 45–53, also in RMG, p. 345: "A thing is right only when it tends to preserve the integrity, stability, and beauty of the community, and the community includes the soil, waters, fauna, and flora, as well as people." These lines, with some modifications, occur in "The Land Ethic," SCA, p. 224. It was in two essays from the middle of the decade, however, that Leopold placed land health in the center of his writing, overtly proposing the concept as the much-needed overall goal for conservation. AL, "Conservation: In Whole or in Part?" RMG, pp. 310–319, in which he explains in detail the scientific bases for land health. In abbreviated form ideas from this essay showed up in AL, "Land-Health and the A-B Cleavage," SCA, pp. 221–223, and AL, "The Land-Health Concept and Conservation," FHL, pp. 218–226, in which he considers the conservation implications of the concept, what it would take to achieve the goal, and the importance of professional ecologists in better grounding the idea.
19. Land health was a culminating concept in Leopold's thinking, bringing together as it did scientific and moral matters. Yet Leopold plainly understood the concept as a work in progress. It was an idea that would need continual fleshing out as science revealed new information and culture evolved. See AL, "The Land-Health Concept and Conservation," FHL, p. 220. Leopold's uncertainty about the details of the concept—and his intent to keep working on them—seem the most reasonable explanation for why he left so many key writings in his desk drawer. Leopold's principal writings on land health were thus known only to Leopold scholars until they were published in edited volumes of Leopold's work in the 1990s. These include AL, "Biotic Land-Use," FHL, pp. 198–206; AL, "Conservation: In Whole or in Part?" RMG, pp. 310–319; and AL, "The Land-Health Concept and Conservation," FHL, pp. 218–226. Still unpublished writings of substance



- include AL, “Land-Health in Southwest Wisconsin,” unpublished lecture drafts of 3 November 1943 (for the American Society of Civil Engineers) and 7 April 1944 (for the Garden Club of America), LP 10-6, 14, and AL, “Land as a Circulatory System” (draft of chap. 1, 12 July 1943, LP 10-6, 16), apparently intended as the first chapter of his proposed text on ecology, which remained unfinished. This may explain why Leopold’s readers over the years have underappreciated the importance he attached to the concept.
20. AL, “To the Forest Officers of the Carson,” *Carson Pine Cone* (15 July 1913); also in RMG, pp. 41–46.
  21. AL, “Standards of Conservation,” RMG, p. 84. See Callicott, “Standards of Conservation: Then and Now.”
  22. AL, “The Conservation Ethic,” *Journal of Forestry* 31, no. 6 (October 1933): 634–643; also in RMG, p. 182.
  23. AL, “Conservation Economics,” *Journal of Forestry* 32, no. 5 (May 1934): 537–544; also in RMG, p. 202.
  24. AL, “Biotic Land-Use,” FHL, p. 202.
  25. AL, “Foreword,” SCA, p. ix.
  26. AL, “Land Health and the A–B Cleavage,” SCA, p. 221. “A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land.”
  27. AL, *Watershed Handbook* (Albuquerque: U.S. Department of Agriculture, Forest Service, District 3, December 1923 [revised and reissued October 1934]), p. 8, LP 10-11, 1.
  28. E.g., in his 1935 lecture “Land Pathology,” society and land regarded together as an organism had “suddenly developed pathological symptoms, i.e. self-accelerating rather than self-compensating departures from normal functioning.” AL, “Land Pathology,” RMG, p. 217.
  29. AL, SCA, p. 221.
  30. In his report from Germany titled “Deer and *Dauerwald*,” “soil sickness” was described as a troubling condition in artificialized forests, whereas more natural, diverse forests exhibited signs of “ecological health.” AL, “Deer and *Dauerwald* in Germany: I. History,” *Journal of Forestry* 34, no. 4 (April 1936): 374. In Leopold’s major early writing about the Sierra Madre, “Conservationist in Mexico,” he remarked that the Chihuahua presented “so lovely a picture of ecological health.” AL, “The Conservationist in Mexico,” *American Forests* 43, no. 3 (March 1937): 118–120, 146; also in RMG, p. 239. And in his 1939 “The Farmer as a Conservationist,” Leopold declared that the fields and pastures of an ecologically diverse farm were all “built on a foundation of good health,” which he linked with soil fertility. AL, “The Farmer as a Conservationist,” FHL, p. 173.
  31. AL, “Land-Use and Democracy,” RMG, p. 300.
  32. AL, “Conservation: In Whole or in Part?” RMG, p. 310. For similar definitions of land health, see AL, “The Role of Wildlife in a Liberal Education,” RMG, p. 303, and AL, “Land Health and the A–B Cleavage,” SCA, p. 221. Leopold used an alternative phrasing in his 1941 “Wilderness as a Land Laboratory,” RMG, p. 287: Health was the “capacity for internal self-renewal.”
  33. See also S. Flader, *Thinking Like a Mountain*, pp. 31–32.

34. AL, unpublished manuscript, 12 July 1943; AL, "Land as a Circulatory System," p. 1. In thinking this way, it was possible to speak in terms of general principles of health while recognizing that particular measures of health—e.g., fertility and diversity—would be relative conditions in relation to unique locales.
35. Leopold also pointed out that in human-dominated landscapes much of the land system's energy was rerouted directly to humans as the new top animal in the land pyramid. Modern humans rarely returned their nutrient intake to the soil; it ended up in rivers and lakes via sewers, in which case "the circulatory system suffers a short-circuit which must ultimately impoverish the land." See AL, "Land as a Circulatory System," p. 5.
36. See AL, "Foreword," SCA, unpublished, 31 July 1947, p. 7, LP 10-6, 16 (4), published in *Companion to "A Sand County Almanac": Interpretive and Critical Essays*, edited by J. B. Callicott (Madison: University of Wisconsin Press, 1987), p. 287.
37. AL, "Odyssey," SCA, pp. 107–108.
38. *Ibid.*, p. 107.
39. AL, "Land as a Circulatory System," p. 2. Leopold collected a data set (incomplete at his writing) from an actual scientific experiment comparing the downhill wash of nutrients on six different landscapes, ranging from continuous corn to ungrazed woods. He found, for instance, that downhill wash was twenty times as rapid in corn as in ungrazed grass.
40. *Ibid.*, p. 6.
41. AL, *Watershed Handbook*, December 1923, p. 11. In a 1946 letter to Bill Vogt, Leopold admitted that he maintained "only a casual contact with the erosion field and have been able to do less and less contact with the erosion field." AL to Bill Vogt, 12 August 1946, LP 10-1, 3.
42. See W. P. Taylor, "Some Effects of Animals on Plants," *Scientific Monthly* 43 (1936): 262. Taylor, too, noted that large numbers of people with powerful tools had disturbed "natural equilibria," resulting in temporary bursts of productivity of some species; "accelerated erosion . . . shrinking water supplies . . . forest, range, and wildlife depletion; and soil exhaustion."
43. AL, "The Land-Health Concept and Conservation," FHL, p. 219.
44. AL, "Wilderness for Science," SCA, p. 194.
45. *Ibid.*, p. 196.
46. See Douglas Wade, round-robin letter to "The Gang," 5 May 1944, p. 2, LP 10-1, 3; AL, letter to "Wildlifers" titled "Mobility of Wildlifers: 2nd Progress Report," 1 September 1943, LP 10-1, 3; AL, letters to William Vogt, 12 August 1942 and 8 July 1943, LP 10-1, 3.
47. AL, introduction to unpublished manuscript, ca. 1943, p. 5, LP 10-6, 17.
48. AL, "Conservation in Whole or in Part?" RMG, p. 310.
49. *Ibid.*, p. 318.
50. AL, unpublished manuscript, 12 July 1943; AL, "Land as a Circulatory System," p. 1.
51. AL, "Land as a Circulatory System," p. 6.
52. *Ibid.*
53. *Ibid.*, p. 5.
54. AL, "Land as a Circulatory System," p. 1. See AL, unpublished fragment, ca.

- 1930s, "Social Consequences Material," LP 10-6, 16; and AL, "Land-Health in Southwest Wisconsin." Leopold's approach to time scales in conservation science was influenced by several works of history, including C. Beard and M. Beard, *The Rise of American Civilization* (New York: Macmillan, 1930) (Leopold appreciated the Beards' dialectic approach); B. De Voto, *The Year of Decision, 1846* (Boston: Little, Brown, 1943), which was, according to Leopold, a "slow-motion picture of the year 1846 in America"; H. G. Wells, *The Outline of History* (New York: Garden City, 1920), which begins in geologic time with ages of rocks, reptiles, mammals, and man and human society and ends with a chapter that projects into a hopeful future of progressing unity among mankind (which Leopold said had "photographed the unfolding of the so-called human race from Cro-Magnon to the Jazz age"); and W. P. Webb, *The Great Plains* (Boston: Ginn and Company, 1931), which Leopold called an outstanding work that viewed "all aspects of land from a long time-scale." Leopold modeled his historical study of southwestern Wisconsin on Webb's work, the purpose of which was to show how the Great Plains landscape "affected the various peoples, nations as well as individuals, who came to take and occupy it, and was affected by them" (Webb, *The Great Plains*, p. 8). Leopold was also fascinated with the history of ideas, or "idea succession," about which he and P. S. Lovejoy corresponded at some length. P. S. Lovejoy, letters to AL, e.g., 1 May 1941, 10 May 1941. See also AL, "Wildlifers and Game Farmers," RMG, p. 63; AL, *Game Management*, chap. 1, "A History of Ideas"; AL, "Wisconsin Wildlife Chronology," *Wisconsin Conservation Bulletin* 5, no. 11 (1940): 8-20; AL, "Obituary: P. S. Lovejoy," *Journal of Wildlife Management* 7, no. 1 (1943): 127. See also Flader, *Thinking Like a Mountain*, pp. 54, 122, 170-172.
55. AL, "Suggestions for Individual Projects," class handout for Wildlife Ecology 118, 1942, UWDWE. Students were assigned "Interpretation of Case Studies." See also C. Meine, "Reading the Landscape: Aldo Leopold and Wildlife Ecology 118" *Forest History Today* (Fall 1999): 35-42.
  56. AL, "Case Studies for Wildlife Ecology 118 Class," Cases 1-8, respectively, ca 1940s: "Recent History of Roadsides" (1948); "History of a Prairie Coulee" (n.d.); "History of the Ragweed Patch, Faville Grove" (n.d.); "History of Central Wisconsin Marshes" (n.d.); "History of Northern Wisconsin" (n.d.); "Evolution of the Fencerow" (n.d.); "History of a Tussock Marsh" (n.d.); "History of Gilbert Creek, Dunn County, Wisconsin" (n.d., compiled by student Irven O. Buss).
  57. AL, "Conservationist in Mexico," RMG, pp. 239-244. See also AL, letter to Carl O. Sauer, 29 December 1938, LP 10-3, 3: "I was much pleased to learn . . . that you are interested in deciphering the ecology of the northern Sierra Madre . . . before the terrain is manhandled and before the opportunity is lost. . . . To my mind, the most important item is to decipher the soil-water-streamflow relation and compare it with the 'modified' terrain of similar geologic formation on this side of the line [using historical records]. . . . By comparing the ecology of an unspoiled terrain with the known history of a similar spoiled terrain, some important deductions would probably result" about how to better use the land.
  58. AL, "Report of the Iowa Game Survey," "Chapter Two: Iowa Quail,"

- Outdoor America* 2, no. 2 (1932): 11: "The known past is, in fact, a laboratory, in which quail have been successively exposed to four sets of conditions."
59. This idea bears similarity to the concept termed today historic range of variability (HRV), which requires the identification of variables in nature and an estimation of how those variables have fluctuated at various scales in the past, particularly before European-American land use affected an area. The suggestion is that if management promotes conditions that are within the HRV, it is more likely to be promoting forms of sustainable land use. See T. Veblen, "Historic Range of Variability of Mountain Forest Ecosystems: Concepts and Applications," *Forest Chronicle* 79 (2003): 223–226, and P. Landres, P. Morgan, and F. Swanson, "Overview of the Use of Natural Variability Concepts in Managing Ecological Systems," *Ecological Applications* 9 (1999): 1179–1188.
  60. It seems likely that "northeastern Europe" in "Wilderness as a Land Laboratory" (reprinted as "Wilderness for Science" in SCA) is a typographical error and that Leopold intended to say "northwestern Europe." Leopold had already claimed in an earlier writing that northwestern Europe might have provided the only such example. See "Biotic Land-Use," FHL, p. 204.
  61. AL, "Report of the Iowa Game Survey," "Chapter Two: Iowa Quail," pp. 11–13, 30–31.
  62. AL, "Marshland Elegy," SCA, p. 99.
  63. AL, "The Wisconsin River Marshes," *National Waltonian* 2, no. 3 (September 1934): 59–60; also in FHL, p. 40.
  64. Ibid., pp. 41–42. Leopold retold the story in "Marshland Elegy," SCA, p. 99.
  65. Ibid., p. 42.
  66. Also see J. L. Dupouey et al., "Irreversible Impact of Past Land Use on Forest Soils and Biodiversity," *Ecology* 83, no. 11 (2002): 2978–2984.
  67. Also see AL, "Case Studies for Wildlife Ecology 118 Class," Case 4: "History of Central Wisconsin Marshes," n.d., UWDWE, and "Bogs, Swamps, and Marshes in Relation to Wisconsin Game Animals," by Franklin Schmidt (a top student of Leopold's who died tragically in 1935), LP 10-5, 7.
  68. Leopold likely drew on works of Edward Deevey and Stanley Cain, who were prominent in this field and remained so until the 1980s. Estella Leopold, personal communication.
  69. S. Cain, *Foundations of Plant Geography* (New York: Harper and Brothers, 1944). Techniques of analysis improved in the following decades, and not all claims made via this technique have held. In Leopold's time it was believed that pollen evidence indicated a floral and faunal composition in Wisconsin that remained intact geographically throughout changing climatologic and geologic eras over 20,000 years. Paleontologist Linda Brubaker more recently (1988) sketched a picture of communities seldom persisting intact for more than 2,000–5,000 years; see J. B. Callicott, "Do Deconstructive Ecology and Sociobiology Undermine the Leopold Land Ethic?" in *Beyond the Land Ethic: More Essays in Environmental Philosophy* (Albany: State University of New York Press, 1999), p. 125. Whether 2,000 or 20,000 years,

- however, the point holds that radical changes in landscape trends occurred after European settlement in Wisconsin around 1840. See AL, "Conservation: In Whole or in Part?" RMG, pp. 310–319.
70. AL, "Conservation: In Whole or in Part?" RMG, pp. 311–312.
  71. See also AL, "Sick Trout Streams" (unpublished, 14 April 1944, LP 10-6, 16), which linked dried-up and silted Wisconsin trout streams to land misuse, including overgrazing and exhaustion of soil organic matter.
  72. AL, "Land-Health in Southwest Wisconsin," 1943 and 1944.
  73. Ibid., 1944, p. 1.
  74. Ibid., 1943, p. 5.
  75. Ibid., p. 7.
  76. Ibid.
  77. AL, "Coon Valley: An Adventure in Cooperative Conservation," *American Forests* 41, no. 5 (May 1935): 273–275; also in RMG, p. 220, and FHL, p. 49.
  78. AL, "Land-Health in Southwest Wisconsin," 1943 draft, p. 10.
  79. AL, "Deer and *Dauerwald* in Germany: I," p. 374; AL, "Deer and *Dauerwald* in Germany: II. Ecology and Policy," *Journal of Forestry* 34, no. 5 (May 1936): 460.
  80. AL, "Deer and *Dauerwald* in Germany: I," p. 374.
  81. AL, "Sketches of Land Use in Germany," address to the Taylor-Hibbard Club, 22 January 1936, pp. 2, 5, LP 10-6, 14. Leopold pointed out in a photograph a dead tree "snag left for woodpeckers—a revolutionary change in the mental habit of foresters, unthinkable a decade ago. In short, the Germans do not cease and desist from conflicting uses; they fit, modify, and adjust, realizing that the whole organic universe is a process of adjustment."
  82. AL, "Land Pathology," RMG, p. 213.
  83. AL, "Conservation: In Whole or In Part?" RMG, p. 311. Leopold cited E. P. Farrow, *Plant Life on East Anglian Heaths* (Cambridge: Cambridge University Press, 1925). Leopold was interested in international conservation. He undertook an informal comparative study of the historical effects of human occupancy on land pyramids of England and Arizona, concluding that plant succession provided a key to the differences in land's resistance to human alteration. He also comparatively considered land pyramids of southern Arizona, South Africa, and land and marine environments of the Arctic tundra. See AL, informal class lecture notes for Wildlife Ecology 118 at the University of Wisconsin, ca. 1940, LP 10-6, 14, and AL, "A Biotic View of Land," RMG, p. 270.
  84. AL, "Land Pathology," RMG, pp. 213–214.
  85. See, too, AL, "Vertical Planning for Wild Life," address to Rural Regional Planning group, 25 March 1936, LP 10-6, 14: "As an antidote for the recent errors [in land use]: go to the local area (group of men as versatile as possible). Forget all the isms, manuals, bureaus, abstractions and ask: 1. What is this land good for? 2. What is on it? 3. What could be on it? 4. How can its resources be used with least damage to each other?"
  86. AL, "Wilderness as a Land Laboratory," RMG, p. 289; AL, "Foreword," in Callicott, *Companion to "A Sand County Almanac,"* pp. 285, 286.
  87. AL, "Conservationist in Mexico," RMG, p. 239.

88. Ibid.
89. Ibid.
90. AL, "Foreword," in Callicott, *Companion to "A Sand County Almanac,"* pp. 285, 286.
91. AL, "Wilderness for Science," SCA, p. 197. See also AL, "Wilderness as a Land Laboratory," RMG, p. 289. Leopold had no time to study the Sierra Madre, but he hoped others would do so. His particular hope was to interest prominent geographer Carl Sauer of the University of California to take up the task. Leopold's eldest son, Starker, was in contact with Sauer and raised the prospect with him. Leopold proposed for the region the kind of comparative historical inquiry that he had undertaken elsewhere, looking not just at both sides of the border but at present conditions in comparison with past ones. AL, letter to Carl Sauer, 29 December 1938, LP 10-3, 3. Leopold also tried to get the Ecological Society of America involved in studying the region, but it lacked the leadership and resources at the time to undertake the task. Additionally, Mexico's political landscape was changing, which dimmed the prospects further. See AL, letter to Harvey Broome, 7 August 1940, LP 10-2, 9.
92. AL, "Conservation: In Whole or in Part?" RMG, p. 315.
93. AL, "The Land-Health Concept and Conservation," FHL, p. 220.
94. Draft attached to AL, letter to Rudolf Bennitt, 22 October 1940, LP 10-1, 1; later draft in FHL, pp. 198–207.
95. AL, "Biotic Land-Use," FHL, p. 200.
96. Ibid. See also Flader, *Thinking Like a Mountain*, p. 31, and C. D. Meine, *Aldo Leopold: His Life and Work* (Madison: University of Wisconsin Press, 1988), p. 404.
97. Ibid., p. 203.
98. Ibid.
99. Ibid., p. 205. In Leopold's lexicon, in short, stability ranked as a fundamental characteristic of healthy land. Indeed, so linked was the land's health to its stability—to its sustained ability to recycle nutrients and maintain soil fertility—that Leopold several times treated the words "health" and "stability" as if they were synonyms. In "Biotic Land-Use" he would talk about the goal of "stabilization or land-health" (FHL, p. 202). In "Planning for Wildlife" he would talk of "stable (i.e., healthy) land" (FHL, p. 194); in "Conservation: In Whole or in Part?" he would explain that "land was stable, i.e., it retained its health" (RMG, p. 311). The words were not synonyms, though: "stability" had a more narrow, particular meaning, whereas "health" was a broader concept, not yet well grasped. As Leopold understood land health, however, stability was a defining element; if stable land was not fully healthy, it was very close.
100. AL, "Biotic Land-Use," FHL, p. 205.
101. AL, "Substitutes for a Land Ethic," SCA, p. 210.
102. AL, "Biotic Land-Use," FHL, p. 205.
103. AL, "Conservation: In Whole or in Part?" RMG, p. 315.
104. Ibid.
105. Ibid. For an interesting discussion of the recent emphasis within the field of

- ecology on flux and change in nature in relation to ideas of stability, predictability, and conditions of equilibrium in nature and how we understand good land use and define healthy land, see Callicott, "Deconstructive Ecology and Sociobiology," pp. 117–139. See also B. Norton, "Change, Constancy, and Creativity: The New Ecology and Some Old Problems," *Duke Environmental Law and Policy Forum* 7, no. 49 (1996): 49–70; B. Norton, "The Constancy of Leopold's Land Ethic," *Conservation Biology* 2, no. 1 (1988): 93–102; D. Worster, "The Ecology of Order and Chaos," in *The Wealth of Nature: Environmental History and the Ecological Imagination* (New York: Oxford University Press, 1993), pp. 156–170; and D. Worster, ed., *Nature's Economy: A History of Ecological Ideas* (Cambridge: Cambridge University Press, 1994). Leopold intended the land pyramid concept to replace the balance-of-nature idea of land as an ecologically "truer image"—one that tried to incorporate the limits and flexibilities of self-organization and dynamism in nature. See AL, "The Land Pyramid," SCA, p. 214.
106. Work exploring possible relationships between diversity and stability has continued. See, e.g., D. Goodman, "The Theory of Diversity-Stability Relationships in Ecology," *Quarterly Review of Biology* 30 (1975): 237–266; D. Tilman and J. A. Downing, "Biodiversity and Stability in Grasslands," *Nature* 367, no. 6461 (January 1994): 363–365; and S. Naeem et al., "Declining Biodiversity Can Alter the Performance of Ecosystems," *Nature* 369, no. 6473 (April 1994): 734–737.
  107. AL, "Wilderness for Science," SCA, p. 196.
  108. AL, "The Land-Health Concept and Conservation," FHL, p. 204.
  109. AL, "The Basis of Conservation Education," unpublished address to Kiwanis Club, Racine, Wisconsin, 20 July 1939, p. 3, LP 10-6, 14.
  110. AL, "Economics, Philosophy, and Land," unpublished manuscript, 23 November 1938, p. 5, LP 10-6, 16: "The first law of intelligent tinkering is to keep all the parts. We might need them." See also AL, "The Land-Health Concept," FHL, pp. 221–222, and AL, "The Community Concept," SCA, pp. 204–205.
  111. AL, "Substitutes for a Land Ethic," SCA, pp. 210–211.
  112. AL, "The Community Concept," SCA, p. 204.
  113. AL, "The Land-Health Concept and Conservation," FHL, p. 221.
  114. Ibid.
  115. Along with the terms "stability" and "integrity," which he used with particular meanings of his own, he also drew on words and phrases such as "continuity," "structure," "capacity for self-renewal," "complexity," "beauty," "wholeness," and "collective functioning" to define health.
  116. AL, "Conservation: In Whole or in Part?" RMG, p. 310.
  117. AL, "The Land Pyramid," SCA, p. 216; AL, "A Biotic View of Land," RMG, p. 269.
  118. AL, "The Land Pyramid," SCA, p. 217.
  119. Ibid.
  120. AL, "The Outlook," SCA, p. 226.
  121. AL, "The Land-Health Concept and Conservation," FHL, p. 224.

122. Ibid.
123. AL, "Wilderness for Science," SCA, pp. 195–196. See also AL, "The Meaning of Conservation," unpublished address, Milwaukee, 10 September ca. 1942, LP 10-6, 17. Also see AL, "Scientific Uses of Wilderness," unpublished address to the Get-Away Club, 17 January 1942, LP 10-6, 14.
124. See AL, "Ticks and Deer," unpublished manuscript, 5 December 1944; AL, "On a Monument to the Pigeon," SCA, p. 110.
125. AL renamed the essay "Yet Come June" in a subsequent draft. Both drafts dated 23 December 1941, LP 10-6, 17.
126. AL, "Yet the Trees Grow"/"Yet Come June," p. 1.
127. Quoted in AL, "The Conservation Ethic," RMG, p. 191.
128. AL, "Marshland Elegy," SCA, p. 101.
129. Ibid.
130. AL, "Conservation," unpublished manuscript stapled to letter from Horace Fries (member of the National Educational Committee for a New Party), 8 August 1946, LP 10-1, 1.
131. AL, "Land Health and the A-B Cleavage," SCA, p. 221.
132. AL, "The Outlook," SCA, pp. 224–225. For further discussion of Leopold's use of "beauty" in his land ethic, see C. D. Meine, "Building the Land Ethic," in Callicott, *Companion to "A Sand County Almanac,"* p. 184, and C. D. Meine, "Building 'the Land Ethic': A History of Aldo Leopold's Most Important Essay," master's thesis, University of Wisconsin–Madison, 1983, p. 67. On Leopold and aesthetics, see also J. B. Callicott, "The Land Aesthetic," in *Companion to "A Sand County Almanac,"* pp. 157–171.
133. AL, "The Ethical Sequence," SCA, p. 203.
134. Ibid.
135. AL, "The Land Ethic," SCA, pp. 224–225.
136. Ibid., p. 224.
137. Ibid.
138. Ibid., p. 223.
139. AL, "Ethical Sequence," SCA, p. 203.
140. Ibid., p. 202.
141. AL, "The Ecological Conscience," RMG, p. 340.
142. Ibid., pp. 345–346.
143. AL, "Ethical Sequence," SCA, p. 203.
144. Ibid.
145. AL, "Conservation," unpublished manuscript stapled to letter from Horace Fries (member of the National Education Committee for a New Party), 8 August 1946, LP 10-1, 1.
146. AL, "Community Concept," SCA, p. 204; AL, "Substitutes for a Land Ethic," SCA, p. 211.
147. AL, "Community Concept," SCA, p. 204.
148. AL, "Defenders of Wilderness," SCA, p. 200.
149. See AL, "Foreword," SCA, pp. vii–ix.
150. AL, "Sky Dance," SCA, p. 34.