

Aldo Leopold (1887-1948) is considered the father of wildlife ecology. He was a renowned scientist and scholar, exceptional teacher, philosopher, and gifted writer. It is for his book, A Sand County Almanac, that Leopold is best known by millions of people around the globe. The Almanac, often acclaimed as the century's literary landmark in conservation, melds exceptional poetic prose with keen observations of the natural world. The Almanac reflects an evolution of a lifetime of love, observation, and thought. It led to a philosophy that has guided many to discovering what it means to live in harmony with the land and with one another.

The roots of Leopold's concept of a "land ethic" can be traced to his birthplace on the bluffs of the Mississippi River near Burlington, Iowa. As a youngster, he developed a zealous appreciation and interest in the natural world, spending countless hours on adventures in the woods, prairies, and river backwaters of a then relatively wild Iowa. This early attachment to the natural world, coupled with an uncommon skill for both observation and writing, lead him to pursue a degree in forestry at Yale.

After Yale, Leopold joined the U.S. Forest Service and was assigned to the Arizona Territories. During his tenure, he began to see the land as a living organism and develop the concept of community. This concept became the foundation upon which he became conservation's most influential advocate. In 1924, he accepted a transfer to the U.S. Forest Products Laboratory in Madison where he served as associate director, and began teaching at Wisconsin in 1928.

Often credited as the founding father of wildlife ecology, Leopold's cornerstone book Game Management (1933) defined the fundamental skills and techniques for managing and restoring wildlife populations. This landmark work created a new science that intertwined forestry, agriculture, biology, zoology, ecology, education and communication. Soon after its publication, the University of Wisconsin created a new department, the Department of Game Management, and appointed Leopold as its first chair.

Leopold's unique gift for communicating scientific concepts was only equal to his fervor for putting theories into practice. In 1935, the Leopold family purchased a worn-out farm near Baraboo, in an area known as the sand counties. It is here Leopold put into action his beliefs that the same tools people used to disrupt the landscape could also be used to rebuild it. An old chicken coop, fondly known as the Shack, served as a haven and land laboratory for the Leopold family, friends, and graduate students. And it was here Leopold visualized many of the essays of what was to become his most influential work, A Sand County Almanac.

Adapted from <http://www.naturenet.com/alnc/aldo.html>

**From *A Sand County Almanac* (1949)
Aldo Leopold**

February – Good Oak

There are two spiritual dangers in not owning a farm. One is the danger of supposing that breakfast comes from the grocery, and the other that heat comes from a furnace.

To avoid the first danger, one should plant a garden, preferably where there is no grocer to confuse the issue.

To avoid the second, he should lay a split of good oak on the andirons, preferably where there is no furnace, and let it warm his shins while a February blizzard tosses the trees outside. If one has cut, split, hauled, and piled his own good oak, and let his mind work the while, he will remember much about where the heat comes from, and with a wealth of detail denied to those who spend the weekend in town astride a radiator.

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The particular oak now aglow on my andirons grew on the bank of the old emigrant road where it

climbs on the sandhill. The stump, which I measured upon felling the tree, has a diameter of 30 inches. It shows 80 growth rings, hence the seedling from which it originated must have laid its first ring of wood in 1865, at the end of the Civil War. But I know from the history of present seedlings that no oak grows above the reach of rabbits without a decade or more of getting girdled each winter, and re-sprouting during the following summer. Indeed, it is all too clear that every surviving oak is the product either of rabbit negligence or of rabbit scarcity. Some day some patient botanist will draw a frequency curve of oak birth years, and show that the curve humps every ten years, each hump originating from a low in the ten year rabbit cycle. (A fauna and flora, by this very process of perpetual battle within and among species, achieve collective immortality.)

It is likely, then, that a low in rabbits occurred in the middle 'sixties, when my oak began to lay on annual rings, but that the acorn that produced it fell during the preceding decade, when the covered wagons were still passing over my road into the Great Northwest. It may have been the wash and wear of the emigrant traffic that bared this road bank, and thus enabled this particular acorn to spread its first leaves

to the sun. Only one acorn in a thousand ever grew large enough to fight rabbits, the rest were drowned at birth in the prairie sea.

It is the warming thought that this one wasn't, and thus lived to garner eighty years of June sun. It is this sunlight that is now being released, through the intervention of my axe, and saw, to warm my shack and my spirit through eighty gusts of blizzard. And with each gust a wisp of smoke from my chimney bears witness to whomever it may concern, that the sun did not shine in vain.

My dog does not care where heat comes from, but he cared ardently that it come and soon. Indeed he considers by ability to make it come as something magical, for when I rise in the cold black pre-dawn and kneel shivering by the hearth making a fire, he pushes himself blandly between me and the kindling splits I have laid on the ashes, and I must touch a match to them by poking it between his legs. Such faith, I suppose, is the kind that moves mountains.

It was a bolt of lightning that put an end to the woodmaking of this particular oak. We were all awakened one night in July, by the thunderous crash; we realized that the bolt must have hit near by, but, since it had not hit us, we all went back to sleep. Man

brings all things to the test of himself, and this is notably true of lightning.

Next morning, as we strolled over the sandhill rejoicing with the cone-flowers and the prairie clovers over their fresh accession of rain, we came upon a great slab of bark freshly torn from the trunk of the roadside oak. The trunk showed a long spiral scar of barkless sapwood, a foot wide and not yet yellowed by the sun. By the next day the leaves had wilted and we knew that the lightning had bequeathed to us three cords of prospective fuel wood.

We mourned the loss of the old tree, but knew that a dozen of its progeny standing straight and stalwart on the sands had already taken over its job of woodmaking.

We let the dead veteran season for a year in the sun it could no longer use, and then on a crisp winter's day we laid a newly filed saw to its bastioned base. Fragrant little chips of history spewed from the saw cut and accumulated on the snow before each kneeling sawyer. We sensed that these two piles of sawdust were something more than wood; that they were the integrated transect of a century; that our saw was biting its way, stroke by stroke, decade by decade, into the chronology of a lifetime, written in concentric annual rings of good oak.

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It took only a dozen pulls of the saw to transect the few years of our ownership, during which we had learned to love and cherish this farm. Abruptly we began to cut the years of our predecessor, the bootlegger, who hated this farm, skimmed it of its residual fertility, burned its farmhouse, threw it back into the lap of the County (with delinquent taxes to boot), and then disappeared among the landless anonymities of the Great Depression. Yet the oak had laid down good wood for him; his sawdust was as fragrant, as sound, and as pink as out own. An oak is no respecter of persons.

The reign of the bootlegger ended sometime during the dust-bowl droughts of 1936, 1934, 1933, and 1930. Oak smoke from his still and peat from burning marshlands must have clouded the sun in those years, and alphabetical conservation was abroad in the land, but the sawdust shows no change.

Rest! cries the chief sawyer, and we pause for breath.

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Now our saw bites into the 1920's the Babbittian decade when everything grew bigger and better in heedlessness and arrogance-until 1929, when stock markets crumpled. It the oak heard them fall, its wood gives no sigh. Nr did it heed the Legislatures several protestations of love for tree; a National Forest and a forest-crop law in 1927, a great refuge on the Upper Mississippi bottomlands in 1924, and a new forest policy in 1921. Neither did it notice the demise of the state's last marten in 1925, nor the arrival of its first starling in 1923.

In March 1922, the 'Big Sleet' tore the neighboring elms limb from limb, but there is no sign of damage to our tree. What is a ton or ice, more or less, to a good oak?

Rest! cries the chief sawyer, and we pause for breath.

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Now the saw bites into 1910-1920, the decade of the drainage dream, when steam shovels sucked dry the marshes of central Wisconsin to make farms, and made ash-heaps instead. Our marsh escaped, not because of any caution or forbearance among engineers, but because the river floods it each

April, and did so with a vengeance-perhaps a defensive vengeance-in the years 1913-16. The oak laid on wood just the same, even in 1915, when the Supreme Court abolished the state forests and Governor Phillip pontificated that ‘state forestry is not a good business proposition.’ (It did not occur to the Governor that there might be more than one definition of what is good, and even of what is business. It did not occur to him that while the courts were writing one definition of goodness in the law books, fires were writing quite another one on the face of the land. Perhaps, to be a governor, one must be free from doubt on such matters.)

While forestry receded during this decade, game conservation advanced. In 1916 pheasants became successfully established in Waukesha County; in 1915 a federal law prohibited spring shooting; in 1913 a state game farm was started; in 1912 a ‘buck law’ protecting female deer; in 1911 an epidemic of refuges spread over the state. “Refuge” became a holy word, but the oak took no heed.

Rest! cries the chief sawyer, and we pause for breath.

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Now we cut 1910, when a great university president published a book on conservation, a great sawfly epidemic killed millions of tamaracks, a great drought burned the pineries, and a great dredge drained Horicon Marsh.

We cut 1909, when smelt were first planted in the Great Lakes, and when a wet summer induced the Legislature to cut the forest-fore appropriations.

We cut 1908, a dry year when the forests burned fiercely, and Wisconsin parted with its last cougar.

We cut 1907, when a wandering lynx, looking in the wrong direction for the promised land, ended his career among the farms of Dane County.

We cut 1906, when the first state forester took office, and fires burned 17,000 acres in these sand counties; we cut 1905 when a great flight of goshawks came out of the North and ate up the local grouse (they no doubt perched in this tree to eat some of mine). We cut 1902-3, a winter of bitter cold; which brought the most intense drought of record (rainfall only 17 inches); 1900, a centennial year of hope, of prayer, and the usually annual ring of oak.

Rest! cries the chief sawyer, and we pause for breath.

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Now our saw bites into the 1890's, called gay by those whose eyes turn cityward rather than landward. We cut 1899, when the last passenger pigeon collided with a charge of shot near Babcock, two counties to the north; we cut 1898 when a dry fall, followed by a snowless winter, froze the soil even feet deep and killed the apple trees; 1897, another drought year, when another forestry commission came into being; 1896, when 25,000 prairie chickens were shipped to market from the village of Spooner along; 1895, another year of fires; 1894, another drought year; and 1893, the year of 'The Bluebird Storm,' when a March blizzard reduced the migrating bluebirds to near-zero.(The first bluebirds always alighted in this oak, but in the middle 'nineties it must have gone without.) We cit 1892, another year of fires; 1891, a low in the grouse cycle, and 1890, the year of the Babcock Milk Tester, which enabled Governor Heil to boast, half a century later, that Wisconsin is America's Dairyland. The motor licenses which not parade that boast were not foreseen, even by Professor Babcock.

It was likewise in 1890 that the largest pine rafts in history slipped down the Wisconsin River in full view of my oak, to build an empire of red barns for the cows of the prairie states. Thus it is that good pine now stands between the cow and the blizzard, just as the good oak stands between the blizzard and me.

Rest! cries the chief sawyer, and we pause for breath.

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Now our saw bites into the 1880's; into 1889, a drought year, in which Arbor day was first proclaimed; into 1887, when Wisconsin appointed its first game wardens; into 1886, when the College of Agriculture held its first short course for farmers; into 1885, preceded by a winter 'of unprecedented length and severity'; into 1883, when Dean W.H. Henry reported that the spring flowers at Madison bloomed 13 days later than average; into 1882, the year Lake Mendota opened a month late following the historic 'Big Snow' and bitter cold of 1881-2.

It was likewise in 1881, that the Wisconsin Agricultural Society debated the question,

‘How do you account for the second growth of black oak timber that has sprung up all over the country in the last thirty years?’ My oak was one of these. One debater claimed that spontaneous generation, another claimed regurgitation of acorns by southbound pigeons.

Rest! Cries the chief sawyer, and we pause for breath.

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Now our saw bites into the 1970’s, the decade of Wisconsin’s carousel in wheat. Monday morning came in 1879, when cinch bugs, grubs, rust, and soil exhaustion finally convinced Wisconsin farmers that they could not compete with the virgin prairies further west in the game of wheating land to death. I suspect that this farm played its share in the game, and that the sand blow just north of my oak had its origin in this over-wheat.

This same year of 1879 saw the first planting of carp in Wisconsin, and also the first arrival of quackgrass as a stowaway from Europe. On 27 October 1879, six migrating prairie chicken perched on the roof of the German Methodist Church in Madison, and took a look at the growing city. On 8

November the markets of Madison were reported to be glutted with ducks at 10 cents each.

In 1878 a deer hunter from Sauk Rapids remarked prophetically, “The hunters promise to outnumber the deer.”

On 10 September 1877, two brothers shooting Muskego Lake, bagged 210 blue-winged teal in one day.

In 1876 came the wettest year of record; the rainfall piled up 50 inches. Prairie chicken declined, perhaps owing to hard rains.

In 1875 four hunters killed 153 prairie chickens at York Prairie, one county to the eastward. In the same year, the U.S. Fish Commission planted Atlantic salmon in Devil’s Lake, 10 miles south of my oak.

In 1874 the first factory-made barbed wire was stapled to oak trees; I hope no such artifacts are buried in the oak now saw!

In 1873 one Chicago firm received and marketed 25,000 prairie chickens. The Chicago trade collectively bought 600,000 at \$3.25 per dozen.

In 1872, the last wild Wisconsin turkey was killed, two counties to the southwest.

It is appropriate that the decade ending the pioneer carousel in wheat should likewise have ended the pioneer carousel in pigeon blood. In 1871, within

a 50-mile triangle spreading northwestward from my oak, 136 million pigeons are estimated to have nested and some may have nested in it, for it was then a thrifty sapling 20 feet tall. Pigeon hunters by scores plied their trade with net and gun, club and salt lick, and trainloads of prospective pigeon pie moved southward and eastward toward the cities. It was the last big nesting in Wisconsin, and nearly the last in any state.

This same year 1871 brought other evidence of the march of empire; the Peshtigo Fire, which cleared a couple of counties of trees and soil, and the Chicago Fire said to have started from a protesting kick of a cow.

Rest! cries the chief sawyer, and we pause for breath.

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Our saw now cuts the 1860's, when thousands dies to settle the question: Is the man-man community lightly to be dismembered? They settled it, but they did not see, nor do we yet see, that the same question applies to the man-land community.

This decade was not without its gropings toward the larger issue. In 1868 Increase A. Lapham

induced the State Horticultural Society of offer prizes for forest plantation. In 1866 the last native Wisconsin elk was killed. The saw now severs 1865, the pith-year of our oak. In that year John Muir offered to by from his brother, who then owned the home farm thirty miles east of my oak, a sanctuary for the wildflowers that had gladdened his youth. His brother declined to part with the land, but he could not suppress the idea. 1865 still stands in Wisconsin history as the birth year of mercy for things natural, wild and free.

We have cut the core. Our saw now reverses its orientation in history; we cut backward across the years and outward toward the far side of the stump. At last there is a tremor in the great trunk; the saw kerf suddenly widens; the saw is quickly pulled as the sawyers spring backward to safety; all hands cry "Timber!"; my oak leans, groans, and crashes with earth-shaking thunder, to lie prostrate across the emigrant road that give it birth.

-10-

Now comes the job of making wood. The maul rings on steel wedges as the sections of trunk are upended one by one, only to fall apart in fragrant slabs to be corded by the roadside.

There is an allegory for historians in the diverse functions of saw, wedge, and axe.

The saw works only across the years, which it must deal with one by one, in sequence. From each year the raker teeth pull little chips of fact, which accumulate in little piles, called sawdust by woodsmen and archives by historians; both judge the character of what lies within by the character of the samples thus made visible without.

It is not until the transect is completed that the tree falls, and the stump yields a collective view of a century. By its fall the tree attests the unity of the hodge-podge called history.

The wedge, on the other hand, works only in radial splits; such a split yields a collective view of all the years at once, or no view at all, depending on the skill with which the plane of the split is chosen (If in doubt, let the section season for a year until a crack develops. Many a hastily driven wedge lies rusting in the woods, imbedded in unsplittable cross-grain.)

The axe functions only at an angle diagonal to the years, and this only for the peripheral rings of the recent past. Its special function is to lop limbs for which both the saw and wedge are useless.

The three tools are requisite to good oak, and to good history.

-11-

These things I ponder as the kettle sings, and the good oak burns to red coals on white ashes. Those ashes, come spring, I will return to the orchard at the foot of the sandhill. They will come back to me again, perhaps as red apples, or perhaps as a spirit of enterprise in some fat October squirrel, who, for reasons unknown to himself, is bent on planting acorns.

Thinking Like a Mountain

A deep chesty bawl echoes from rimrock to rimrock, rolls down the mountain, and fades into the far blackness of the night. It is an outburst of wild defiant sorrow, and of contempt for all the adversities of the world. Every living thing (and perhaps many a dead one as well) pays heed to that call. To the deer it is a reminder of the way of all flesh, to the pine a forecast of midnight scuffles and of blood upon the snow, to the coyote a promise of gleanings to come, to the

cowman a threat of red ink at the bank, to the hunter a challenge of fang against bullet. Yet behind these obvious and immediate hopes and fears there lies a deeper meaning, known only to the mountain itself. Only the mountain has lived long enough to listen objectively to the howl of a wolf.

Those unable to decipher the hidden meaning know nevertheless that it is there, for it is felt in all wolf country, and distinguishes that country from all other land. It tingles in the spine of all who hear wolves by night, or who scan their tracks by day. Even without sight or sound of wolf, it is implicit in a hundred small events: the midnight whinny of a pack horse, the rattle of rolling rocks, the bound of a fleeing deer, the way shadows lie under the spruces. Only the ineducable tyro can fail to sense the presence or absence of wolves, or the fact that mountains have a secret opinion about them.

My own conviction on this score dates from the day I saw a wolf die. We were eating lunch on a high rimrock, at the foot of which a turbulent river elbowed its way. We saw what we thought was a doe fording the torrent, her breast awash in white water. When she climbed the bank toward us and shook out her tail, we

realized our error: it was a wolf. A half-dozen others, evidently grown pups, sprang from the willows and all joined in a welcoming melee of wagging tails and playful maulings. What was literally a pile of wolves writhed and tumbled in the center of an open flat at the foot of our rimrock.

In those days we had never heard of passing up a chance to kill a wolf. In a second we were pumping lead into the pack, but with more excitement than accuracy: how to aim a steep downhill shot is always confusing. When our rifles were empty, the old wolf was down, and a pup was dragging a leg into impassable slide-rocks.

We reached the old wolf in time to watch a fierce green fire dying in her eyes. I realized then, and have known ever since, that there was something new to me in those eyes - something known only to her and to the mountain. I was young then, and full of trigger-itch; I thought that because fewer wolves meant more deer, that no wolves would mean hunters' paradise. But after seeing the green fire die, I sensed that neither the wolf nor the mountain agreed with such a view.

Since then I have lived to see state after state extirpate its wolves. I have watched the face of many a newly wolfless mountain, and seen the south-facing slopes wrinkle with a maze of new deer trails. I have seen every edible bush and seedling browsed, first to anaemic desuetude, and then to death. I have seen every edible tree defoliated to the height of a saddlehorn. Such a mountain looks as if someone had given God a new pruning shears, and forbidden Him all other exercise. In the end the starved bones of the hoped-for deer herd, dead of its own too-much, bleach with the bones of the dead sage, or molder under the high-lined junipers.

I now suspect that just as a deer herd lives in mortal fear of its wolves, so does a mountain live in mortal fear of its deer. And perhaps with better cause, for while a buck pulled down by wolves can be replaced in two or three years, a range pulled down by too many deer may fail of replacement in as many decades. So also with cows. The cowman who cleans his range of wolves does not realize that he is taking over the wolf's job of trimming the herd to fit the range. He has not learned to think like a mountain. Hence we have dustbowls, and rivers washing the future into the sea.

We all strive for safety, prosperity, comfort, long life, and dullness. The deer strives with his supple legs, the cowman with trap and poison, the statesman with pen, the most of us with machines, votes, and dollars, but it all comes to the same thing: peace in our time. A measure of success in this is all well enough, and perhaps is a requisite to objective thinking, but too much safety seems to yield only danger in the long run. Perhaps this is behind Thoreau's dictum: In wildness is the salvation of the world. Perhaps this is the hidden meaning in the howl of the wolf, long known among mountains, but seldom perceived among men.

The Land Ethic

The Ethical Sequence

[The] extension of ethics, so far studied only by philosophers, is actually a process in ecological evolution. Its sequence may be described in ecological as well as in philosophic terms. An ethic, ecologically, is a limitation on freedom action in the struggle for existence. An ethic, philosophically is a differentiation of social from anti-social conduct.

These are two definitions of one thing. The thing has its origin in the tendency of interdependent individuals or groups to evolve modes of co-operation. The ecologist calls these symbioses. Politics and economics are advanced symbioses in which the original free-for-all competition has been replaced, in part, by co-operative mechanisms with an ethical content. . . .

There is as yet no ethic dealing with man's relation to land and to the animals and plants which grow upon it. Land, like Odysseus' slave-girls, is still property. The land relation is still strictly economic, entailing privileges but no obligations.

The extension of ethics to this third element in human environment is, if I read the evidence correctly, an evolutionary possibility and an ecological necessity. It is the third step in a sequence. The first two have already been taken. Individual thinkers since the days of Ezekiel and Isaiah have asserted that the despoliation of land is not only inexpedient but wrong. Society, however, has not yet affirmed their belief. I regard the present conservation movement as the embryo of such an affirmation.

An ethic may be regarded as a mode of guidance for meeting ecological situations so new or intricate, or involving such deferred reactions, that the path of social expediency is not discernible to the average individual. Animal instincts are modes of guidance for the individual in meeting such situations. Ethics are possibly a kind of community instinct in-the-making.

The Community Concept

All ethics so far evolved rest upon a single premise: that the individual is a member of a community of interdependent parts. His instincts prompt him to compete for his place in that community, but his ethics prompt him also to co-operate (perhaps in order that there may be a place to compete for).

The land ethic simply enlarges the boundaries of the community to include soils, waters, plants, and animals, or collectively: the land.

This sounds simple: do we not already sing our love for and obligation to the land of the free and the home of the brave? Yes, but just what and whom do we love? Certainly not the soil, which we are sending helter-skelter downriver. Certainly not the waters, which we assume have no function except to turn

turbines, float barges, and carry off sewage Certainly not the plants, of which we exterminate whole communities without batting an eye. Certainly not the animals, of which we have already extirpated many of the largest and most beautiful species. A land ethic of course cannot prevent the alteration, management, and use of these '*resources*,' but it does affirm their right to continued existence, and, at least in spots, their continued existence in a natural state.

In short, a land ethic changes the role of *Homo sapiens* from conqueror of the land-community to plain member and citizen of it. It implies respect for his fellow-members, and also respect for the community as such. . . .

That man is, in fact, only a member of a biotic team is shown by an ecological interpretation of history. Many historical events, hitherto explained solely in terms of human enterprise, were actually biotic interactions between people and land. The characteristics of the land determined the facts quite as potently as the characteristics of the men who lived on it. . . .

We are commonly told what the human actors in this drama tried to do, but we are seldom told that their

success, or the lack of it, hung in large degree on the reaction of particular soils to the impact of the particular forces exerted by their occupancy. . . .

Plant succession steered the course of history; the pioneer simply demonstrated, for good or ill, which successions inhered in the land. Is history taught in this spirit? It will be, once the concept of land as a community really penetrates our intellectual life. . . .

The Land Pyramid

An ethic to supplement and guide the economic relation to land presupposes the existence of some mental image of land as a biotic mechanism. We can be ethical only in relation to something we can see, feel, understand, love, or otherwise have faith in.

The image commonly employed in conservation education is 'the balance of nature.' For reasons too lengthy to detail here, this figure of speech fails to describe accurately what little we know about the land mechanism. A much truer image is the one employed in ecology: the biotic pyramid. I shall first sketch the pyramid as a symbol of land, and later develop some of its implications in terms of land-use.

Plants absorb energy from the sun. This energy flow through a circuit called the biota, which may be represented by a pyramid consisting of layers. The bottom layer is the soil. A plant layer rests on the soil, an insect layer on the plants, a bird and rodent layer on the insects, and so on up through various animal groups to the apex layer, which consists of the larger carnivores.

The species of a layer are alike not in where they came from, or in what they look like, but rather in what they eat. Each successive layer depends on those below it for food and often for other services, and each in turn furnishes food and services to those above. Proceeding upward, each successive layer decreases in numerical abundance. Thus, for every carnivore there are hundreds of his prey, thousands of their prey, millions of insects, uncountable plants. The pyramidal form of the system reflects this numerical progression from apex to base. Man shares an intermediate layer with the bears, raccoons, and squirrels which eat both meat and vegetables.

The lines of dependency for food and other services are called food chains. Thus soil-oak-deer-Indian is a chain that has now been largely converted to soil-corn-cow-farmer. Each species, including ourselves,

is a link in many chains. The deer eats a hundred plants other than oak, and the cow a hundred plants other than corn. Both, then, are links in a hundred chains. The pyramid is a tangle of chains so complex as to seem disorderly, yet the stability of the system proves it to be a highly organized structure. Its functioning depends on the co-operation and competition of its diverse parts.

In the beginning, the pyramid of life was low and squat; the food chains short and simple. Evolution has added layer after layer, link after link. Man is one of thousands of accretions to the height and complexity of the pyramid. Science has given us many doubts, but it has given us at least one certainty: the trend of evolution is to elaborate and diversify the biota.

Land, then, is not merely soil; it is a fountain of energy flowing through a circuit of soils, plants, and animals. Food chains are the living channels which conduct energy up ward; death and decay return it to the soil. The circuit is not closed; some energy is dissipated in decay, some is added by absorption from the air, some is stored in soils, peats, and long-lived forests; but it is a sustained circuit, like a slowly augmented revolving fund of life. There is always a net loss by downhill wash, but this is normally small

and offset by the decay of rocks. It is deposited in the ocean and, in the course of geological time, raised to form new lands and new pyramids.

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 complex cellular organization. Without this complexity, normal circulation would presumably 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.

When a change occurs in one part of the circuit, many other parts must adjust themselves to it. Change does not necessarily obstruct or divert the flow of energy; evolution is a long series of self-induced changes, the net result of which has been to elaborate the flow mechanism and to lengthen the circuit. Evolutionary changes, however, are usually slow and local. Man's invention of tools has enabled him to make changes of unprecedented violence, rapidity) and scope.

One change is in the composition of floras and fauna. The larger predators are lopped off the apex of the pyramid food chains, for the first time in history, become short rather than longer. Domesticated species from other lands are substituted for wild ones, and wild ones are moved to new habitats. In this world-wide pooling of faunas and floras, some species get out of bounds as pests and diseases, others are extinguished. Such effects are seldom intended or foreseen; they represent unpredictable and often untraceable readjustments in the structure. Agricultural science is largely a race between the emergence of new pests and the emergence of new techniques for their control.

Another change touches the flow of energy through plant and animals and its return to the soil. Fertility is the ability of soil to receive, store, and release energy. Agriculture, by overdrafting on the soil, or by too radical a substitution of domestic for native species in the superstructure, may derange the channels of flow or deplete storage. Soils depleted of their storage, or of the organic matter which anchors it, wash away faster than they form. This is erosion.

Waters, like soil, are part of the energy circuit. Industry by polluting waters or obstructing them with

dams, may exclude the plants and animals necessary to keep energy in circulation.

Transportation brings about another basic change: the plants or animals grown in one region are now consumed and returned to the soil in another.

Transportation taps the energy stored in rocks, and in the air, and uses it elsewhere; thus we fertilize the garden with nitrogen gleaned by the guano birds from the fishes of seas on the other side of the Equator.

Thus the formerly localized and self-contained circuits are pooled on a world-wide scale.

The process of altering the pyramid for human occupation releases stored energy, and this often gives rise, during the Pioneering period, to a deceptive exuberance of plant and animal life, both wild and tame. These releases of biotic capital tend to becloud or postpone the penalties of violence.

This thumbnail sketch of land as an energy circuit conveys three basic ideas:

1. That land is not merely soil.
2. That the native plants and animals kept the energy circuit open; others may or may not,

3. That man-made changes are of a different order than evolutionary changes, and have effects more comprehensive than is intended or foreseen

These ideas, collectively, raise two basic issues: Can the land adjust itself to the new order? Can the desired alterations be accomplished with less violence?

Biotas seem to differ in their capacity to sustain violent conversion. Western Europe, for example, carries a far different pyramid than Caesar found there. Some large animals are lost; swampy forests have become meadows or plow land; many new plants and animals are introduced, some of which escaped as pests; the remaining natives are greatly changed in distribution and abundance. Yet the soil is still there and, with the help of imported nutrients, still fertile, the waters flow normally; the new structure seems to function and to persist. There is no visible stoppage or derangement of the circuit. . . .

The combined evidence of history and ecology seems to support one general deduction: the less violent the man made changes, the greater the probability of successful readjustment in the pyramid. Violence, in turn, varies with human population density; a dense

population requires more violent conversion. In this respect, North America has a better chance for permanence than Europe, if she can contrive to limit her density.

This deduction runs counter to our current philosophy which assumes that because a small increase in density enriched human life, that an indefinite increase will enrich it indefinitely. Ecology knows of no density relationship that holds for indefinitely wide limits. All gains from density are subject to a law of diminishing returns.

Whatever may be the equation for men and land, it is improbable that we as yet know all its terms. Recent discoveries in mineral and vitamin nutrition reveal unsuspected dependencies in the up-circuit: incredibly minute quantities of certain substances determine the value of soils to plants, of plants to animals. What of the down-circuit? What of the vanishing species, the preservation of which we now regard as an esthetic luxury? They helped build the soil; in which unsuspected ways may they be essential to its maintenance? Professor Weaver proposes that we use prairie flowers to re-flocculate the wasting soils of the dust bowl; who knows what purpose cranes and condors, otters and grizzlies may some day be used?

The Outlook

It is inconceivable to me that an ethical relation to land can exist without love, respect, and admiration for land and a high regard for its value. By value, I of course mean something far broader than mere economic value; I mean value in the philosophical sense.

Perhaps the most serious obstacle impeding the evolution of a land ethic is the fact that our educational and economic system is headed away from, rather than toward, a intense consciousness of land. Your true modern is separate from the land by many middlemen, and by innumerable physical gadgets. He has no vital relation to it; to him it is the space between cities on which crops grow. Turn him loose for a day on the land, and if the spot does not happen to be a golf links or a 'scenic' area, he is bored stiff. If crops could be raised by hydroponics instead of farming, it would suit him very well. Synthetic substitutes for wood, leather, wool, and other natural land products suit him better than the originals. In short, land is something he has 'outgrown.'

Almost equally serious as an obstacle to a land ethic is the attitude of the farmer for whom the land is still an

adversary or a taskmaster that keeps him in slavery. Theoretically, the mechanization of farming ought to cut the farmer's chains, ' but whether it really does is debatable.

One of the requisites for an ecological comprehension of land is an understanding of ecology, and this is by no means co-extensive with 'education'; in fact, much higher education seems deliberately to avoid ecological concepts. An understanding of ecology does not necessarily originate in courses bearing ecological labels; it is quite as likely to be labeled geography, botany, agronomy, history, or economics. this is as it should be, but whatever the label, ecological training is scarce.

The case for a land ethic would appear hopeless but for the minority which is in obvious revolt against these 'modern' trends.

The 'key-log' which must be moved to release the evolutionary process for an ethic is simply this: quit thinking about decent land-use as solely an economic problem. Examine each question in terms of what is ethically and esthetically right, as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability, and beauty of the

biotic community. It is wrong when it tends otherwise.

It of course goes without saying that economic feasibility limits the tether of what can or cannot be done for land. It always has and it always will. The fallacy the economic determinists have tied around our collective neck, and which we now need to cast off, is the belief that economics determines *all* land-use. This is simply not true. An innumerable host of actions and attitudes, comprising perhaps the bulk of all land relations, is determined by the land-users' tastes and predilections, rather than by his purse. The bulk of all land relations hinges on investments of time, forethought, skill and faith rather than on investments of cash. As a land-user thinketh, so is he.

I have purposely presented the land ethic as a product of social evolution because nothing so important as an ethic is ever 'written.' Only the most superficial student of history supposes that Moses 'wrote' the Decalogue; it evolved in the minds of a thinking community, and Moses wrote tentative summary of it for a 'seminar.' I say tentative because evolution never stops.

The evolution of a land ethic is an intellectual as well as an emotional process. Conservation is paved with *good* intentions which prove to be futile, or even dangerous, because they are devoid of critical understanding either of the land or of economic land-use. I think it is a truism that as the ethical frontier advances from the individual to the community, its intellectual content increases.

The mechanism of operation is the same for any ethic: social approbation for right actions: social disapproval for wrong actions.

By and large, our present problem is one of attitudes and implements. We are remodeling the Alhambra with a steam shovel, and we are proud of our yardage. 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.