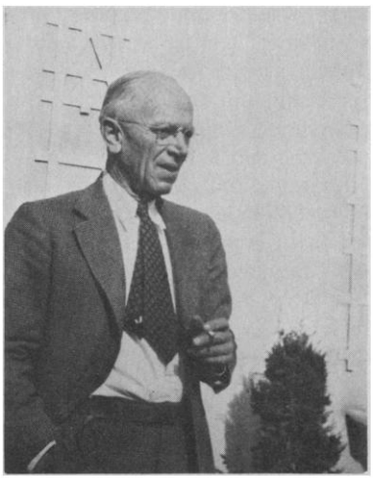
The Leopolds: A Family of Naturalists

Aldo Leopold was a guiding light of the environmental movement; his five children followed him into science

On any bright moonlit December night in the mid-1930's, Starker and Luna Leopold, students at the University of Wisconsin, were likely to be skate sailing on Lake Mendota. The lake borders the north side of the campus and by late fall usually freezes hard, giving the city of Madison a splendid centerpiece of smooth fresh ice. A skate sail is a simple rig consisting of sail cloth attached to a mast and a cross spar. The skater grasps the mast, turns slightly sideways to the wind, and speeds away over the ice at up to 60 miles per hour.

Starker Leopold recalls vividly those cold, bright nights when scores of skate



Aldo Leopold

sails flashed in the moonlight. "We'd play tag," he says. "The lake is 5 miles across, and you'd chase someone to the far side and finally tag him, then look back and all the other sails would be out of sight. But just lean into that sail and start back, and those sails just grew right out of the ice and you'd find somebody else to chase."

Adding zest to the sport was the expansion crack, some 10 to 15 feet wide, that ran down the middle of the frozen lake from Picnic Point to Maple Bluff. Starker reminisces: "As you approached the crack, you'd get up all the speed you could and then turn straight on with the wind and jump. You'd be going fast enough to land 20 feet beyond the far edge. No problem at all." No problem, that is, unless you were still leaning on the sail when you jumped, in which case sail and skater would fall into the near-freezing water. "It obviously was very dangerous," says Luna Leopold, Starker's brother and frequent companion on the ice.

Their mother viewed this sport with an understandable apprehension. But their father, Aldo Leopold, saw it as an interesting technical problem. Dinner talk at the Leopolds was, as Starker remembers it, wide-ranging and fun. He recalls that on one occasion the family talked about "how big a sail could be designed without its ripping to pieces as you sailed across the lake."

There were seven members of the Leopold family: Aldo; his wife Estella; the elder boys Starker and Luna; then Nina and Carl, both high school students; and the youngest, Estella, still in grade school. Perhaps no one suspected it in those years, back in the 1930's, but this was a family of remarkable potential.

Aldo Leopold, an outdoorsman, craftsman, scientist, and skilled naturalist, would later come to be recognized as a pioneer in scientific wildlife management and a profound and eloquent philosopher of the environmental movement, a follower in the footsteps of Thoreau and John Muir.

All five of Aldo's children became passionate and skillful observers of nature. Four of them became professional scientists, and three—Luna, Starker, and Estella—gained election to the National Academy of Sciences, a unique achievement for a group of siblings.*

Aldo impressed some of his own most distinctive traits upon his children. Skill in the exact observation of nature was the chief characteristic he bequeathed. He also gave them an inner assurance that has found expression in their science and in their involvement with issues of public policy.

Each of the Leopold children became a naturalist in his own way. Starker is a zoologist and leading expert on wildlife management. Luna, a hydrologist, is a specialist on the geomorphology of rivers. Carl has won distinction in plant physiology; Estella, in paleobotany. Nina is a botanist and wildlife researcher.

Though now scattered across America, the Leopolds still retain a strong sense of place for the sandy Wisconsin River bottomlands near Baraboo. Here the family acquired an abandoned farm that was gradually restored to health. This is the setting for most of the essays in Aldo Leopold's *A Sand County Almanac*, which became a best seller in the late 1960's and 1970's and established him as a patron saint of the environmental movement.

Born in 1887 in Burlington, Iowa, Aldo Leopold became interested in nature while accompanying his father on hunting trips and learning to "read sign" left by wild creatures. Deciding at an early age that he wanted a career in the outdoors, Aldo took a forestry degree from Yale and landed a job with the Forest Service in Arizona and New Mexico. He became a persuasive advocate of conservation, and eventually was able to convince the Forest Service to designate a half-million acres of the Gila National Forest as roadless, undisturbed wilderness even though his proposal conflicted with the still-dominant conservation doctrine of "wise use" propounded by the Forest Service's first chief, Gifford Pinchot.

Aldo was among the first to promote the then novel idea that wild game can be managed, like timber, as a renewable resource; wild animals, he proposed, can be sustained by improving their habitats, establishing refuges, controlling hunting, and eliminating "varmints" such as wolves and cougars (although later he came to view the war against predators as ecologically unsound and ethically wrong).

Aldo left the Forest Service in 1928 to devote himself to his consuming interest in wildlife. Over the next several years he wrote *Game Management*, which is

*Their closest rivals are the LeConte family. Two LeConte brothers and a first cousin were elected to the Academy in the 1860's and 1870's.

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Nina Leopold and friends at "the shack," the setting for Aldo Leopold's A Sand County Almanac. (Photo by L. J. Carter)

still in print and is regarded as a classic in its field. As historian Susan Flader points out in her study† of the evolution of his ideas, Aldo integrated the new functional concepts of ecology with field observations by himself and other pioneers in wildlife research. Also, his book marked the rejection by serious researchers of the long-dominant notion that abundance of game could be ensured by restricting the kill and controlling predators.

The professorship in wildlife management that the University of Wisconsin created for Aldo was the first such position to be established by any university. In those days wildlife management and ecology were not popular fields, but Aldo inspired his few graduate students to unusual devotion and excellent research, some of it dealing with fundamental aspects of animal behavior and population dynamics. For example, Aldo and his students established the "inversity principle," which states that as a breeding population increases its average productivity decreases.

Aldo not only had his father's gift of "reading sign" of wild creatures; he could also "read the landscape." "He had a way of looking at a landscape and telling you its history and its future 50 years hence," says Robert A. McCabe, a student of Aldo's who succeeded him as chairman of the department of wildlife management that he established. "He was an exceptionally observant field man. I always tried to stay near him in the field so I could hear what he was saying."

Aldo exerted the same fascination on his children. As a family friend observes, "He had this amazing courtesy to the young. You felt intelligent talking to him because he was so attentive and respectful of your ideas." For the children, Aldo was a naturalist, teacher, and master craftsman who impressed them by what they speak of as their father's quiet assurance and gentle example.

"Starting when I was 5," says Starker, "Dad and I used to go down to the Rio Grande River on his bicycle, with me seated on the handle bars. I don't remember talking land ecology at the age of 5, but it wasn't very damned long after that that he would stand out on the hillside and talk about why quail were in one place and not another, or why ducks preferred a particular pond because of some food he recognized in the water." But Aldo usually began by asking Starker what he thought. "He treated us with considerable dignity—I suppose that had as much as anything else to do with our being so intensely interested in what he had to say," Starker says.

Estella, Aldo's wife, was devoted to him and was for the children "the amplifier of a lot of what Dad was thinking and doing," says Carl Leopold. She joined in many of Aldo's outdoor activities, and even became Wisconsin's champion woman archer after Aldo took up bow hunting and target shooting.

Aldo was a superb craftsman. Luna remembers the duck decoys that his father made during the winter months in Albuquerque as "beautiful works of art." "Dad was a real perfectionist," Luna says. "He made a yew bow and 24 arrows that had a flatter trajectory than any of us had ever seen before or since. It shot point black at 100 yards. Boy, that was a piece of equipment."

Inspired and encouraged by their father's example, all the Leopolds became craftsmen. At Christmas, it was their custom to exchange handmade gifts. "The tradition was that, if you did it by hand, it was good," says Luna, who still counts as a prized possession a fly rod that Starker made for him years ago. Luna thinks this emphasis on craftsmanship helped prepare him and the others to become scientists. "Science is a craft," he says.

As the Leopolds reached high school and college age, they were allowed a voice in family decisions. Luna recalls that at the age of 15 or 16, his father asked him to go out and select a new family car. "He really meant it when he said, 'you take the responsibility, and go do it.' "

But Aldo never pushed his sons and daughters to be high achievers in school. Estella says that in her sophomore year in high school she went into a bad slump, then pulled out of it, all without her father taking much notice.

Starker, discovering "booze, women, and fraternities" as a freshman at Wisconsin, flunked out, then—without his father ever intervening—talked his way back in after 2 years in exile with the Soil Erosion Service. He says that the closest his father came to remonstrating with him was to invite him occasionally for a quiet lunch at the faculty club and gingerly bring up the sore subject, always beginning, "Starker, your mother is worried about you. . . ."

The deserted sand county farm, near Baraboo and 50 miles north of Madison, became a favorite place of retreat for the Leopolds. Situated on the Wisconsin River, the farm was worn out and had no standing building except an old, manure-filled stable. But when this modest structure was cleaned out and rebuilt it became the family's beloved "shack."

Weekends at the shack were taken up with planting thousands of white pines, restoring native prairie grasses, trapping and banding birds, cutting firewood, and sports such as swimming, canoeing, and hunting. In the evenings there was singing and guitar playing.

The more intimately the Leopolds came to know the farm—the more woodcock nests they found, the more trees, shrubs, and grasses they planted, the more chickadees and sparrows they banded—"the more they found to anticipate, to ponder, to marvel at," says Susan Flader, who, in examining the family journals of their visits to the farm, found an exponential increase in recorded observations over the years.‡

"Dad was interested in all parts of the

†*Thinking Like a Mountain* (University of Missouri Press, Columbia, 1974).

‡*The Sand County of Aldo Leopold*, a photographic interpretation by Charles Steinhacker, with an essay by Susan Flader (Sierra Club, San Francisco, 1973).

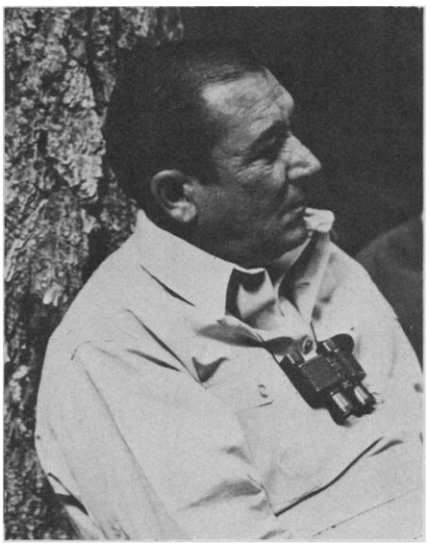
landscape, and this was his gift to us," Luna says. "If you look at the kinds of things we have done, you'll see we are interested in the vegetation, the mammals, the soils, the topography, the hydrology, the meterology, the whole gamut of things."

Of all the Leopolds, Starker had perhaps the closest relationship with his father and his career parallels Aldo's more closely than do the careers of the others. As youngsters, he and Luna were always ready to go along with their father on hunting trips, and when he could not take them both, they would draw straws. "If I won, fine. If Luna won, then I would trade him out of it with one thing or another. Every damned thing I had except my pocket knife," Starker recalls. "So I had the advantage of sitting around campfires with dad most of my early life."

Starker's decision to pursue a career in wildlife biology and management came early, even before his father established a wildlife program at the University of Wisconsin. For his Ph.D. at Berkeley, it was the heritability of wildness in turkeys that he chose as the subject of his thesis. As Starker tells it, "I was working in the Missouri Ozarks and my primary assignment was to bring back the wild turkey, which was damned scarce at that time. The state had a game farm and was releasing a good many hundreds of birds on refuges every year, but the turkeys just disappeared. So I began to ask myself, Are these really wild turkeys at all?"

Relying on a few hillbilly friends and his own naturalist's eye to locate a wild turkey nest, Starker stole the eggs and had them incubated at the game farm. Sacrificing these newly hatched wild chicks, he found that they had larger brains and adrenal glands than did domesticated or hybrid turkeys. Starker learned that on the game farm, the tamer birds had a breeding advantage over the wild turkeys, but their offspring were not suited to survival in the wild. Influenced in part by Starker's research, most state game departments abandoned their game farms and put their efforts into stocking promising habitats with wild turkeys trapped in areas where they are plentiful. This management strategy was successful and turkeys began making a strong comeback.

Later, Starker was caught up in a deer management controversy in California strikingly similar to one in which his father was involved in Wisconsin. Aldo was called a "Bambi killer" and worse by Wisconsin hunters because of his efforts to have the state conservation commission, of which he was a member, permit controlled shooting of does and thus reduce the deer herd to a sustainable level. As in Wisconsin, deer habitat in California was being overbrowsed and damaged by an excessively large herd, and Starker's recommendation calling for the hunting of does as well as bucks met with just as strong a reaction as the one his father had had to face. "I was practically hung in effigy," he recalls. "Now they are doing it [shooting does], but an awful lot of carrying capacity was lost by carrying too many deer too long."

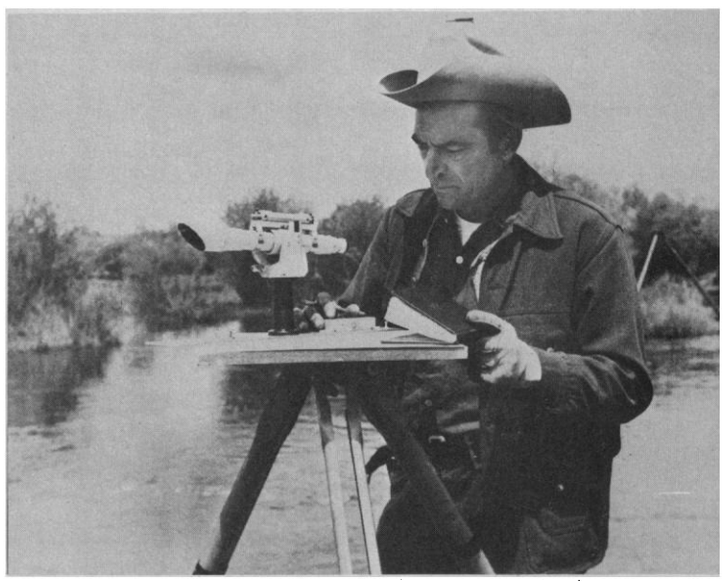


Starker Leopold

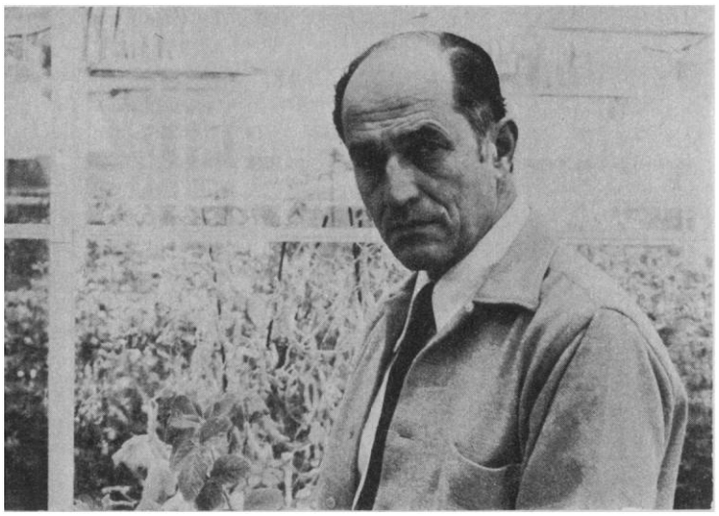
Luna's interests in environmental science took a different form from those of Starker and his father. His specialty was to be observing and predicting the behavior of rivers. He eventually earned a Ph.D. in geology at Harvard, then joined the U.S. Geological Survey, becoming chief hydrologist in 1957. With a colleague, Tom Maddock, he developed a new theory of "hydraulic geometry." They discovered that there are four characteristics of a stream—depth, width, velocity, and the suspended load of sediment—which are interrelated in such a way as to represent a predictable system.

This discovery had significant practical implications. It meant that water project agencies such as the Bureau of Reclamation and the Corps of Engineers would be able to predict and—through design features, influence—the shape and behavior of stream channels. In the mid-1950's, Maddock persuaded the Bureau of Reclamation to apply this new predictive technique in Wyoming on Five Mile Creek, which was rapidly eroding its banks and contributing most of the sediment that was threatening to silt up Boysen Reservoir on the Big Horn River. For less than a half-million dollars, the bureau reduced the volume of sediment entering the reservoir by 80 percent, and in so doing made hydraulic geometry something of a religion among its engineers.

According to Maddock, Luna is much less the theoretical scientist than he is the practical field observer and analyst. "He is a tremendous individual for collecting, analyzing, and synthesizing information," says Maddock. One piece of field research in which this gift for field observation was particularly manifest had to do with explaining the tendency of rivers to meander. He had noticed that even along relatively straight stretches of a river, the channel itself is often sinuous. The similarity of this phenomenon to full meandering led him to speculate that the same mechanism that causes meanders must also be at work in straight channels. Then, to his surprise he discovered from measurements which he made on a small river in Wyoming



Luna Leopold



Carl Leopold

Photo by L. J. Carter

that the river's gradient, or rate of fall, was steeper and more uniform in a long meandering reach than in a straight reach. This meant, Luna inferred, that by meandering the river achieves a more uniform expenditure of energy, even though it expends more energy in following the curved (and longer) path. His thesis was, in brief, that meanders are "the form in which a river does the least work in turning and hence are the most probable form a river can take."

Luna has been involved as a technical adviser in furious disputes over such issues as allocation of Colorado River water, plans for a south Florida jetport, and construction of the trans-Alaska oil pipeline. In the spring of 1969, he was asked to look into the latter project before the Interior Department issued a permit for it. He flew the length of the pipeline route and was appalled at the possible consequences of laying a hot oil pipeline in Arctic and subarctic terrain, and his report to his superiors warned of a costly failure and environmental mess.

Later, Luna was shown a massive planning document for the pipeline project. "I took the top file and turned it over to see what kind of cross section they had, how they were going to build the pipeline," Luna recalls. "The cross section, you wouldn't believe. It showed a round pipe, with gravel underneath and gravel on the top, and that's all. No dimensions, no nothing. I said, Look, this is absolutely ridiculous. You mean you haven't even thought how the construction is going to change when you go from permafrost to frost action and river crossings. I said, that's all I want to know. I told the director's office, These guys really haven't thought about the problem at all. The permit should not be granted. And it wasn't, not for another three or four years."

In their careers as environmental scientists, Carl and Estella turned toward plants. When Carl entered graduate school at Harvard he planned to plunge into the infinitely complex world of plant ecology but then switched to the more manageable field of plant physiology. Estella, the youngest of the Leopolds, decided in her teens to choose a different field of science from all her siblings and told her father she was going to become an entomologist. But Aldo gently steered her away from insects to plants, she recalls. "He said, 'Oh, I always meant to buy you a botany book, a hand lens, and a plant press. How about our going down Monday, and we'll do this.' " Later, as a graduate student at Yale, Estella turned to palynology, the study of fossil pollen.

Carl went to Purdue University and took up research on the regulation of plant growth, and within 6 years was a full professor and was becoming widely known. One of his major interests was plant senescence, the process by which all annual and biennial plants die in a programmed manner and at a predictable time. Carl and his colleagues confirmed that senescence is associated with reproduction and hormonal change. Their research represented a step toward what may someday be the discovery of a practical way to delay, by chemical means, senescence in plants such as wheat, oats, and barley which in some years may die before the seed heads are completely filled.

Estella Leopold

Photo by L. J. Carter

Carl served for a time in the mid-1970's at the National Science Foundation as a senior policy analyst on food and agriculture and helped set up the National Academy of Sciences' study of the world food problem. Then, in a career move that his brother Starker says was "very, very foolish," Carl left NSF to become graduate dean at the University of Nebraska. "Carl isn't any dean," Starker says. "He likes to work with plants. He is not interested in giving speeches and throwing his weight around. That didn't work at all. But then this very nice opportunity at Cornell came along, thank God."

Carl was hired as a distinguished scientist at Cornell's Boyce Thompson Institute for Plant Research. There, he is one of the leaders of a research program on plant stress, which the institute is emphasizing because development of more stress-tolerant food crops could help relieve world hunger.

Estella, after receiving her Ph.D. in 1955, joined the Geological Survey and spent the next 20 years at the Survey's paleontology and stratigraphy laboratory in Denver. Although perhaps better known as a conservationist than as a scientist, her scientific work and some of her work as an environmental activist have been closely related. In particular, her early studies of the evolution of Rocky Mountain flora from fossil pollen samples led to the possibly critical role she played in the successful campaign to save Colorado's florissant fossil beds.

Recognized the world over as one of the great treasures of paleontology, the fossil beds lie about 100 miles southwest of Denver in a high, narrow valley on the western slope of the Rockies. They were formed some 35 to 40 million years ago, during the Oligocene, when clouds of volcanic ash rained down on the lake that once ran the length of the valley, burying insects and plant foliage characteristic of that then subtropical region.

When the National Park Service in 1962 decided to preserve the fossil beds as a national monument, Estella was

asked to identify the richest beds and help delineate the boundaries of the proposed park. But bills establishing the park failed to pass Congress in 1963, 1965, and 1967, and meanwhile developers were encroaching on the park with recreational subdivisions.

Estella, already a leader in environmental causes, decided to take the matter in hand. She and a colleague invited Gordon Allott, then a U.S. senator from Colorado and ranking Republican on the Interior Committee, to visit the fossil beds. They took Allott down in an arroyo and began showing him fossil leaves, from ancient walnut and sequoia-type trees. "He just got intrigued," Estella says. "He went back to Washington and drafted a new florissant bill, then [in the next Congress] got it through the Senate lickety split." Later, the Defenders of Florissant, Inc., a group which Estella and some other scientists and environmentalists had formed, went to court and stopped the subdivision developers' bulldozers long enough for the legislation to become law.

Aldo Leopold died of a heart attack in 1948, at age 62, while helping a neighbor fight a brush fire. But his influence is greater today than ever, because with the environmental awakening of the late 1960's *A Sand County Almanac* found hundreds of thousands of new readers. Starker is now a professor emeritus at Berkeley but he still gets out in the field as the researcher and ardent outdoorsman his father taught him to be. Luna left the Geological Survey some years ago and is a professor of geology and landscape architecture at Berkeley. Carl is at Cornell and Estella is at the University of Washington, where she heads the Quaternary Research Center.

Coming Home

The shack and the Leopold farm on the Wisconsin River is in a sense the family shrine, and Nina Leopold and her husband Charles Bradley are the keepers of that shrine, although they regard themselves as only conscientious stewards and observers of the modest and once-abused landscape that Aldo restored to health.

Nina returned to Wisconsin in 1976 after a long absence. In 1940 she married William H. Elder, a mammalogist and wildlife specialist now at the University of Missouri. Over much of the next three decades, Nina took part in Elder's research, on subjects such as lead poisoning in waterfowl, the role of family groups in the formation of goose flocks, and the life history of the waterbuck in Central Africa.

Nina Leopold

Photo by L. J. Carter

In the late 1960's, however, her marriage to Elder broke up. A few years later, in 1971, she married Bradley, a geologist and old family friend. The marriage ceremony that took place at the shack one August afternoon was a grand homecoming for all the Leopolds, and was a most unusual affair.

The wedding party canoed some 10 miles downstream to the shack, where the wedding took place about 5 o'clock. Luna read "Great Possessions," one of the family's favorite essays from *Sand County*. It begins: "One hundred and twenty acres, according to the County Clerk, is the extent of my worldly domain. But . . . it is a fact, patent both to my dog and myself, that at daybreak I am the sole owner of all the acres I can walk over. It is not only boundaries that disappear, but also the thought of being bounded. Expanses unknown to deed or map are known to every dawn, and solitude, supposed no longer to exist in my county, extends on every hand as far as the dew can reach."

Eyes misted up at the recollection of Aldo seated on a bench before daybreak, notebook in hand, coffee pot near, recording the sequence of birdsongs, first that of the field sparrow, then the robin's, the oriole's, the indigo bunting's, and the wren's. Carl played his guitar and Estella sang "The Cottonwood," a song of her own composition about a venerable 100-year-old tree.

Several years later the Bradleys moved permanently to the Wisconsin farm and built a home there of logs from white pines the Leopolds had planted in the 1930's. Part of their home serves as a study center for Leopold Reserve, which is made up of some 1200 acres whose various owners have agreed by covenant to preserve the land in memory of Aldo. An Aldo Leopold Fellowship program brings several students to the reserve each summer to do research, usually in ecology. Nina is tending, on a 3-acre plot, her own research on restoration of native prairie grasses.

The other Leopolds return to the farm and the shack regularly, stopping by for a few days every year. The old times from the 1930's are relived. There are always projects, cutting wood, planting trees, and the like, and a lot of quiet walks. The river trail between the Bradleys' new home and the shack is a favorite; from prairie meadows it passes by potholes, a big marsh, and winds through the aspen and alder thickets along the river where one always sees deer tracks and may hear the alarmed squeal of wood ducks flushing from the river sloughs.

The shack is the place to understand the Leopolds as people and as scientists, for symbolically, and even literally, it is for them a place of emotional and spiritual nourishment and renewal. It provides a sense of continuity, a link between them and the past, and between one another.

Like their father, all the Leopolds show a respect for nature that has at once an intellectual, emotional, and—although none of the Leopolds belongs to any faith—religious dimension. All share the sentiments and beliefs expressed by Aldo Leopold in his *Sand County* essay "The Land Ethic," which says, "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."

All of the Leopolds learned early, from their father, to find both joy and fascination in nature. From this, and from the sense of great caring Aldo imparted, has come the dedication to their work in science as well as a sense of assurance and fulfillment.

—LUTHER J. CARTER