

This excerpt from the forthcoming book Hemlock: A Forest Giant on the Edge, by David Foster, director of Harvard Forest, explores the work of Robert Marshall, the famed forester and cofounder of the Wilderness Society, during his time in graduate school at the Harvard Forest. Marshall's ecological understanding of hemlock drew heavily upon forest history.

LESSONS FROM HARVARD FORESTS AND ECOLOGISTS

BOB MARSHALL'S PLOT

The letter was dated April 21, 1924. The recipient—a young man of means and extraordinary ability—was about to graduate from forestry school at Syracuse University. The writer—the director of Harvard's graduate forestry program—lay before his prospective student a remarkable opportunity.

"My dear Marshall," the letter began:

Al Cline gave me your article about the Adirondack Forest Preserve, and I have read it with entire sympathy and agreement. There is no argument about the proposition that to furnish the highest kinds of enjoyment a forest should be left strictly alone. With so little real primeval forest now left, sparing the remnants that still exist in the Adirondacks does not seem too much to ask.

Your argument gave me a thought about a project, which I have long had in mind, and which might interest you for your investigative work next autumn at Petersham [Massachusetts]. Not far from there is at least one considerable tract of virgin forest

which is gradually being cut in small areas. How would you like to make a detailed study of the origin and maintenance of the virgin forest, with special reference to what might be called the chronological order in which the several species and elements of the stand came in? This sort of study I think will be very useful as a background for the forest management of the future, and unless we make it soon the opportunity will be gone...

Very truly yours,

Richard T. Fisher¹

BY DAVID R. FOSTER



COURTESY OF THE HARVARD FOREST

Bob Marshall (center) with Harvard Forest researchers at the Adams Fay lot experiment in 1924. Faculty included Rupe Gast (second from left), Al Cline (with machete), and Richard Fisher (far right).

When Bob Marshall rejected Richard Fisher's offer to study the ancient old-growth white pine and hemlock forest on Pisgah Mountain in New Hampshire, the Harvard Forest director must have been dumbfounded. But, however surprising the decision was, given Marshall's already clear passion for wildland forests, the choice was consistent with the young man's life plan. Ironically, the alternative path that he followed as a graduate student—working on a timber harvesting study—led to a research approach that others would later apply successfully at Pisgah. Marshall's work also did as much as any study to reinforce Fisher's belief in the value of forest history to ecology and scientific forestry.

Marshall's answer shocked Fisher because the professor had every reason to expect that his new graduate student from Syracuse University would be enthralled to spend his days amidst the ancient trees in the rugged New Hampshire landscape. Through their prior meetings and correspondence leading up to his acceptance in the graduate program at Harvard, Marshall had shared with Fisher many thoughts on forestry, conservation, and the value of forest reserves. In his essay on the Adirondack Reserve for a course in silviculture, Marshall had stated that the "finest formal parks, the most magnificent artificially grown and cleaned woods, can not compare with the grandeur of the primeval woodland. In these days of over civilization it is not mere sentimentalism which makes the virgin forest such a genuine delight." The paper had earned the eager and innovative student an A, along with a

measure of scorn from some in the more timber production-oriented sector of the forestry school.

Moreover, Fisher knew a bit about Marshall's extraordinary background as the son of one of the leading civil rights attorneys in America, a prominent man in New York's Jewish community, who fought to protect the poor, the immigrant, and the defenseless in venues ranging from the local courthouse to the U.S. Supreme Court. Among the defenseless and voiceless clients championed by Louis Marshall was nature. Through the years while visiting his spectacular Adirondack camp, Louis had witnessed the devastation driven by greed and wrought by ax and fire to the lakeshores and mountain slopes of upstate New York. Impassioned by these insults to the environment, armed with knowledge derived as a founder, major funder, and board chair of the New York State College of Forestry at Syracuse University, and equipped with an orator's skill and expansive legal mind, he had championed the defense of one of the most important conservation documents in America—Article Seven of the New York Constitution. This legal document included the "forever wild" clause that made the Adirondack State Park the first designated wilderness in the country and protected its land from further logging. Fisher certainly knew that Bob Marshall had wild forest running in his veins.

Fisher also had keen reasons for disappointment. Marshall showed the potential for greatness, graduating near the top of his class with a degree in forestry from Syracuse in 1924 and supported



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Bob Marshall (right) and fellow students with their field vehicle at the Adams Fay lot in 1924.

by rave recommendations from his professors and dean. Fisher was keen to get real scientific research initiated at Pisgah, and this new candidate promised to bring considerable woods skills along with proven writing and computational abilities. Since the successful campaign to purchase and protect the ancient forest, Fisher had conspired with John Phillips, a national leader in forest and wildlife conservation, to establish a small endowment to pay the annual taxes on the tract and support a scholarship for research into the history, dynamics, and ecology of the old-growth forest. Though the fund was growing, its income remained inadequate to cover the desired field studies. But Marshall had means; he was the sole member of the incoming class at the Harvard Forest who took no salary and required no scholarship. He could freely attach to any project and might jump-start the old-growth effort. And, he had one last trait that augured success in the rugged and remote New Hampshire mountains. Bob had a passion for hiking and a knack for navigation. With brother George and guide Herb Clark, he was well on his way to becoming the first of the “46ers”—individuals who had reached the summit of each of the forty-six Adirondack peaks exceeding 4,000 feet. Marshall’s fanaticism for distance hiking was already well established and his life list of twenty-, thirty-, and forty-mile treks was lengthy and growing. Bob would not need any hand-holding in the confusing topography around Pisgah Mountain. The match between the man and the Harvard Forest’s newest project seemed perfect.

A WELL-DEFINED LIFE PLAN

Yet, unbeknownst to Fisher, by age nineteen Bob Marshall had already developed a remarkably well-defined life plan and one that did not allow for wilderness studies at Harvard. His scheme had emerged in general terms on trips to the family’s Adirondack camp and had been first articulated in the starkly simple prose of a high school writing assignment. Over the years the plan was honed through endless letters and discussions with his father and became elaborated into a well-defined course of action. As he had written in that high school essay, more than anything else Marshall wanted to be a forester. As passionate as he was about wilderness, he had precocious insight; he recognized that society had a more pressing immediate need, one made clear from the vistas he gained atop nearly every Adirondack mountain peak. The United States needed to learn to manage its forests better and more sustainably in order to generate a renewable supply of a precious commodity and to protect the associated resources of water, wildlife, and human well-being. Marshall also understood keenly that society would be willing and able to carve large wilderness areas out for protection only if the bulk of the country’s forestland was productive and well managed. Finally, he was his father’s son, deeply earnest in his pursuits, beholding to an ethic of work, responsibility, and caring for the neglected, and already emerging as an insightful, strategic, and politically minded thinker. He recognized that his greatest hope of working the system for good and of advancing the cause of wilderness and all that was abused by society would come from a powerful platform within that system. He was not about to veer off headstrong into a wilderness campaign. And, he was not going to fritter away his hours alone in the woods simply figuring out how nature operated. Bob Marshall never delved into casual pursuits. When he hiked at his blistering pace, he always chased a destination, a distance goal, and a personal milestone. He was no sauntering Thoreau who mused over plants, scenery, or natural history.

No, Marshall’s decision to attend graduate school was shrewdly calculated to advance his life goals; his thesis project would fit that grand scheme and position him for a job in the world’s pre-eminent forestry institution—the U.S. Forest Service. It would focus on forestry and advance his expertise in silviculture and systems of tree harvesting, areas in which his background was thin and Fisher’s expertise was already legendary. It would also base him in Petersham, where he could benefit from association with other students, faculty, and the frequent visitors from other universities, state agencies, the Forest Service, and Europe who appeared on the doorstep of the Harvard Forest headquarters and shared their stories and camaraderie in the small Forest community. There the stream of conversations would advance his knowledge and broaden the web of contacts that he could draw upon for the rest of his life. Through this path, Marshall sought to build on the foundation he had established at home in Manhattan, at Syracuse, and in the Adirondacks to reach a prominent rank in national forestry. Once there he could achieve the multiple goals that inspired his daily and lifelong efforts: promote good forestry and resource use, advance the cause of wilderness, make a difference to society and nature, and live up to his father’s expectations. To reach that elevated platform, he needed skills, credentials, and connections.

Louis Marshall’s reputation and the family’s place in society ensured strategic and powerful connections; adding Harvard to this arsenal was a significant step, and the younger Marshall clearly

planned to utilize his year in Petersham and Cambridge effectively. The four years of classes at Syracuse, summers at the university's Cranberry Lake Ranger School, and a top score on the civil service exam guaranteed him a posting with the U.S. Forest Service that might be improved through strategic graduate work. A detour through Harvard would produce more options and connections and ultimately lead to a more rapid trajectory through the agency. As he wrote to his father in one of their near daily exchanges, "It is generally considered that advanced training will lead to greater opportunities and a faster pace through the forest agency. Harvard is the best place in the country to get that training along Silvicultural and Management Lines...and Fisher...is generally recognized as the foremost silviculturalist in the United States."

Once there, Bob just needed to capitalize fully on the assets represented by the university, Richard Fisher, and the Harvard Forest. With a solid forestry project, perhaps crowned by a publication, he could get on with his life's ambition. In recent months he had mulled over these topics endlessly with friends, Syracuse faculty, and even the dean. But, from the correspondence that they had maintained since the death of Bob's mother, it was clear that for both father and son, the project at Harvard was much more than a single study. Great as Pisgah and the old-growth topic may have been, the project was not the goal. Rather, it was the means and one more deliberate building block toward future success.

All of this is not to say that the year at the Harvard Forest was spent in single-minded and somber pursuits or that the young forester did not develop a passionate love for the place, the people, and his experience. Quite the contrary. As he put it in a letter home to his father, "[Y]ou will note that everyone except the Director is a Syracuse man. Six of us live together in a very large old farmhouse which also contains the office. We have more room than we know what to do with. For once I think there will be plenty of room even for my junk. I have a tremendous writing table 6 x 3, a typewriting table, dresser, closet and limitless floor space all to myself. We cook our own meals which are therefore uniformly excellent, far better than the regular restaurant hash."

In Petersham, Marshall bunked and enjoyed countless exploits with his closest college chum, Neil Hosley. He forged lifelong friendships with faculty members Al Cline and Rupe Gast and fellow students. He also emerged as both the prankster wit of Community House and the grand chronicler of all of their exploits and accomplishments, all the while ratcheting his career forward and maintaining a daily stream of letters home. The experience also left an enduring appreciation for the "sagacious wisdom" and kindness of R. T. Fisher. From his extracurricular writings and the impish grin adorning his mug in nearly every photo, Marshall thrived in the close community of foresters in Petersham. This mixture of companionship and humor emerged in many realms, including the acknowledgments in his thesis.

I am also much obliged to Messrs. Arthur Davis, Fred Goulet, and Otis Goulet for their cooperation while felling timber. It was necessary to study the stumps on several sample plots while the timber was being cut. The three choppers went to considerable trouble to avoid dropping trees on me while I was engaged in this work.²

Marshall's curious personal habits of self-evaluation and documentation attest to the importance of his year with hemlock and Harvard. Annually, beginning in 1928 when he was 27 and continuing until his sudden death in 1939, Marshall systematically

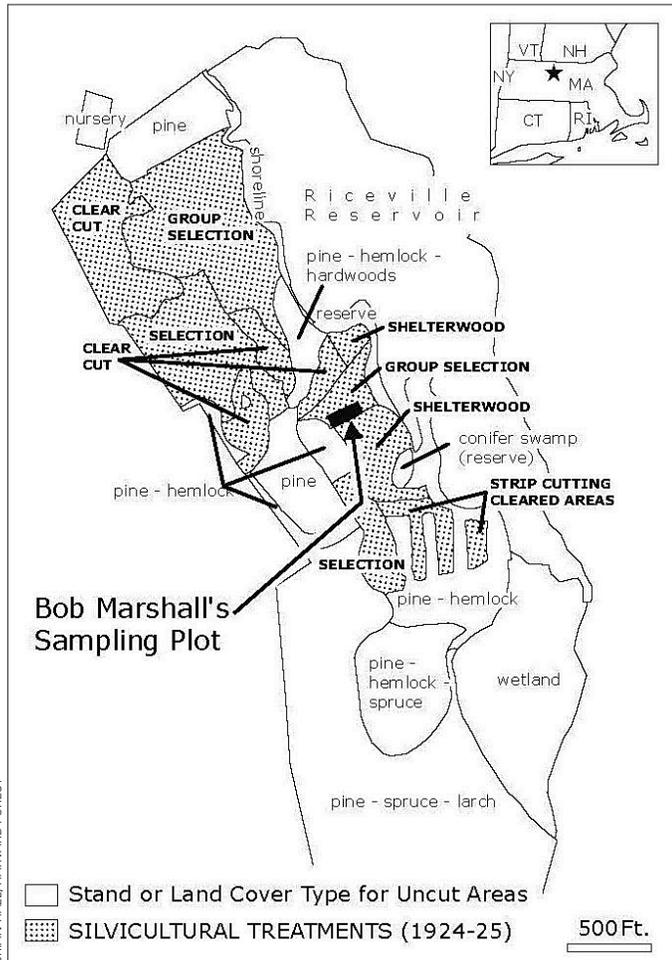
reevaluated his place in life through a series of life lists of "favorites" that he maintained in almost every conceivable category—friends, books, months, places, professional men, women, authors, and more. His favorite "causes" at his death as enumerated in this life list, as well as in his will, were the Wilderness Society, union labor, the advancement of American Indians, and the Harvard Forest. Indeed, Marshall regularly ranked the Harvard Forest, Professor Fisher, and those summer months of fieldwork alongside students, faculty, and the Harvard Forest Woods Crew at the very top of his life list. This is all the more remarkable given the breadth of experience that this determined man was able to cram into his short life. He grew up in Manhattan, explored Alaska's Brooks Range thoroughly, lived with northern Indians and Eskimos, and hiked the wild mountains of the West vigorously; throughout his life he made a point of searching out and meeting Supreme Court justices, Civil War generals, great scientists, and scholars; and he worked alongside the likes of Hart Merriam, Gifford Pinchot, Aldous Murie, and Aldo Leopold. But every January in his adult life when Bob sat back to wrack his brain and rework his hand-scrawled life lists in order to update them with the most recent year's experience, his mind faithfully returned to Petersham. There, in a project focused on logging and hemlock, he bonded with a team of men from many different walks of life and was inspired by a bespectacled gentleman who shared his love for the wild and its lessons for conservation.

THE GRANDEST OF EXPERIMENTS

Marshall's project was part of the grandest of the large long-term experiments that Richard Fisher established, one that is a magnificent precursor to the large, long-term manipulations that constitute the Harvard Forest Long Term Ecological Research program today. Following Fisher, we now undertake 50-year projects, such as pulling down two acres of forest to simulate a hurricane, warming the forest with miles of heating cable in the soils to mimic climate change, spraying nitrogen onto acres of pines and hardwoods to simulate the effects of increasing acid rain, and alternately girdling or harvesting hemlock to contrast the effect of an insect infestation with that of salvage logging.

In the design of his big forestry study, Fisher sought to contrast the ecology of hemlock and white pine and evaluate the effectiveness of different ways of promoting each of these species through logging. Although these two dominant conifers are similar in their longevity and abundance in old-growth forests, they contrast strongly in their growth rates, shade tolerance, and timber value. The study sought to investigate whether it was possible to purposefully manipulate their growth and relative abundance by harvesting the stands in very different ways.

By coincidence, the site the Harvard group selected for the experiment in that summer of 1924 belonged to the New England Box Company, whose owners—the Dickinson brothers—were already thick in negotiations with Fisher over the sale of the Pisgah tract. The so-called Adams Fay parcel, named for previous owners, adjoins the Tom Swamp tract of the Harvard Forest and occupies an extraordinary site, a flat outwash plain that was thickly and rather uniformly covered with hemlock and pine. The remarkable homogeneity of the sandy site was ideal for experimentation because it allowed nearly identical plots to be assigned to different harvesting treatments for comparison with each other and with additional plots that would be left intact and unharvested as controls. The treatments covered the range of common commercial



The Adams Fay lot of the Harvard Forest showing the layout of the large experiment with its many types of harvests. The plot that Marshall dissected in detail is blackened in the center of the area.

logging practices along with some experimental approaches.

This project actively engaged Richard Fisher and senior scientist Rupe Gast, a brilliant though eccentric quantitative ecophysicist. The tree felling, hauling, and associated work was all undertaken by the Harvard Forest woods crew, assisted by the graduate students and supervised by the faculty. Al Cline was newly hired as lecturer and straw boss, having just received his own graduate degree from Syracuse, a convenient decision given that the incoming graduate students were all from his former department.

Marshall dived in with the group, contributing to diverse aspects of the experiment, from laying out plots, measuring timber volumes, and marking trees to hauling cordwood and burning brush. But his separate project also played a key role in framing the larger study. Marshall sought to document hemlock's growth patterns and its unique ability to hunker down for decades in the deep shade, eking out an existence and barely growing, and then to capitalize on the death of surrounding trees with a burst of new growth. Though ultimately focused on hemlock, Marshall began by comprehensively dissecting all the trees on his eighty-by-two-hundred-foot plot to shed light on the history of the entire forest. Fisher and his colleagues used these initial insights to expand their understanding of the differences between pine and hemlock and sharpen their hypotheses concerning how the forest would develop following each of the different treatments.

Although Fisher may have been accustomed to applying his natural history skills to interpreting the long-term history of the forests that he studied, Marshall took the art of forest reconstruction and refined and formalized it to the level of science. In his efforts, Marshall was guided closely through regular meetings with Fisher, daily exchanges with Cline in the woods and dorm where he lived with his fellow students, and intense strategy discussions with Rupe Gast. Gast devoted extensive time to providing the young student with the background in the physics, meteorology, and electronics he needed to evaluate the environment and growth of plants. (In later years, Gast came to exert a major influence on Marshall's decision to attend Johns Hopkins University for his doctoral work and on his thesis research on the growth and physiology of spruce at treeline in alpine Alaska.) Marshall also benefited from daily exchanges beneath the conifers with the Harvard Forest woods crew of veteran loggers and farmers, who shared great depths of local knowledge. Through the process of working out the history of the Adams Fay area, Marshall developed, refined, and unified all the major steps to forest reconstruction that were subsequently applied by generations of Harvard Forest students.

The scientific approach to forest history that emerged that summer was remarkably straightforward: scour the landscape for every scrap of information from living and dead plant material, the soil, human artifacts, and the local topography, and then integrate this with information from more typical historical sources, such as interviews, newspapers, census data, correspondence, deeds, and other records. Marshall systematically dissected the forest applying these diverse approaches. He cored trees and sectioned decaying logs to establish tree ages and growth records; he examined uprooted mounds and moss-covered stumps and attempted to reconcile these clues on past disturbances with his tree records; and he ferreted through archives, libraries, and notes from interviews with previous owners and loggers to provide context and fill in gaps in the story emerging from the woods. Every evening, save the few that they spent at movies in the adjoining mill town of Athol or on Bob's infrequent trips back to Manhattan, he sat alongside the others at two lengthy tables in the large living room of the Harvard Forest headquarters and dorm, compiling notes, computing figures, or chatting about work, life, and their futures.

The 1927 publication of "The Growth of Hemlock before and after the Release from Suppression" in the *Harvard Forest Bulletin* earned Marshall a footnote in the history of science. But his failure, and that of his mentors to document the approach he developed and its value to ecology and conservation, is a stunning lapse by someone so focused on fame and his career. It would be a half-century before two articles in the journal *Ecology*³ exposed the science world to the field and laboratory methods developed by Marshall and employed ever since by Harvard researchers to reconstruct nature's history. Those papers brought historical ecology into the limelight and earned it a solid place in the discipline, but even their authors appear to have been unaware that the techniques had been forged in the Petersham woods on what we now call the Bob Marshall plot.

Marshall's efforts resulted in a comprehensive chronology of tree growth and response to wind and repeated harvesting. As revealed in the opening of his *Harvard Forest Bulletin* article, Bob Marshall relished this trip back in forest history and his newfound ability to extend the record back before the area's colonial settlement.



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The Harvard Forest Woods Crew during the experimental harvest on the Adams Fay lot (1924). From left: Harry Upham, Rodney Stevens, and Burt Upham.

The history here considered commenced 272 years ago, at the time of the inception of the oldest element in the stand of 1924. In 1652, a year before Cromwell became Lord Protector of England, and thirty years before William Penn crossed the Atlantic, a hemlock seed germinated in the dense shade of the virgin forest and a tree commenced its long life of suppression. The history of the stand previous to 1822 can only be conjectured. The forest probably consisted principally of white pine, with considerable hemlock, and a sprinkling of chestnut, beech, yellow birch, and red oak. It was no doubt autochthonous in character. When one element dropped out, either the surrounding trees seeded in the spot or advance growth reproduction replaced the dead tree. But only the most shade-tolerant species could possibly survive with the slight amount of light which penetrated the canopy. Therefore, the understory consisted chiefly of that extremely shade-enduring species, hemlock, which, though it grew on the average about an inch in a century, was nevertheless able to maintain life. It was only when some natural catastrophe made a small opening in the forest that the trees had an opportunity to grow to a large size. No doubt the majority died after years of stunted existence. Frequently in larger openings the less tolerant white pine would seed in and overtake the slower growing hemlock. Then another period of suppression would ensue.

A REMARKABLE SPECIES

One consistent and abundant element through time was hemlock, whose persistence Marshall came to attribute to a combination of the species' remarkable physiology and the complete absence of fire. He noted that, while white pine was favored whenever big holes were created in the canopy and the soils were disturbed, hemlock prevailed under most other conditions. What Marshall and the Harvard group learned that summer took them a long way toward explaining hemlock's great abundance on the site and success in the region. From the tree-ring records, he documented that hemlock persisted under heavy shade, displaying minute rates of growth under conditions that the sensors built and deployed by Rupe Gast showed as supporting less than three-tenths of one percent of ambient sunlight. Marshall's data also revealed that hemlock was able to increase its growth rate tenfold or more whenever more light became available. In contrast to most species, which lose or never display this flexibility, hemlock could bounce back repeatedly until it either became a dominant tree or was taken down by a violent wind gust or a two-man saw. Whereas white pine had a boom-and-bust behavior in which it dominated after major disturbances through prolific seed production, long-distance dispersal, and rapid growth, hemlock employed a strategy of stealth and persistence. It invaded slowly,



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Cross-section of a large hemlock analyzed by Bob Marshall on the Adams Fay lot (1924). The dense rings in the center adjacent to the knife show that the tree grew in the shade for 108 years until the overstory was harvested around 1840 when the rings widen abruptly. The wood exhibits cracks along the radii and shake between the rings.

hunkering down, biding its time, and continually leveraging its position in the woods.

From the growing appreciation of hemlock's ecology and the site's history emerging from Marshall's plot, Fisher developed some guiding hypotheses for the big experiment. He proposed that in the absence of fire, both hemlock and pine would persist on the site indefinitely, as it appeared that they had for thousands of years. But the relative amount of each would depend strongly on the scale of disturbance. White pine would secure a great foothold when intense windstorms or clearcuts opened the canopy broadly. Hemlock would establish in the understory of pine forests and be favored by lengthy periods with few large disturbances. Then, with the death of every pine from lightning, selective harvesting, or senescence, hemlock would increase toward a dominant position. The larger context of this experiment as it pertained to Marshall's specific focus on the release of hemlock from suppression is laid out nicely in his 1927 article:

In the autumn of 1924 the Harvard Forest marked for cutting a lot owned by the New England Box Company which contained a stand unusual in northern Massachusetts. It was composed of dense, almost pure, white pine and hemlock with very little ground

cover or advance growth hardwood. The composition ranged from pure hemlock to nearly pure pine. But of special interest was the fact that the entire area was thickly sprinkled with old pine stumps which clearly testified that years before a heavy softwood cut had been made on the same area. Now as a general rule the forests which have followed nineteenth century softwood logging operations have resulted both in a conversion and a marked deterioration of type. But here softwood had followed softwood, and furthermore the new stand had both a large volume and excellent form. What was the history which had caused this anomaly? It was in answer to this question that the present study was undertaken. Almost as soon as the first hemlocks had been felled, it was noticed that at the center of every stump there was a core of wood from one to five inches in diameter which frequently had taken one hundred or more years to grow. At the outside of this core there was a very abrupt change in growth rate, and for a period of years rings from one-eighth to one-fourth of an inch thick were found. Coinciding in point of time with this acceleration in growth were old scars, evidently caused by logging. The obvious explanation was that a previous stand had been cut, and the consequent infusion of light had released the long stunted hemlocks from suppression.

The hypotheses laid out by Fisher and supported by Marshall's work were tested directly in the large experiment, which sought to guide harvesting in the real world of commercial forestry. The experiment would put these ideas to the test by establishing a gradient of disturbance size and intensity through different patterns of harvesting. The specific harvesting approaches included *selection cutting*, in which the canopy was thinned of one-quarter to one-half of its stems presumptively to increase hemlock; *shelterwood harvests*, in which the initial thinning was followed in a few years by removal of the remaining overstory to allow the release of hemlock and the establishment of many pines; *strip cuts*, which removed alternating sections of forest, producing strong gradients of shade to full sun that favored both species; and sizable *clearcuts*, which exposed large areas to direct sunlight and overwhelmingly favored the establishment of white pine. Working alongside the Woods Crew, the students would measure the trees in each area before and after every harvest. The entire group would then stack and haul the wood and cart and burn the branches. At the end of the day, the scientists and woodsmen parted ways. The students and younger mentors like Cline would retreat to the headquarters for dinner, their skulls sessions, data analysis, and evening pranks. Gast lived off-site with his family, while Fisher maintained homes in both Petersham and Weston, a wealthy Boston suburb, and so was an episodic visitor.

From the evidence in photographs, journals, and letters along with a distinctive reduction in the frequency of Marshall's correspondence home, the summer presented a thoroughly exhausting, stimulating, and engaging experience for the close-knit group in Petersham. Through the fall they conducted fieldwork, wrapping up the slash burning and wood hauling in midwinter while the woods crew and horses worked the mill and reduced the logs to large and well-ordered stacks of lumber. As the winter turned into a muddy spring and summer approached, the students completed their studies. Many stayed on for a second summer or more as they sought jobs, tied up loose ends, or established careers at the Harvard Forest, as Neil Hosley and Al Cline did. Marshall followed a unique path, however. He pushed off immediately following the semester's end, having completed his work on schedule and

successfully converting his original Forest Service offer into a posting in Missoula. If he had glanced back on his way out west, he would have realized that in launching his career, he had contributed to an experimental legacy for future generations, established a fundamental historical approach for ecology, and advanced the knowledge of a critical forest species.

DEATH AND DESTRUCTION

The future did not play out for the Harvard Forest or for the group of students as they may have envisioned in their year together. But many of their lives remained intertwined, and nearly a century later their insights, methods, and approach to science-based silviculture have been fully vindicated. Their legacies certainly persist. Bob Marshall worked from a distance to publish his master's thesis three years later, and his career advanced on a meteoric trajectory grounded in ambition, rare talent, boundless energy, and important connections. He died just fourteen years after departing Petersham in a train heading to Washington, D.C., likely of heart failure; at 39, he was chief of the U.S. Division of Indian Forestry and founding board member of the Wilderness Society. He had looked back annually to that grand summer as he updated his life lists. He also maintained contact with Professor Fisher and figured strongly in the lives of his friends Hosley and Cline. The grand experiment on the Adams Fay lot was resampled three times while Fisher was alive, keeping Cline and a regular stream of new graduate students busy.

Yet, like so much of the scientific infrastructure established in the woods during the first quarter-century at the Harvard Forest, the big experiment was abandoned following the 1938 hurricane. The neat experimental design of harvests was shredded, initially by the wind that flattened the remaining hemlock and pines and then by salvage logging that left the landscape covered with stumps, skid trails, charcoal mounds, and the residue from a portable sawmill.

Russell Lutz and Al Cline capture the scene and response to the 1938 hurricane in the publication that brought the big silvicultural study to a close.

The stand left after the cutting of 1935 was completely blown down by the hurricane of September 1938. The stumpage was sold to a private operator. Because of the tangled condition of the trees, oftentimes piled in criss-cross fashion to a depth of twenty feet, no attempt was made to control the cutting or the extraction; the logging was done at the discretion of the operator. The logs were hauled on scoots by tractors. Although the logging was done in the winter, there was very little snow on the ground; consequently much of the remaining organic layer was broken up and mixed with the mineral soil, particularly along the many skid trails. After logging was completed, the slash was ricked and partly burned. The hurricane and attendant logging operation caused heavy damage to the reproduction; much of it was broken by falling trees or knocked down in the course of logging. Fortunately there was a good crop of pine seed on the trees when the hurricane struck. With the improved seedbed conditions brought about by the second shelterwood cutting and the further scarification of the soil caused by cleaning up after the hurricane, a fairly abundant new reproduction started in 1939.⁴

It was more than three-quarters of a century before the next group of faculty and students refocused on the work that Marshall,

Fisher, and the crew had initiated. Though it was challenging for us to relocate Marshall's original plot, given the intervening damage and regrowth, a group that included students Alex Ireland and Ben Mew eventually succeeded by using the original maps and locating persistent landmarks and features that Bob Marshall had surveyed so carefully.⁵ We also revisited and reimagined the original experiment, though the well-conceived cutting patterns cannot be discerned on the landscape today. Eight decades after the hurricane, the forest is now inspiring in many ways. And, thanks to financial contributions by Marshall and other alumni, the Adams Fay lot was purchased from the New England Box Company and now belongs to the Harvard Forest. Its forest condition repeated the historical pattern that Marshall reconstructed and Fisher predicted. Despite the vicissitudes wrought by wind and ax, both hemlock and white pine continue to dominate the site. The hypothesis rooted in forest reconstruction has been supported, and Bob Marshall's historical methods have been in active use ever since. □

David Foster is an ecologist and faculty member at Harvard University and author of several books on New England's forests. He has served as the director of the Harvard Forest's 3,750-acre ecological laboratory and classroom in central Massachusetts since 1990. David is also Principal Investigator for the Harvard Forest Long Term Ecological Research program. Supporting and additional information on Bob Marshall, forest history, and hemlock are available on the Harvard Forest website, at <http://harvardforest.fas.harvard.edu>. This excerpt is reprinted with permission of Yale University Press.

NOTES

1. All unpublished documents may be found in the Harvard Forest Archives.
2. R. Marshall, "The Growth of Hemlock Before and After the Release from Suppression," *Harvard Forest Bulletin* 11(1927): 7.
3. J. D. Henry, J. M. A. Swan, "Reconstructing Forest History from Live and Dead Plant Material—An Approach to the Study of Forest Succession in Southwest New Hampshire," *Ecology* 55: 772–83; and C. D. Oliver and E. P. Stephens, "Reconstruction of a Mixed-species Forest in Central New England," *Ecology* 58: 562–72.
4. R. J. Lutz and A. C. Cline, "Results of the First Thirty Years of Experimentation in Silviculture in the Harvard Forest, 1908–1938. Part II. Natural Reproduction Methods in White Pine–Hemlock Stands on Light, Sandy Soils," *Harvard Forest Bulletin* 27: 1–69.
5. A. W. Ireland, B. J. Mew, and D. R. Foster, "Bob Marshall's Forest Reconstruction Study: Three Centuries of Ecological Resilience to Disturbance," *Journal of the Torrey Botanical Society* 125(2008): 411–22.