When the U.S. Congress passed the Forest Management Act in 1897, the government had little idea what natural resources lay within the boundaries of the national forests. The surveys and inventories conducted in the wake of the law's passage still hold information of value to historians and land managers alike.

THE FOREST EXPLORERS

PROBING THE WESTERN FOREST RESERVES, 1897–1904

Historians have diligently investigated the exploration of the American West and the subsequent era of conservation when many national parks, wildlife refuges, and vast forest reserves were established. Still, one phase of exploration that helped provide a foundation for natural resources management has largely escaped notice. A collection of surveyors and natural scientists hired by the U.S. Geological Survey between 1897 and 1904 explored, mapped, inventoried, and reported on the geography, natural resources, and human activities in 110,000 square miles of the remote, rugged western mountains. These areas were proclaimed or proposed as new federal forest reserves, forerunners of today's national forests.

The intrepid surveyors and scientists produced several thousand pages of detailed maps and reports, illustrated with photographs, which describe largely unexplored territory and even recommend appropriate stewardship of watersheds and timber resources. The reports were published by the U.S. Geological Survey, and they reside in university libraries all across the country. However, they are seldom consulted today, despite their treasure trove of historical information. To highlight the contribution of these "forest explorers" and encourage further interest in them, this article introduces the explorations, some of the people involved, and features of the reports. As an example, it profiles the most prolific explorer, John B. Leiberg, and relates some of his findings from the inaccessible Bitterroot Forest Reserve.

CONGRESS ORDERS AN EXPLORATION

When President Grover Cleveland unexpectedly proclaimed 33,000 square miles of new forest reserves on Washington's Birthday, February 22, 1897, his proclamation more than doubled the area of federal forest reserves. Many westerners viewed it as a threat to their economic welfare, since it made no provisions for entry, use, or management of these areas.[1] Newspaper and magazine editors called for management policies and inspections to ensure the new reserves did not include lands suitable for agriculture.[2]

After months of arguing and political maneuvering, on June 4, 1897, Congress passed legislation that established the basis of forest reserve management.[3] The Forest Management Act suspended the new reserves' official status for nine months to allow for investigation to define boundaries so as to exclude agricultural lands.

Charles Walcott, director of the U.S. Geological Survey, had drafted and promoted the original version of the 1897 act, and his agency received $150,000 for mapping and inventorying the newly proclaimed reserves.[4] Ultimately, the surveys were expanded to cover many more forest reserves, and appropriations were continued for eight years. Including publication costs, allocations eventually totaled at least $1.5 million—an impressive amount in

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ALL IMAGES ARE FROM THE FOREST INSPECTOR REPORTS, 1898–1900

An inspector's camp somewhere on the Washington Forest Reserve.

those days. Year after year, the Geological Survey published magnificent illustrated reports on the forest reserves.

Immediately after the act was signed, Secretary of Interior Cornelius Bliss ordered a detailed examination and description of all the reserves, suspended or not. Henry Gannett, a seasoned geographer who had served on the famed Hayden Survey a quarter-century earlier, was assigned to marshal this effort.[5] Gannett promptly assembled mapping crews and natural scientists, some of whom were suggested by Bernhard Fernow, the U.S. Department of Agriculture's forester, and Gifford Pinchot, then a consulting forester and eventual successor to Fernow.[6] The crews hurried to the western reserves so as not to miss the 1897 field season, already well underway. The few scientific surveys that had been conducted on any of these lands focused on geology, paleontology, and mineral resources, with little if any information on watershed, forest, forage, or agricultural values.

Gannett sent out two types of parties.[7] Topographic parties were to survey and prepare maps of the reserves at a scale of two miles to the inch, with elevational contours at 100-foot intervals. These would serve as base maps for representing forest resources and agricultural and mineral lands. To ensure accuracy, numerous benchmarks (latitude, longitude, and elevation) would have to be established, including regional reference points determined by using astronomical observations and telegraphed time signals. Topographers would also establish township and section lines near the reserve boundaries and outline all forested areas.

The rushed schedule and remote, rugged terrain made mapping difficult, but the accompanying forestry survey posed an entirely new challenge. The need for professional evaluation of forest resources arose before a profession had developed to provide it. The handful of trained foresters in the United States had been schooled in Europe, where concepts of forestry developed primarily to establish plantation forests on denuded lands.[8] America needed a much different and broader application, designed to help initiate management of native forests and associated water and forage resources.

Walcott instructed the forest inspectors to report on "the size and density of the timber, the distribution of the leading economic species, the effect of…forest fires,…the amount of dead timber, the extent to which the forests are pastured, and the extent of the timber already cut and the effects of the deforesting; also the relation of the timber supply to transportation, local demands of miners and settlers, and the supply needed for more distant markets."[9]

Gannett's assignments to individual forest inspectors were broader yet, and their reports frequently encompassed even more than had been assigned.[10] The immediate concern in 1897 was to survey portions of the suspended Washington's Birthday reserves where private interests made claims of injury by forest reserve designation. The surveys were not limited to the confines of the reserves but included adjacent public lands. Ultimately, the surveys found that very little agricultural land had been included in the reserves, and the information they supplied on natural resource values was used instead by the government to expand the reserves to encompass adjacent timberlands still in the public domain.[11]

Pinchot pointed out the reason the boundary work was especially urgent:

> *An army of timber cruisers [hired by lumber companies and speculators] was scouting the forests of the West for the choicest bodies of Government timber. Once discovered and reported, these prizes*

would be claimed, fairly or fraudulently, under lieu [land] selection or under the Timber and Stone or other public-land laws, and then their forests would be lost to Forestry and the people.[12]

With the exception of Henry S. Graves, who inspected the Black Hills Forest Reserve and later became the second chief of the U.S. Forest Service, most of Gannett's forest inspectors are not well-remembered today.[13] Many did not continue work in forestry but resumed careers in teaching, engineering, botany, or other fields. Although we will examine the reports of just one inspector in one region, most of the other inspectors provided reports of comparable detail and value for other forest reserve areas.

JOHN LEIBERG: CONSUMMATE EXPLORER

Gannett's most prolific forest inspector, John B. Leiberg, was a life-long botanical explorer. He was born at Malmo, Sweden, in 1853 and immigrated with his family to Iowa in 1868.[14] He apparently graduated from gymnasium (high school) in Sweden but is not known to have had further schooling. Nevertheless, he began publishing notable plant collections at age 17. In 1884 he settled on Lake Pend Oreille, Idaho Territory, with his wife, Carrie, a medical doctor and surgeon—a rare profession for women at the time. He regularly corresponded with and supplied specimens to the New York Botanical Garden. An 1889 letter to curator Elizabeth Britton describes the field conditions, which were no doubt similar to those he encountered later as a U.S. Geological Survey employee:[15]

No one that has not seen it personally can form the least conception of the terrible mountain wildernesses that surround us on all sides but the South. During most of the year we are constantly in the saddle exploring these mountains [perhaps prospecting for minerals] and it can well be understood that the opportunities for determining plants of any sort with us are not of the best…The mountains are all very densely timbered and the constant use of the axe is necessary to force one's way through the enormous masses of vegetable debris that encumber the ground everywhere.

Leiberg spent the winter of 1892–93 in Hamilton, Montana, in the Bitterroot Valley immediately east of the future Bitterroot Forest Reserve. His letter to Elizabeth Britton reveals a thirst for the adventures he would engage there four years later:[16] "When one looks [westward] towards these immense mountain fastnesses that fill such a large portion of Idaho and which have never been explored botanically it makes me wild with desire to penetrate them and reap the harvests that undoubtedly lie in there, awaiting the explorer."

After working as a field botanist for Frederic Coville, curator of the U.S. National Herbarium, in 1897 he was transferred to the U.S. Geological Survey and assigned to examine the mountain fastness he had longed to explore, now set aside in the 6,480-square-mile Bitterroot Forest Reserve. (This reserve now encompasses large sections of the Bitterroot, Clearwater, and Nez Perce national forests.) Like many nineteenth-century naturalists, Leiberg was a keen observer. He was also a prolific writer, photographer, botanist, and proponent of wise use of natural resources.

Leiberg's treatise on the Bitterroot reserve, which he surveyed in 1897 and 1898, covers 124 pages in the 19th and 20th annual reports of the U.S. Geological Survey. These volumes also contain his detailed inventories of the Priest River (Idaho) and Southern California forest reserves. From 1900 to 1904 Leiberg examined and published descriptions of several other western forest reserves. His peripatetic life next took him to the Philippines, a U.S. protectorate at the time, to serve a stint as forest inspector for the Insular Forest Service.[17] He left government service in 1906 and settled on a farm near Eugene, Oregon, but only briefly. He journeyed around the world in 1910 and continued to collect plants until his death in 1913.

Below is a summary of Leiberg's findings as reported in the 19th and 20th annual reports, organized by topic.

BITTERROOT RESERVE GEOGRAPHY

Leiberg was the first scientist to examine the formidable territory designated as the Bitterroot Forest Reserve in February 1897. The reserve was roughly square and 75 to 80 miles across. However, even the best travel routes required several arduous days afoot or on horseback following rough trails up and down narrow ridges and plunging into deep canyons only to ascend again. Lewis and Clark had nearly starved to death trying to traverse this same terrain 95 years earlier. By Leiberg's time, not much had changed. In 1898 geographer Richard Goode reported, "There is probably no portion of the country exclusive of Alaska, about which there was so little known."[18]

The eastern one-sixth of the reserve lay in Montana and consisted of the crest and eastern slope of the lofty Bitterroot Range, bordered to the east by the 10-mile-wide agricultural valley of the Bitterroot River. Leiberg described it well:

The [Bitterroot] range rises abruptly from the valley level, with no intermediate foothill region. It is cut at frequent intervals by long, nearly straight, bowlder-obstructed canyons that extend to the main backbone of the range. The ridges between the canyons are steep rocky divides, usually with peaked and saw-toothed crest lines…with slopes covered by masses of slidden rock…The crest of the main divide…is exceedingly rocky and tortuous…At intervals it is pierced with passes affording egress from the east to the west…found at the head of nearly all the larger canyons.[19]

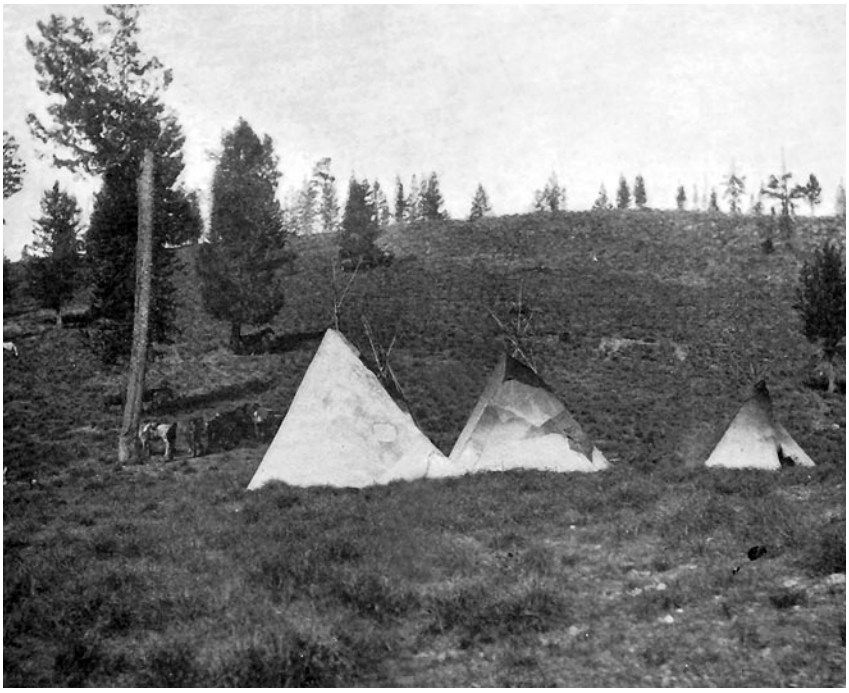
The remaining five-sixths of the reserve lay in the jagged ridge and canyon country of north-central Idaho: "The western slope of the Bitterroot Mountains is primarily formed by a few great branches from the main range, which in their turn branch out into a vast mass of curving, winding, peak-crowned spurs…[forming] a perfect maze of bewildering ridges."[20]

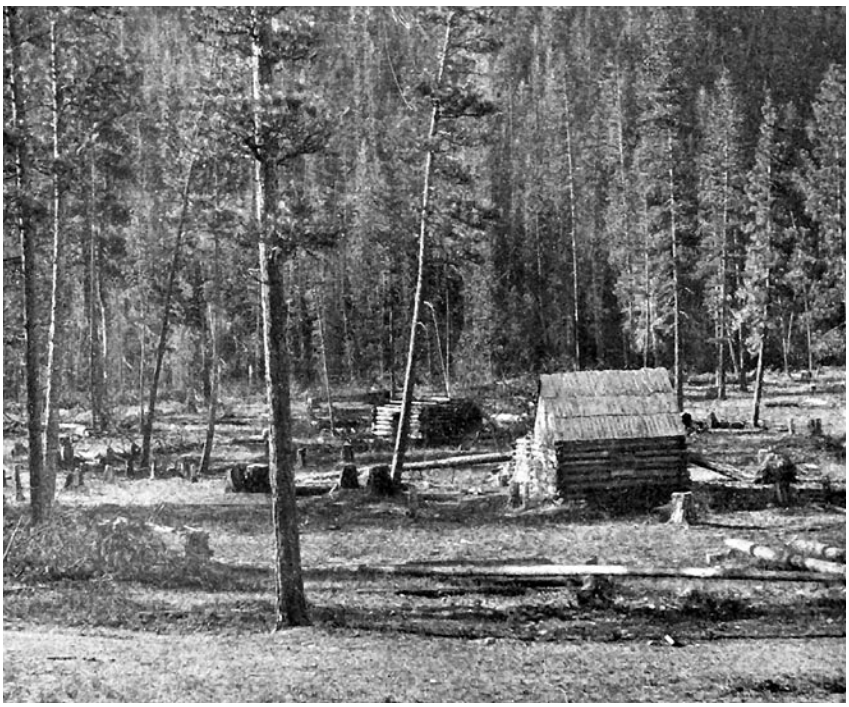
The mapping party established a control point in the new Bitterroot Valley town of Hamilton and triangulated measurements to fix the latitude, longitude, and elevation of many prominent peaks. From their summits surveyors could see "naught but mountains," except for the Bitterroot Valley bordering the reserve's eastern edge. New hand-drawn maps sketched from high viewpoints provided the first detailed representation of the region's tortuous terrain.[21] The Salmon River Canyon, southern boundary of the reserve and one of Idaho's most prominent features, was found to be mislocated by at least 10 to 15 miles on earlier maps, such as the 1876 Rand McNally Atlas.[22]

Leiberg reported that three very rough, informal trails crossed the reserve. They were used by native peoples, sometimes hundreds in a party, on traditional migrations to hunt buffalo in central Montana. Early prospectors, trappers, hunters, and traders used the same routes: "The Lolo trail on the north [used by Lewis and

TABLE 1. U.S. GEOLOGICAL SURVEY REPORTS ON WESTERN FOREST RESERVES

Contributions to the U.S. National Herbarium 5:1 (1897)	
Coeur d'Alene Mountains, Idaho	John B. Leiberg
U. S. Geological Survey, 19th Annual Report, Part V (1899)	
Black Hills Forest Reserve	H. S. Graves
Bighorn Forest Reserve	F. E. Town
Teton Forest Reserve	T. S. Brandegee
Priest River Forest Reserve	J. B. Leiberg
Bitterroot Forest Reserve (Montana portion)	J. B. Leiberg
Washington Forest Reserve	H. B. Ayres
Eastern Part of Washington Forest Reserve	M. W. Gorman
San Jacinto, San Bernardino, and San Gabriel Forest Reserves, Part 1	J. B. Leiberg
Forest Conditions in Northern Idaho	J. B. Leiberg
U. S. Geological Survey, 20th Annual Report, Part V (1900)	
Pikes Peak, Plum Creek, and South Platte Reserves	J. G. Jack
White River Plateau Reserve	G. B. Sudworth
Battlement Mesa Forest Reserve	G. B. Sudworth
Flathead Forest Reserve	H. B. Ayres
Bitterroot Forest Reserve (Idaho portion)	J. B. Leiberg
San Jacinto, San Bernardino, and San Gabriel Forest Reserves, Part 2	J. B. Leiberg
U. S. Geological Survey, 21st Annual Report, Part V (1900)	
Lewis and Clark Forest Reserve	H. B. Ayres
Mount Rainier Forest Reserve	F. G. Plummer
Olympic Forest Reserve	A. Dodwell and T. F. Rixon
Cascade Range Forest Reserve	J. B. Leiberg
Stanislaus and Lake Tahoe Forest Reserves	G. B. Sudworth
U. S. Geological Survey, Professional Papers, Series H. Forestry (1902)	
Forests of Oregon	H. Gannett
Forests of Washington, a revision of estimates	H. Gannett
Forests in the Cascade Range between the Washington and Mount Rainier Forest Reserves	F. G. Plummer
Olympic Forest Reserve	A. Dodwell and T. F. Rixon
Forests of the Northern Sierra Nevada	J. B. Leiberg
U. S. Geological Survey, Professional Papers, Series H, Forestry (1903–05)	
Cascade Range Forest Reserve, Oregon (1903)	H. D. Langille and others
San Francisco Mountains Forest Reserve (1904)	J. B. Leiberg and others
Black Mesa Forest Reserve (1904)	Plummer, Rixon, and Dodwell
Absaroka division of Yellowstone Forest Reserve (1904)	J. B. Leiberg
Little Belt Mountains Forest Reserve (1904)	J. B. Leiberg
Lincoln Forest Reserve (1904)	F. G. Plummer and M. G. Gowsell
Gila River Forest Reserve (1905)	T. F. Rixon





Left: A rare sighting of Indian teepees on the Montana-Idaho divide, in the Bitterroot Forest Reserve. The Salish had been forcibly removed from the Bitterroot valley in 1891.

Below: A squatter's cabin on an illegal claim on the Bitterroot Forest Reserve in Montana.

Clark], the trail through Lost Horse Pass in the center, and the Nez Perce[']s trail on the south, were laid out by the Indians ages ago and their course was made to coincide as nearly as possible with the crest of the primary ridges…the canyons being utterly impassable."[23] Leiberg photographed Indian teepees pitched in the meadow at Nez Perce Pass, on the southern trail.[24]

Leiberg detected the influence of ancient glaciers in sculpting these mountains and creating a legacy of cirque lakes that farmers and ranchers in Bitterroot Valley were impounding to store water for irrigation. More than a decade before the first geological publication acknowledged the existence of Glacial Lake Missoula, Leiberg reported evidence of a huge glacial lake that once filled the Bitterroot Valley: "[The valley] appears to have been at one time a depression holding a lake, or, rather, an arm of a much larger lake lying to the northward which covered to a large extent the present head of Clarks Fork of the Columbia River Basin. The existence of the lake was probably due to a blocking of the valley trough of Clarks Fork by ice masses sliding into it from the adjacent mountains."[25] The ice dam was later determined to be a southern lobe of the continental ice sheet blocking the Clark Fork valley at what is now the Montana-Idaho border.

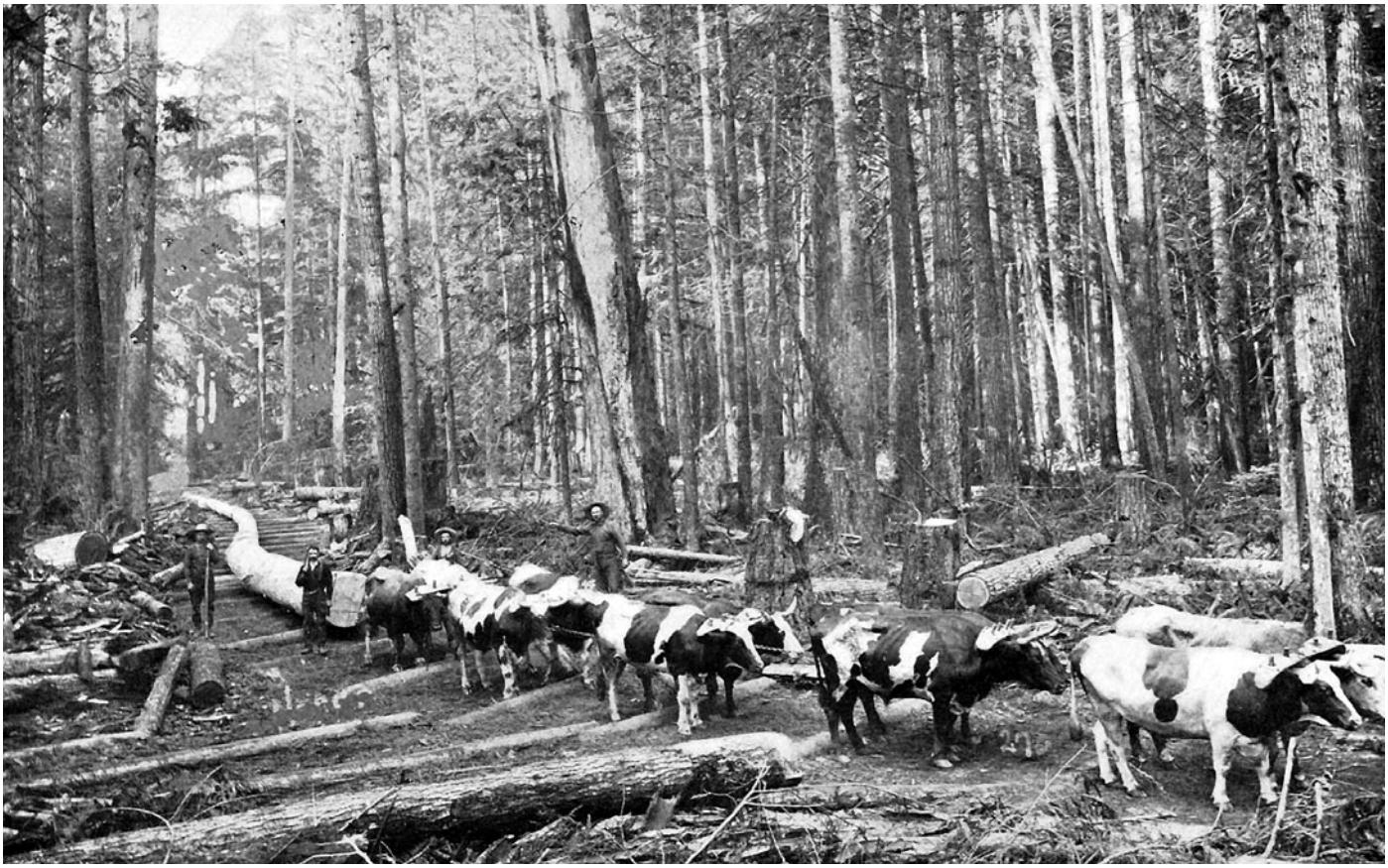
WATER RESOURCES

The semiarid climate of most inland valleys made water resources a primary concern of the U.S. Geological Survey investigations. Leiberg discerned that the Bitterroot Valley's dry climate resulted from its location downwind of a vast expanse of high mountains that wrung moisture out of oceanic air masses as they migrated in from the southwest and west. He estimated annual precipitation along the crest of the Bitterroot Range to be about 60 to 65 inches, a figure confirmed a century later by data from storage gauges and snow courses. He competently described features of the Bitterroot reserve that made possible the year-round stream flows necessary for irrigation in the valley. Numerous glacial cirque basins with lakelets, marshy tracts, and springs along the Bitterroot Crest and high ridges, he wrote, collectively formed "a natural reservoir system which is one of the main regulators in the flow of water from the Bitterroot canyons." In addition, abundant "rock fissuring" in the bedrock slopes and boulder piles facilitated percolation of water into the subsurface reservoirs that fed springs, conserving and prolonging runoff flows during the long dry season.[26]

AGRICULTURE AND GRAZING

Leiberg's search for agricultural lands within the Montana portion of the Bitterroot Reserve in 1897 turned up only 82 acres under cultivation—small, isolated tracts along the West Fork of the Bitterroot River.[27] The following year revealed a few small tracts marginally suitable for agriculture within the Idaho portion at the junction of the Lochsa and Selway rivers and a few miles downstream at Syringa. He also described the handful of extremely isolated homesteads and squatters living in the Salmon River canyon on alluvial terraces where small tributaries enter the river, noting they subsisted largely on gardens and wild game and had had minor success in panning for gold.

The forest inspectors were also tasked with evaluating livestock grazing in the reserves. Leiberg reported some cattle and horse



Skidding Douglas-fir on the Washington Forest Reserve.

grazing in open-growing stands of ponderosa pine adjacent to the Bitterroot Valley, which he felt caused "no appreciable damage." However, he was concerned about proposals from some valley residents who wanted to use meadows high up along streams in the Bitterroot Range for livestock grazing and producing hay: "Such use of these tracts should be rigorously prohibited. We have seen what an important part they perform in the conservation of the waterflow."[28] He also warned that production of hay crops in these meadows would require ditching, which would hasten runoff, diminish late-summer stream flows, and compromise irrigation in the valley far below.

In the Idaho portion, Leiberg found wet meadows totaling perhaps 8,000 acres scattered along upper tributaries of the Clearwater River:

> *A considerable portion is occupied by permanent settlers and utilized for hay lands and pasturage… None of the meadows is under tillage. Grain, fruit, potatoes, and other vegetables do not thrive, and are not raised on these lands, owing to frost… The greater portion of the meadows occupies the place of previously existing lakes, which have been drained [and perhaps filled in] by erosion… [Some] are now constantly diminishing in size, owing to the encroachments of the adjacent forest."*[29]

MINERALS

Leiberg summarized the mineral-bearing lands and mapped the claims found within the Bitterroot Reserve. Mineral production was almost wholly limited to gold, which had been profitable only near Pierce and Elk City at the western edge of the reserve. He mentioned that a mineralized belt stretched across the southern part of the reserve, and on the Montana side, intensive placer mining was occurring along Hughes Creek, but noted these claims "are worked intermittently and are said barely to pay the expenses of working."[30]

TIMBER

The largest sections of Leiberg's report discuss the forest and its ecology, condition, timber volumes, utilization, and conservation opportunities. These observations are remarkable for their detail, considering the limited time available for his inspection, and yet they represented a new frontier in forest resource information. Tables in his report estimate relative abundance and timber volumes by species for six geographic divisions of the reserve. Such data, provided by Leiberg and the other forest explorers, are the only comprehensive estimates of the original timber resources of the western forest reserves.

Mature ponderosa pine on the Montana side of the reserve was being harvested in large quantities and milled in the Bitterroot Valley, Leiberg reported, but other species were of minor interest for sawmilling at that time. A great deal of timber on private lands had been removed since the beginning of intensive sawmilling a decade earlier. Leiberg estimated that even within the Montana portion of the Bitterroot reserve—under jurisdiction of the Government Land Office—about 50 million board feet had been logged by 1897. Moreover, "The cutting was accompanied by a great deal of unnecessary waste. Only the choice portions of the logs were taken. Trees were felled carelessly, breaking and splintering…" Good logs were abandoned, and tops and branches were left in place, constituting "a vast mass of inflammable material." He also warned that given recent trends, "The [accessible] yellow

pine within the reserve could, with ease, be logged off in five years."[31]

The disposal of prime government timberland in the Bitterroot Valley adjacent to the reserve alarmed him. Thousands of acres had been purchased under the Timber and Stone Act for $2.50 per acre "by individuals who, upon acquiring ownership, immediately transferred their holdings to lumber corporations. It is a matter of common report that the purchase money was supplied by these same corporations and a bonus besides to cover the value of the individual's purchasing right under the law."[32] He observed that many of these lands averaged 10,000 to 20,000 board feet of merchantable timber per acre, and that easily accessible stumpage fetched $3 per thousand, rendering the land's purchase price "ridiculously low."

Leiberg inferred that most of the vast timber resources on the Idaho portion of the reserve were inaccessible because of the steep, rocky terrain:

> *No roads can be built up any of the canyons or valleys, small or big, except by blasting out the way through the slopes of the mountains, and the attendant expense would be prohibitory…The streams furnish the best facilities for transporting timber, but, with the exception of the Salmon River, none are fit for driving without large preliminary expenditures in removal [blasting] of numerous bowlders that obstruct their channels.*[33]

Eventually, logging roads were extended into much of the western part of the reserve, but about half of the reserve in both Idaho and Montana remained roadless and is now protected—mostly within the Selway-Bitterroot and Frank Church–River of No Return wilderness areas.[34]

TREE DESCRIPTIONS

Leiberg and the other forest inspectors provided the first detailed descriptions of many western trees. He painted colorful word-pictures, as in his account of the rare "Lyall larch" (alpine larch, *Larix lyallii*):

> *The tree above all others in the reserve that is fashioned to withstand successfully the rigorous climatic conditions prevailing on the high and bleak summits of the main Bitterroot Range. With a light and graceful foliage, offering slight resistance to winter's blasts, a compact strong trunk, and a root system firmly anchored in the crevices of the underlying rocks, it can bid defiance to winds of any violence, and it is very rarely, indeed, that one sees an individual of this species uprooted.*[35]

Perceptions have changed. Hikers visiting the high Bitterroot summits today likely consider them "glorious" rather than "bleak."

"Great silver fir" (grand fir, *Abies grandis*) was found throughout the reserve, Leiberg noted, but in the southwestern portion it "much resembles the white fir (*Abies concolor* Lindl.) of the region farther southwest. In fact, the differences are so slight and obscure that none but the trained botanist can detect them." Intergradation of these two species has now been described by a number of investigators.[36]

Leiberg described a peculiar habit of the "alpine fir" (subalpine fir, *Abies lasiocarpa*) growing on high ridges. Ground-hugging lower branches in contact with the humus take root and form a "fringe of saplings set around the parent tree, and are then capable of maintaining an independent existence."[37] This form of vegetative reproduction, called layering, had not previously been described.

Among the few early naturalists who were familiar with whitebark pine (*Pinus albicaulis*), dweller of the highest ridges, Leiberg was evidently puzzled by the species' "excessively deficient" cone production, especially since disintegrated remains of cones were abundant beneath the trees. He noticed that the large seed was eagerly devoured by rodents. It took another 75 years before careful observation revealed that whitebark pine cones appear in mass every few years and are immediately harvested by red squirrels and hacked apart by the jaylike Clarks nutcracker—which caches thousands of seeds in the ground and inadvertently "plants" new trees by failing to retrieve some of its caches.[38]

Leiberg recognized lodgepole pine (*P. contorta*) as the most abundant tree in the Bitterroot reserve. It bore great masses of cones, and he noted that some of the cones remain closed for years, storing seeds while still attached to the tree. He also observed that "On areas that have been denuded by forest fires it springs up in great abundance as the first tree [to regenerate]…20,000 to 30,000 individuals on a single acre are not uncommon during the sapling stage." He evidently had not discovered that lodgepole's closed cones are an adaptation to fires. Later observers found that the extreme heat of a forest fire melts the bond of resin that seals the cone scales shut, allowing well-preserved seeds to float down into the nearly ideal ash seedbed.[39]

However, Leiberg was far ahead of his time in recognizing that lodgepole pines often survived fires: "The species is moderately sensitive to fire, but its resistance ratio depends largely upon the quantity of litter on the ground. If many decaying logs have remained unburned [on the ground after a previous fire]…a subsequent conflagration is almost sure to destroy all of the growth on such areas. If, on the other hand, the tract was originally burned clean a fire in the since-accumulated litter may not destroy above 20 to 40 per cent of the lodgepole pine."[40]

"Fires in the yellow-pine areas have destroyed much of the red fir [Douglas-fir, *Pseudotsuga menziesii*]," Leiberg observed, "sparing only the yellow pine by reason of its superior fire resisting qualities." He recognized that many of these ponderosa pine forests had burned frequently in low-intensity fires. Still, he expected that mature trees would eventually succumb: "Repeated fires, however, are certain to burn their way through the bark in one or more places, resulting in fire scars and pitch streaks which eventually insure the destruction of the tree." He listed longevity of ponderosa pine as 200 to 300 years. Much later, investigators conducted studies of fire scars on stumps and living ponderosa pines and found that many had survived 15 to 30 fires over lifespans of several centuries (occasionally over 800 years), with little rot or other damage, because the pitch sealed off the wounds.[41]

Though he noted an abundance of large fire scars on mature ponderosas in the valley of the West Fork of the Bitterroot River, his photograph of a "fire scar" actually shows a distinctive bark-peeling scar that was subsequently blackened by fire.[42] Unlike the ground-level fire scars, bark peelings generally started about two feet above the ground and were created by Indians who stripped off the sugary inner bark in spring for use as a food or sweetener. Although this practice was described by Lewis and Clark in 1805, bark peelings were often not recognized by naturalists until the late 1900s. The West Fork valley still harbors hundreds of ponderosa pines with bark-peeling scars made 100 to 300 years ago.[43]

Leiberg was first to publish a description of the magnificent "arbor vitae" [western redcedar, *Thuja plicata*] groves near the

The scar created by Indian bark peeling was later blackened by fire. Photo taken on the Bitterroot Forest Reserve in Montana.

species' southeastern range limits, in the remote upper Selway drainage:[44]

> *It is especially abundant in Moose and Bear creek canyons…these streams widen at various places and form marshy expanses where is found the heavy, nearly pure, old growths of the species, which are commonly known as the cedar groves of the Middle Fork. They are noteworthy as representing the oldest living forest in the reserve. This growth in some cases probably above 1,000 years old, shows the tree with the greatest dimensions that it attains in the reserve. Specimens occur as much as 12 feet in diameter and with clear trunks 100 feet in length.*

He noted these groves held little interest as timber because of the trees' extensive heart rot and inaccessible location.

FIRES

Leiberg found forest fires to be a pervasive and enormously destructive force in the Bitterroot reserve:[45]

> *The after effects of the fires in this region are various, but are always evil, without a single redeeming feature. They are far-reaching and lasting in their consequences, affecting the economic interests not alone of the communities situated adjacent to the burned districts, but even those in most remote localities. The primary interests involved are those of timber and water supply.*

The snowpack melted sooner in burned areas, he observed, causing accelerated runoff, whereas in unburned forest snowpack was retained longer, benefitting summer stream flows. Also:

> *Sterility and aridity of the soil in the mountain districts follow upon the destruction by fire of the forests there. The humus, which is an important soil ingredient, burns readily and is usually completely consumed. Should a bowlder basement [subsoil] exist directly under and in contact with the humus layer, which is the case in many of the canyon bottoms and on slopes as well, complete sterility is apt to ensue, as the remaining soil will wash out from among the bowlders and be carried into the streams.*

Like many other naturalists of that time, Leiberg made no mention of lightning as a source of ignition, although it is today responsible for the majority of fires in the region. He attributed fires prior to 1860 to Indians and calculated a greater than threefold increase in the rate of burning since 1860, due to the prospectors, hunters, and other Euro-Americans who had poured into the region.[46]

During his travels, he observed,

> *It was clearly evident that the regulations of the Interior Department were not being very generally observed.… The roads and trails in the more accessible and generally traveled portions of the reserve were well posted with the department circular calling attention to the penalty provided for the setting of fires. Little attention was paid to it.… In two days' travel on the road from Clearwater post-office to Elk City, six camp fires were seen that had been left burning when the campers departed and were slowly eating their way into the adjacent forests.*[47]

To reduce the threat of wildfires caused by prospectors and hunters, Leiberg recommended establishing a "system of registration and license of all persons entering the reserve."

By the 1930s the U.S. Forest Service had gained broad public

High-elevation fire patterns were visible in the Bitterroot Reserve, Idaho. Leiberg found forest fires to be a pervasive and enormously destructive force in the Bitterroot Reserve.

support for the campaign to prevent and suppress all forest fires. Later it became apparent that the heart of the Bitterroot reserve was better left as undeveloped wilderness, making timber values irrelevant. Moreover, ecological research revealed that fires had functioned as an integral part of Rocky Mountain forests for thousands of years. As a result, during the 1970s the Forest Service established policies that allow most lightning fires to burn in the wilderness portions of the Bitterroot reserve.[48]

FOREST EXPLORERS' RELEVANCE TODAY

Leiberg and the other U.S. Geological Survey forest inspectors were charged with gathering baseline information in preparation for instituting appropriate protection and use of the forest reserves. Did the detailed information they provided, including observations of conditions and needs at the dawn of the twentieth century, influence the initial development of resource management by the U.S. Forest Service? The answer is obscure—thus far historians having paid scant attention to this possible connection.[49] Another question for historians is how Leiberg and his colleagues, using the equipment and technology of the era, could so thoroughly examine and report on vast, remote areas of forest penetrated by only a few rough trails.

Reading Leiberg's account also brings out how times have changed. Today the heart of the Bitterroot reserve and portions of many reserves that were examined by other inspectors are managed as wilderness and roadless areas where forces of nature are allowed to operate largely unfettered. Even in the broad areas of national forest land that have traditionally been managed for timber production, today's management direction often aims to restore some semblance of natural ecological processes and the forest conditions historically associated with them. The forest inspectors' reports provide the most comprehensive information available on the original conditions in extensive areas of western forestland, with maps of late-nineteenth-century burned areas, descriptions of forest structure and composition across the landscape, and quantitative data on some stands. This baseline information is useful for forest restoration work, and it should pique the imagination of people interested in forest history. □

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NOTES

1. Gifford Pinchot, *Breaking New Ground* (1947; repr., Seattle: University of Washington Press, 1972), 109; Harold K. Steen, *The U.S. Forest Service: A History* (1976; repr., Seattle: University of Washington Press, 2004), 33–34.
2. Commentaries from eight prominent newspapers are quoted in *The Forester* 3 (June 1, 1897): 77–78, including the one included here.
3. Pinchot, *Breaking New Ground*, 113, 116; Steen, *U.S. Forest Service*, 51–52.
4. Bernard E. Fernow, *A Brief History of Forestry* (Toronto: University Press, 1913), 485–86.
5. Pinchot, *Breaking New Ground*, 122, 123; Steen, *U.S. Forest Service*, 50–51.
6. Steen, *U.S. Forest Service*, 52.
7. Charles D. Walcott, "The United States Forest Reserves," *Popular Science Monthly* 52 (February 1898): 460–61.
8. Friederich-Karl Holtmeier, *Arctic and Alpine Research* 5 (1973): A45–A54.
9. Walcott, "Forest Reserves," 460–61.
10. Charles D. Walcott, *Nineteenth Annual Report of the United States Geological Survey to the Secretary of the Interior, Part I* (Washington, DC: U.S. Government Printing Office, 1899): 122–24.
11. U.S. Geological Survey, *Twenty-sixth Annual Report of the United States Geological Survey to the Secretary of the Interior* (Washington, DC: U.S. Government Printing Office, 1905): 160.
12. Pinchot, *Breaking New Ground*, 251.
13. Steen, *U.S. Forest Service*, 103–44.
14. Edward B. Chamberlain, *The Bryologist* 18 (May 1915): 47–48; Joseph and Nesta D. Ewan, *Biographical Dictionary of Rocky Mountain Naturalists* (Utrecht, The Netherlands, 1981), 131; Sarah Walker, "John Lieberg," *Sage Notes: Idaho Native Plant Society Newsletter* 21:4 (Fall 1999): 3–14.
15. Walker, "John Lieburg," 4.
16. Ibid., 5.
17. Ibid., 3.
18. Richard U. Goode, "Bitter Root Forest Reserve," *National Geographic* IX (1898): 388. More than two centuries after Lewis and Clark passed over the Bitterroots, the area remains largely uninhabited.
19. John B. Leiberg, *U.S. Geological Survey, 19th Annual Report, Part V* (Washington, DC: U.S. Government Printing Office, 1899): 255.
20. John B. Leiberg, *U.S. Geological Survey, 20th Annual Report, Part V* (Washington, DC: U.S. Government Printing Office, 1900), 317–18.
21. J. B. Lippincott, "Grandeur in an American Forest," *The Forester* 6(2)(February 1900): 25; Goode, "Bitter Root Forest Reserve," 388–90.
22. Rand McNally & Company, *Pioneer Atlas of the American West* (Chicago, 1969), 36–37.

23. Leiberg, *20th Annual Report*, 319, 386; Bud Moore, *The Lochsa Story: Land Ethics in the Bitterroot Mountains* (Missoula, MT, 1996), 15–17.
24. Leiberg, *19th Annual Report*, plate LXVI.
25. Leiberg, *19th Annual Report*, 256–257; David Alt, *Glacial Lake Missoula and Its Humongous Floods* (Missoula, MT, 2001), 7–10, 80–89.
26. Leiberg, *19th Annual Report*, 258–60.
27. Leiberg, *19th Annual Report*, 262–63; and *20th Annual Report*, 325–26.
28. Leiberg, *19th Annual Report*, 264.
29. Leiberg, *20th Annual Report*, 326.
30. Leiberg, *20th Annual Report*, 324; and *19th Annual Report*, 265.
31. Leiberg, *19th Annual Report*, 274.
32. Leiberg, *19th Annual Report*, 274–75.
33. Leiberg, *20th Annual Report*, 322.
34. Leiberg, *20th Annual Report*, 324; Moore, *Lochsa Story*, 372–73.
35. Leiberg, *20th Annual Report*, 336.
36. Leiberg, *20th Annual Report*, 330; Russell Burns and Barbara Honkola, *Silvics of North America. Volume 1, Conifers* (Washington: U.S. Dept. of Agriculture, Forest Service, 1990), 58.
37. Leiberg, *20th Annual Report*, 334.
38. Leiberg, *20th Annual Report*, 342; Ronald M. Lanner, *Made for Each Other: A Symbiosis of Birds and Pines* (New York: Oxford University Press, 1996).
39. Leiberg, *20th Annual Report*, 347; Burns and Honkola, *Silvics*, 305.
40. Leiberg, *20th Annual Report*, 348.
41. Leiberg, *20th Annual Report*, 350, 377; Stephen F. Arno and R. Hammerly, *Northwest Trees* (Seattle, WA: Mountaineer Press, 2007), 29.
42. Leiberg, *19th Annual Report*, plate LXXII.
43. Torbjörn Josefsson, E. K. Sutherland, S. F. Arno, and L. Östlund, *Natural Areas Journal*, 32 (2012): 500–11; Gary E. Moulton, ed. *The Journals of the Lewis & Clark Expedition, Vol. 5* (Lincoln, NE, 1988), 201.
44. Leiberg, *20th Annual Report*, 351–53, 377.
45. Leiberg, *20th Annual Report*, 388–89.
46. Stephen J. Pyne, *Fire in America: A Cultural History of Wildland and Rural Fire* (Princeton, NJ: Princeton University, 1982), 252; Leiberg, *20th Annual Report*, 386–87.
47. Leiberg, *20th Annual Report*, 391–92.
48. Moore, *Lochsa Story*, 409–32. See also Stephen J. Pyne, *America's Fires: A Historical Context for Policy and Practice* (Durham, NC, 2010); Ralph S. Space, *The Clearwater Story: A History of the Clearwater National Forest* 79-03 (Missoula, MT: U.S. Forest Service, Northern Region, 1979).
49. See, for example, Robert D. Baker, L. Burt, R. S. Maxwell, V. H. Treat, and H. C. Dethloff, *The National Forests of the Northern Region—Living Legacy* (College Station, TX, 1993); Pinchot, *Breaking New Ground*; Steen, *U.S. Forest Service*.