As the third chief of the U.S. Division of Forestry (1886–98), Bernhard Fernow was particularly interested in the development and dissemination of scientific data on forestry's environmental impact and economic import. A prolific writer and energetic organizer, Fernow had a hand in the creation of local and state forestry associations as well as of forestry colleges in the U.S. and Canada, giving the profession a powerful boost in its formative years.

BERNHARD FERNOW

ON FOREST INFLUENCES AND OTHER OBSERVATIONS

n 1898, Bernhard E. Fernow, third chief of the Division of Forestry in the Department of Agriculture, responded in 401 pages of detail to Secretary of Agriculture James Wilson's request for a statement of accomplishments during Fernow's twelve-year tenure as agency head. His report—*Forestry Investigations*

and Work of the Department of Agriculture—provides a rich reference to American forestry during the last two decades of the nineteenth century.

Fernow was born in 1851 in Germany and was college educated in forestry. He abandoned a promising forestry career and immigrated to the United States in 1876 to marry his American sweetheart, becoming a U.S. citizen in 1882. By that time, he was much involved in the American Forestry Association, a newly founded conservation group that would be at the center of forestry policy and legislation for the coming century. He was about as prominent a forester as America had.

In 1886, Fernow was named chief of the Division of Forestry, which Congress had made permanent that same year. In 1905, this very small agency would become the U.S. Forest Service. The record reflects his substantial technical skills, including authoring three books, many articles, and translating German forestry reports into English. The record also shows that he was illsuited by temperament to work in the political arena of Washington, D.C., where real and imagined slights by superiors occurred all too frequently. Being treated as an "underling," to use his term, was Fernow's worst nightmare. Family legend insists that his increasing prominence was set upon by mean-spirited journalists to the extent that he turned away from public life.

After Fernow left federal service, he

Bernhard E. Fernow, taken while chief of USDA Division of Forestry. He was the first trained forester to hold the position, and he had one of the longest tenures in the division's history (1886–1898). FOREST HISTORY SOCIETY PHOTO COLLECTION.

BY HAROLD K. STEEN



Chief Bernhard E. Fernow at the Division of Forestry exhibit, part of the Columbian Exposition in Chicago, 1893. Prepared and installed by Fernow, the exhibit was another way of "advancing forestry interests."

founded the nation's first university-level forestry school at Cornell in 1898. Later, he was much involved with founding a forestry school at Pennsylvania State College in 1907 and, that same year, yet another at the University of Toronto, where he remained as a member of the faculty until he retired in 1919. Thus, he contributed very substantially and broadly to North American forestry and forestry education. Fernow died in 1923.

Forestry Investigations begins with a brief history and scope of activities of the Division of Forestry. Fernow continued with an overview of forestry fields, such as silviculture, and he spent two pages answering the question: Is Forestry Profitable? He noted that it could be for the private sector, but profitability per se was

not necessarily essential for the federal reservations that began coming on line in 1891. According to Fernow's careful tabulation, as of 1898 there were 38,944,640 acres of forest reserves, which would be renamed as national forests in 1907. There are more than 193 million acres in the National Forest System today.

Fernow also listed forestry-related publications of the department since 1877, which included forty-seven major studies, twenty circulars, seven formal reports to Congress, and sections in annual reports of the secretary and the *Yearbook of Agriculture*. These annotated citations, which suggest that scientific analysis helped shape public policy and governmental action, include topics such as use of wood by railroads—they used a huge amount; physical



properties of wood—how far can you bend a beam before it breaks; the impact of sheep grazing on forests—it was manageable; and forest influences—the important relation between forests and water supply. This latter topic may be his most lasting contribution and a portion of it is reproduced below.

The sixty-four page section on trees, wood, and naval stores (turpentine and tar) includes a list of the one hundred commercially important tree species, complete with photographs, maps showing where the major species grow, technical sketches of wood in cross-section and various tree parts, and charts tracing rates of growth. These pages are followed with tables that tell us how many sawmills—lumber, shingle, and barrel stave—there were, state by state. We also learn that, according to the 1890 census, forest products were second only to agriculture of all U.S. industries as measured in dollars. Fernow then breaks the big numbers into smaller ones, and provides a list of manufactures: for example, more than five thousand were employed to make cigar boxes but fewer than two thousand made wooden matches. The charts and tables are a resource geographer's dream.

"Propaganda" then lacked today's pejorative connotation, and Fernow used this term as part of a heading to introduce the section on creation of state and local forestry organizations, beginning in St. Paul, Minnesota, with the Minnesota Forestry Association in 1876. "Advancing forestry interests" by "patriotic citizens" would go beyond federal efforts in an important way, he observed, since then as now the majority of America's forests were not in federal ownership. He filled seventeen pages with state programs, with special emphasis on New York, Pennsylvania, and Wisconsin.



Fernow's monumental Forestry Investigations featured illustrations and graphs like these. The illustration is of a longleaf pinecone, and the graphs show evaporation levels in German forests. He typically accompanied his reports with similar material, indicative of his scientific training.

Another useful tabulation is an annotated list of 162 forestry bills introduced in Congress between 1871 and 1897. To that Fernow added a similar list of 52 enacted or proposed laws related to the Timber Culture Act between 1873 and 1897. Even the most skeptical reader of Forestry Investigations will come away convinced that there was a great deal of federal and state activities dealing with forested lands during the latter decades of the nineteenth century, just waiting for the proper mix of political interest to begin what to most of us seems logical today. That is, forestry was not something to be left to the private landowner alone; federal and state involvement was essential. It is this point where Fernow shown most brightly, as his testimony convinced Congress that western watersheds could be protected and logged in accord with standard silvicultural practices. The term then was forest influences; since the 1950s, it has generally been referred to as watershed management.

Fernow was deeply interested in watershed issues. In 1889, his "Influence of forests on water supply" appeared as a chapter in the department's annual report. Four years later in 1893, he put together a volume entitled *Forest Influences*, which incorporated an expanded version of his earlier paper, plus two sections by other authors on the effects of forests on climate and rainfall. This latter "influence" of forests was of great interest to a Congress that two decades earlier had passed the Timber Culture Act. Under this 1873 statute, homesteaders who planted a certain number of trees as part of their bargain to win ownership of the 160-acre parcel would increase rainfall in arid regions and at the same time produce fuel wood, building material, and fence posts. Fernow wrote that favorable links between forests and climate were "difficult to prove," a mild statement by a man who believed such links were insignificant at best. However, a century later there appeared environmental concern that continued deforestation, especially in tropical regions, would adversely affect global climate. It just might be that Congress had been on the right track after all.

But, if he doubted the linkage to climate and rainfall, Fernow definitely believed that forests favorably affected water supply and flow, as he repeatedly testified to Congress. In fact, Congress had generally been convinced that western watersheds needed protection to assure the increasing flood of settlers that their farms would have adequate water to succeed. The sticking point was adding federal involvement that would subtract from state prerogatives. Because of Fernow, the American Forestry Association, the American Association for the Advancement of Science, and the National Academy of Sciences, persistent and authoritative testimony told Congress that federal action was essential, and in 1891 it authorized creation of forest reserves via presidential proclamation. As reported by the chairman of the House Public Lands Committee, Fernow's prestige was such that he convinced them that these reserves could also be logged, rather than just protected as watersheds. All this was leading up to the 1897 Organic Act that defined the purpose of the reserves was to protect water and timber supply.

Fernow included a condensed version of *Forest Influences* in *Forestry Investigations*, revealing just how important he considered his earlier work to be. The "short" version is twenty-six quarto pages, which includes twelve pages of charts that tracked temperature and rainfall under a variety of conditions as recorded at "German stations for forest meteorology." Although he still believed that broad-scale climatic influences were minimal, he definitely believed in local influences—wind speed is higher in openings than in forests, and so on. During the 1930s' Dust Bowl, the federal shelterbelt program was a practical, large-scale application of this earlier knowledge.

Just four years after Fernow prepared *Forestry Investigations*, the Reclamation Act of 1902 would begin supplanting spotty and inadequate state irrigation programs with federal dams throughout the arid West. Thus, America had federal forested watersheds that supplied water to federal dams, making federal presence in the West a dominant fact of life. But it was not Fernow who engineered this second link; it was his much better known successor, Gifford Pinchot, working closely with allies in the Geological Survey, and of course in Congress, that tied the very big package together. With great skill and robust presidential support from Theodore Roosevelt, Pinchot built Fernow's legacy into a powerful conservation movement.

FOREST INFLUENCES

BY BERNARD E. FERNOW, 1898

One of the arguments upon which a change of policy in regard to our forests, and especially on the part of our National Government, is demanded, refers to the influence which it is claimed forest areas exert upon climate and water flow. It is argued that the wholesale removal and devastation of forests affects climate and water flow unfavorably.

Popular writers on forestry, friends of forestry reform, and the public mind have readily taken hold of this proposition, enlarged upon it, and generalized without sufficient and relevant premises, and before it was possible for science and systematic observations to furnish grounds or sound deductions; hence we have only presumptions supported by superficial reasoning and occasional experiences. Even scientific writers have discussed the question without proper bases, and have sought to reason out the existence or absence of such an influence upon general premises and such evidence as the history of the world seemed to furnish, or else upon observations which were either of too short duration to allow elimination or other disturbing factors or else were otherwise unreliable.

From the complication of causes which produce climatic conditions it has always been difficult to prove, when changes of these conditions in a given region were observed, that they are permanent and not due merely to the general periodic variations which have been noted in all climates of the earth, or that they are due to a change of forest conditions and to no other causes; hence some climatologists have thought proper to deny such influences entirely. On the other hand there are as trustworthy and careful observers who maintain the existence of such influences; but only of late has the question been removed from the battlefield of opinions, scientific and nonscientific, to the field of experiment and scientific research, and from the field of mere speculation to that of exact deduction. But the crop of incontrovertible facts is still scanty, and further cultivation will be necessary to gather a fuller harvest and then to set clear the many complicated questions connected with this inquiry....

Leaving the question of forest influences upon climate as still awaiting final solution, we may speak with much more confidence of the effect which forest cover exerts upon the disposal of water supplies. This effect can be much more readily studied and shows itself much more conspicuously. It is perhaps also much more important to human economy, for it is becoming more and more apparent that our agricultural production is dependent not so much upon the amount of rainfall as upon the proper disposal of the waters that fall....

How poorly we understand the use of these supplies is evidenced yearly by destructive freshets and floods, with the accompanying washing of soil, followed by droughts, low water, and deterioration of agricultural lands.

It may be thought heterodox, but it is nevertheless true, that the manner in which most of the water of the atmosphere becomes available for human use (namely, in the form of rain) is by no means the most satisfactory, not only on account of its irregularity in time and quantity, but also on account of its detrimental mechanical action in falling; for in its fall it compacts the ground, impeding percolation. A large amount of what would be carried off by underground drainage is thus changed into surface drainage waters. At the same time, by this compacting of the soil, capillary action is increased and evaporation thereby accelerated. These surface waters also loosen rocks and soil, carrying these in their descent into the river courses and valleys, thus increasing dangers of high flood and destroying favorable cultural conditions.

Here it is that water management and, in connection with it or as a part of it, forest management should be studied; for without forest management no rational water management is possible [emphasis added]. The forest floor reduces or prevents the injurious mechanical action of the rain and acts as a regulator of water flow. Hitherto water management in rainy districts has mainly concerned itself with getting rid of the water as fast as possible, instead of making it do service during its temporary availability by means of proper soil management, horizontal ditches and reservoirs—drainage and irrigation systems combined. It seems to have been entirely overlooked that irrigation, which has been considered only for arid and subarid regions, is to be applied for plant production in well-watered regions with equal benefit and profit, if combined with proper drainage systems and forest management.

The experimental demonstrations of this influence of forests and water flow is also still in doubt, and the problem is as difficult and complex as that regarding the influence on temperature and rainfall. Nevertheless, sufficient experience exists to sustain the general philosophy, to which a close student of nature is forced, long before he can demonstrate the qualitative and quantitative character of an important influence of forests on water conditions.

Harold K. Steen, former president of the Forest History Society, teaches conservation history at New Mexico State University. He is author of The U.S. Forest Service: A History, and editor of Jack Ward Thomas: The Journals of a Forest Service Chief and The Conservation Diaries of Gifford Pinchot, among many other works.

NOTES

1. Bernard E. Fernow, Forest Influences, USDA Bulletin 7, 1893, 197 pp.

The Chiefs Remember: The Forest Service, 1952–2001 *by Harold K. Steen*



ISBN: PAPER: 0-89030-063-1 **\$20** CLOTH: 0-89030-064-X **\$29**

The Chiefs Remember presents excerpts from interviews with Forest Service chiefs whose tenures span fifty years: Richard E. McArdle, 1952–1962; Edward P. Cliff, 1962–1972; John R. McGuire, 1972–1979; R. Max Peterson, 1979–1987; F. Dale Robertson, 1987–1993; Jack Ward Thomas, 1993–1997; and Michael P. Dombeck, 1997–2001.

It was a half-century of rapid change and increasing controversy, marked by words that still clang with contention: wilderness, civil rights, public participation, clearcutting, ecosystem management, spotted owl, environmentalist, timber salvage. Here the former chiefs look back at the issues they faced during their administrations and allow us to glimpse the inner workings of the Forest Service. Sometimes caught unawares by the forces of change, sometimes prescient, by turns humble and defiant but always candid, the chiefs reflect on their efforts to carry out the agency's mission in a time of turbulence.

This book is essential reading for environmental policy analysts, public administration specialists, federal and state foresters, natural resource managers, and historians of forestry and the environmental movement.

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