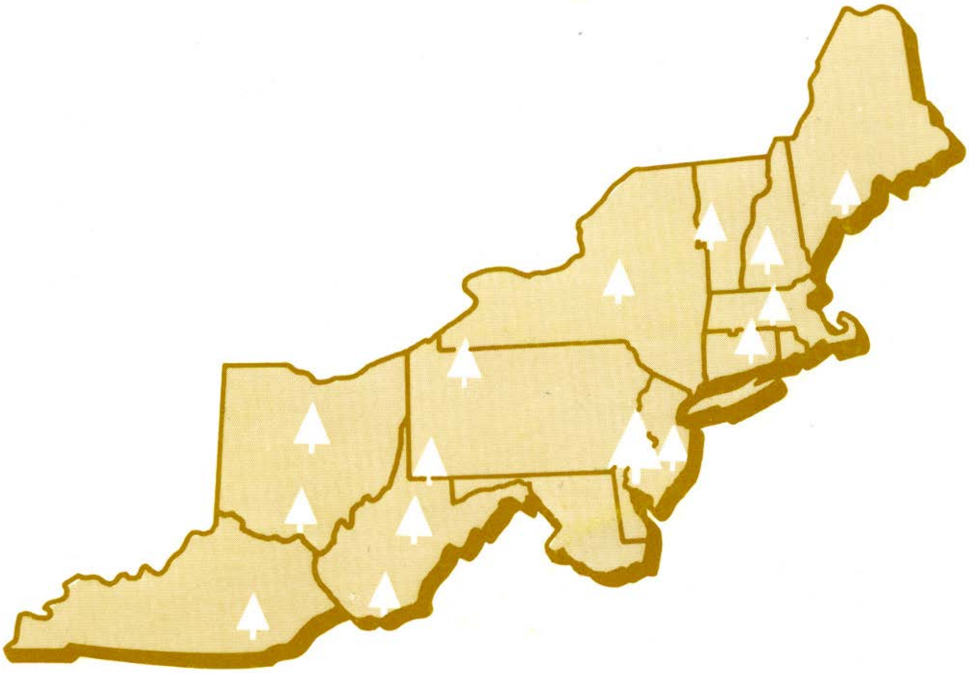
A HISTORY of the NORTHEASTERN FOREST EXPERIMENT STATION 1923 to 1973



U.S.D.A. FOREST SERVICE GENERAL TECHNICAL REPORT NE-7
1973

FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
6816 MARKET STREET, UPPER DARBY, PA. 19082
WARREN T. DOOLITTLE, DIRECTOR

A HISTORY of the NORTHEASTERN FOREST EXPERIMENT STATION 1923 to 1973

by Susan R. Schrepfer
Edwin vH. Larson
Elwood R. Maunder

Susan R. Schrepfer is research assistant in the Forest History Society, Santa Cruz, California, and Elwood R. Maunder is executive director of the Society. Edwin vH. Larson is editor and chief of publications at the Northeastern Forest Experiment Station.

Contents

FIFTY YEARS !

FIFTY YEARS AGO, the Northeastern Forest Experiment Station was established, the first federal forest research establishment in the Northeast. This history was prepared to celebrate that event.

The Northeastern Station began in 1923, at Amherst, Massachusetts, with a handful of scientists. A few years later, in 1927, another small research unit was established at Philadelphia, Pennsylvania—the Allegheny Forest Experiment Station. During World War II, when the Nation's efforts were turned all out for winning the war, forest research was reduced sharply. The Northeastern Station was closed, and its people and projects were transferred to the Allegheny Station.

As the war ended, the research effort was resumed. The Station—renamed the Northeastern Forest Experiment Station—began a steady expansion of its activities, which are now carried on at laboratories and field units in 14 states, by a staff of about 375 people.

BACKGROUND

The Beginnings of Forest Service Research

Nowhere is the scientific foundation of American forestry more dramatically told than in the history of the forest experiment stations established and maintained by the Forest Service of the U.S. Department of Agriculture.

Here is the story of nationally coordinated grass-roots efforts to solve the problems of forest conservation in each of the major forest regions of the United States—efforts that gradually came to encompass research on all the multiple uses of forest land: timber, water, recreation, wildlife, grazing, and environmental amenities.

This history of the Northeastern Forest Experiment Station would not be complete without a brief account of research in the Forest Service before 1923 and the conditions that led to creation of the experiment stations in the Northeast.

The period 1900 to 1915 was the infancy of Forest Service research. In 1909 and 1910 permanent sample plots were first established on the national forests and private lands for determining growth and yield of trees; cooperative studies of forest insects and tree diseases were begun by the Forest Service and the Bureaus of Entomology and Plant Industry; and the Forest Products Laboratory was established at Madison, Wisconsin, to specialize in wood-utilization research.

These early activities needed all the focus and muscle that administrative coordination within the Forest Service could give them. In 1912, district and central committees were organized to supervise all Forest Service research.

In 1915, all research—including that of the experiment stations, the Forest Products Laboratory, and the Branches of Products and Silviculture—was placed under a new Branch of Research, headed by Earle H. Clapp. Thus closer coordination was achieved through the direction of a single administrative unit within the Forest Service. The Branch of Research has governed the experiment stations from its inception till the present.

The First Experiment Stations

By 1921, eight forest experiment stations, designed to tackle regional forestry problems, had been established by the Forest Service. Though small and scantily funded, these stations marked a beginning.

The first experiment stations were all in the West, for good reasons. First, the early research was associated mainly with the national forests, and most of the national forests were in the West.[1] Second, at that time the extent and number of non-federal research programs already under way in the East lessened the urgency for federal research there.

The Yale School of Forestry had begun research projects; so had the New York State College of Forestry at Syracuse University. The Pennsylvania Department of Forests and Waters was conducting more than 60 research projects, and the Pennsylvania State College Department of Forestry operated a research program in association with the State Agricultural Experiment Station. The Maryland State Department of Forestry launched 30 forestry-research projects before 1927, and the New Jersey Department of Conservation and Development was engaged in 35. Connecticut and Vermont Agricultural Experiment Stations employed foresters, and two research foresters were on the staff of the New Hampshire Agricultural College. The Philadelphia and Reading Coal and Iron Company and the Wheeler and Dusenberry Lumber Company funded research programs.

Such developments made it possible for the Forest Service to concentrate its early research west of the Mississippi River.[2]

Research Needs in the Northeast

Despite state and private research efforts, the East had significant unsolved forestry problems. In 1919, Henry S. Graves, Chief of the Forest Service, reported that, although forestry on national forests had made great strides, private forest lands were rapidly being depleted. This was most obvious in the East, he continued, where the supplies of "all our great centers of production" were "approaching exhaustion."

In 1922, William B. Greeley, Chief of the Forest Service, decried the fact that the large sawmills of the country were "in full migration westward to the last great virgin timber supply on the Pacific Coast."

Intensive harvesting had brought about serious depletion. For more than 200 years, the forests of southern New England and New Jersey had been drained again and again for lumber, shingles, ship timbers, and fuel wood. By the 1920s the heavily populated areas of the Northeastern and Middle Atlantic States were able to supply only a fraction of their lumber needs. The people of the East had to obtain their lumber from farther and farther west, paying progressively higher prices due to transportation costs. Many logging communities had become ghost towns.

After the Civil War, when the railroads began extensive shipment of western farm commodities to the East, many of the marginally profitable farms of the Northeast were abandoned and allowed to revert to forest.

Much of the second growth was of commercially less desirable species and of poor quality. By 1920 second and third growth was supplying much of the timber harvested in the Northeast.

Most of these forest lands in the Northeast were in small private ownerships; and owners of small forest tracts, particularly small farmers, could not afford—as big corporations could—to do their own research. Through the Department of Agriculture, the federal government took up the responsibility for research to help forest-land owners, as it had for farmers.

In addition to the need for public action on timber culture on private land, it became obvious to the Forest Service that federal aid was also needed for research in insect and disease control, wood utilization, fire protection, watershed management, and wildlife habitat.

In 1921 the Forest Service made two recommendations to aid eastern forestry. It recommended acquisition of 3 million acres of important watersheds lands in the Eastern States—to be added to the national forests that had been established under the Weeks Act of 1911.

These watershed areas would increase national forest acreage in the East significantly, allowing the Forest Service to further implement its research and management plans. The Allegheny, White Mountain, and Green Mountain National Forests of the Northeast, expanded during the 1920s under the Weeks Act, later provided experimental forests and sample-plot sites for the Northeastern and Allegheny Forest Experiment Stations.

In 1920 and 1921 the Forest Service also recommended creation of a nationwide forest-research system consisting of one forest experiment station for each of the 12 major timber regions of the United States. The Forest Service recognized that research had to focus on conditions unique to the forest types of each region. Completion of this system would mean that four additional stations would be necessary to serve the Northeastern States, the Allegheny Mountain or Middle Atlantic Region, the Lake States, and the California Region. These stations were established in the 1920s.

CREATION OF EXPERIMENT STATIONS IN THE NORTHEAST

The Original Northeastern Station

Congress authorized establishment of the Northeastern Forest Experiment Station in June 1923. Its domain was to include New England and New York, a seven-state area dominated by pine, spruce, fir, and hardwood forests.

The legislation was sponsored by Senators Henry Cabot Lodge of Massachusetts and Henry Wilder Keyes of New Hampshire and Representative Bertrand Hollis Snell of New York. Strong support came from the timberland owners and forest-product industries of the region. One of the most vigorous proponents for establishment of the Station was Samuel T. Dana, then Forest commissioner of Maine.

A native of Maine, Dana went to Bowdoin College, took a master's degree in forestry at Yale in 1907 and then entered the U.S. Forest Service. One of his first jobs, in the Office of Silvics, was to select a site for the first federal forest experiment station, established near Flagstaff, Arizona. He later made the survey that resulted in the choice of Asheville, North Carolina, as the site of the Appalachian Forest Experiment Station.

From 1910 to 1915 he served as assistant chief of the Forest Service's Office of Forest Investigations at Washington, one of the predecessors of the Branch of Research. After an absence due to war duties, he became assistant chief of the new Branch of Research.

Dana knew the Northeast. In 1910 he had completed a study of ghost towns of the East. By tracing the history of these communities, he found example after example of towns that had depended upon the lumber industry for their existence but had virtually disappeared after the timber had run out.

In 1921, Dana left the Forest Service to become Forest Commissioner of Maine.

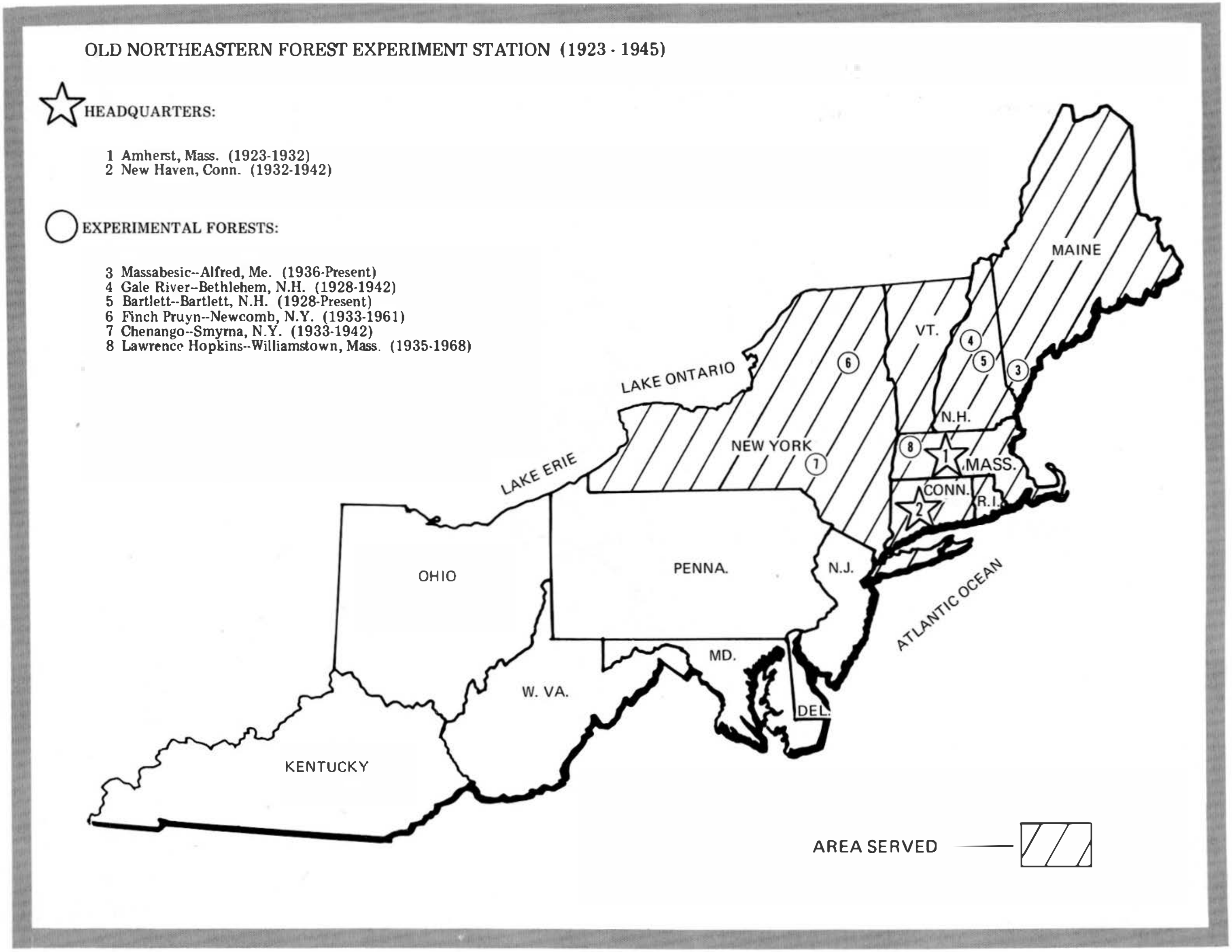
To select a site for the proposed Northeastern Station, the Forest Service called on Dana. By then the Forest Service had developed criteria for locating an experiment station. It preferred a place centrally located in its region, convenient to transportation, and close to library and laboratory facilities. A college or university campus seemed ideal.

The choice narrowed down to the Massachusetts Agricultural College at Amherst, Massachusetts (now the University of Massachusetts). The decision to locate there was due partly to the efforts of Frank A. Waugh, head of the Department of Horticulture, who had previously worked for the Forest Service; he had made the first official inventory of recreational resources of the national forests.[1]

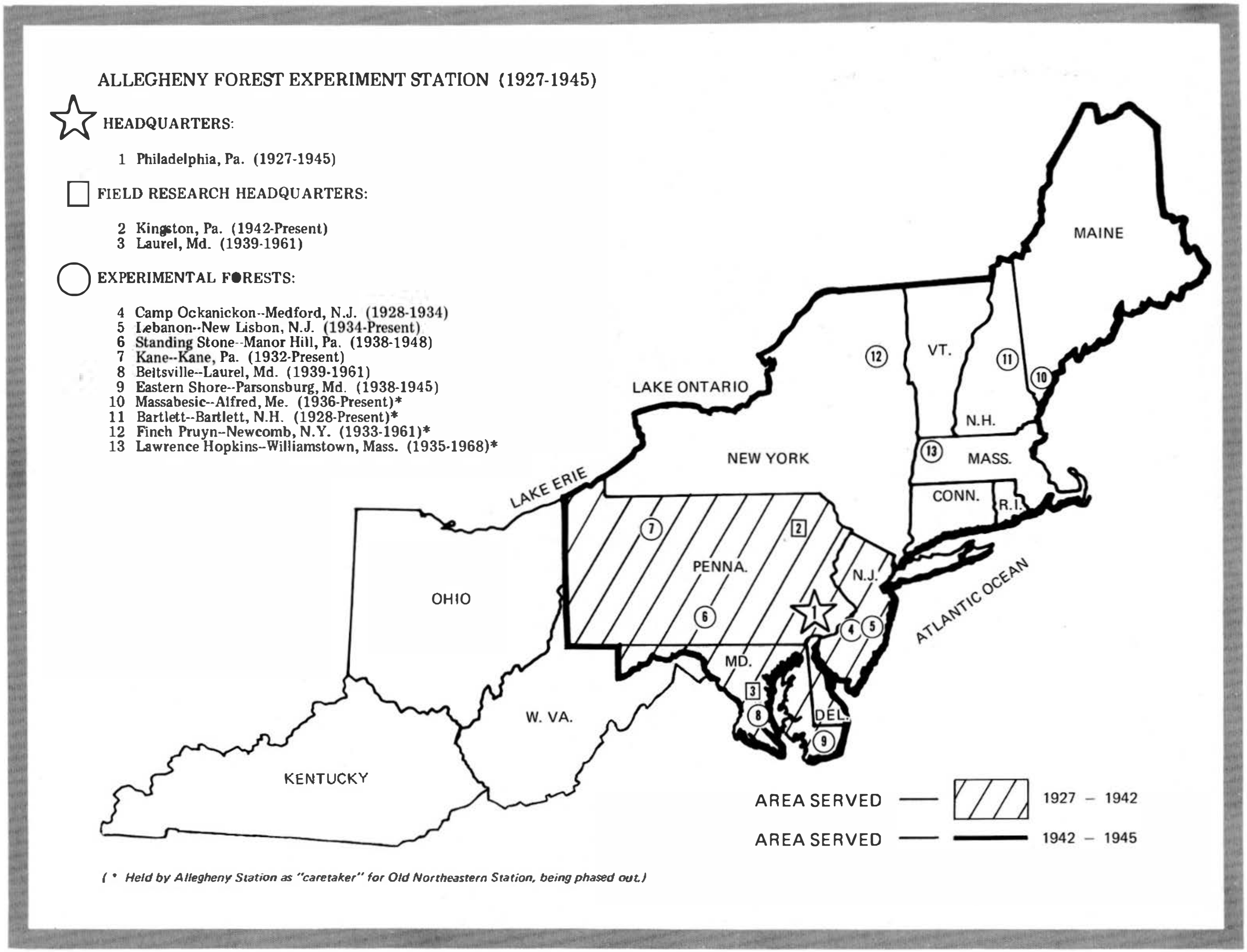
Sam Dana was appointed first director of the Station. Nobody could have been better qualified for the job.

The Station had offices in the College's French Hall and Clark Hall. These quarters were very crowded in winter, when office work took precedence over field work.

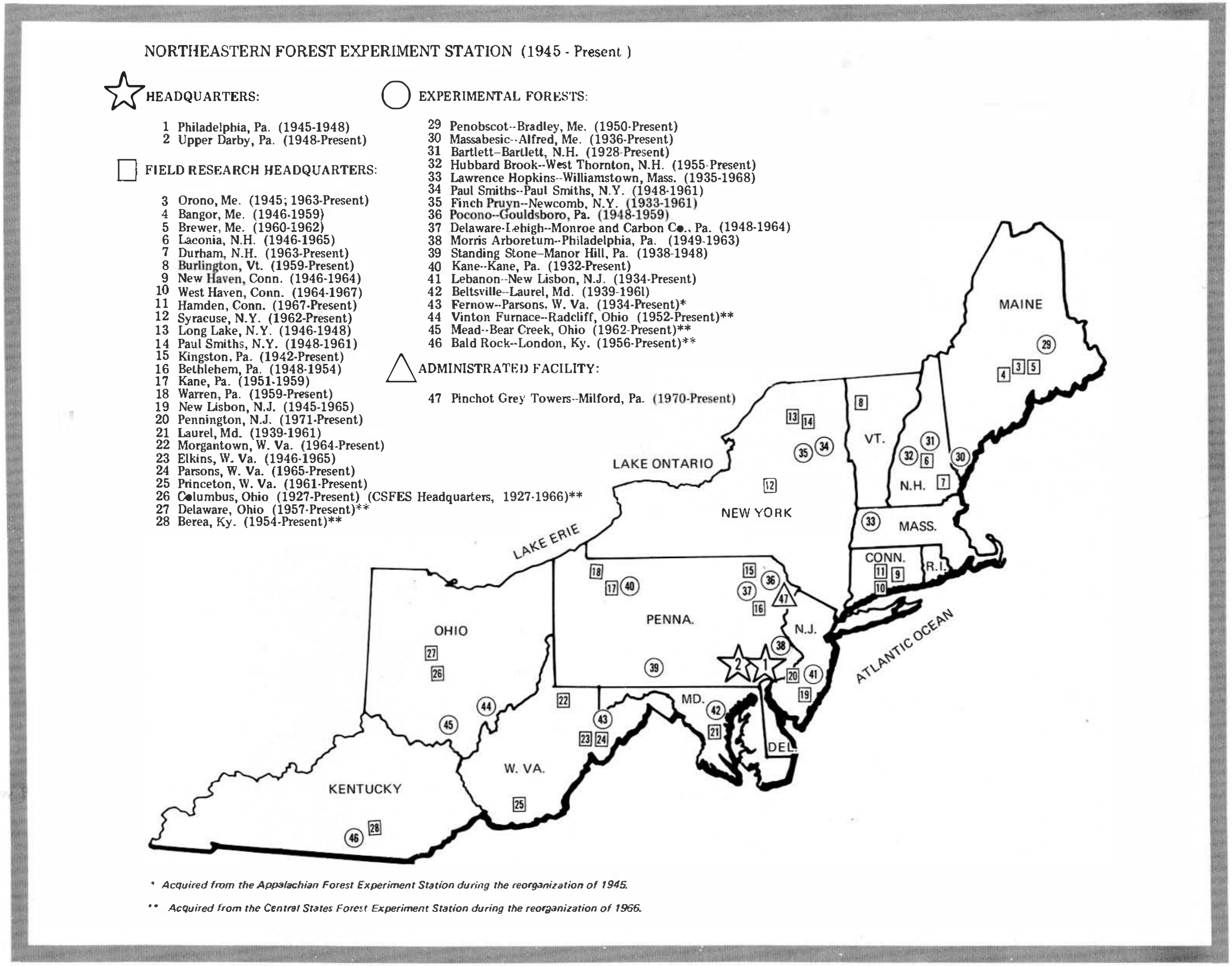
Samuel T. Dana.



The original Northeastern Forest Experiment Station's area of responsibility and its research facilities (1923-45).



The Allegheny Forest Experiment Station's area of responsibility and its research facilities (1927-45).



The present Northeastern Forest Experiment Station's area of responsibility and its research facilities.

The original scientific staff was small, consisting of C. Edward Behre and Marinus Westveld, associate silviculturists, and Walter H. Meyer, forestry assistant.

In 1927, Dana left the Station to become the first dean of the School of Forestry and Conservation at the University of Michigan.

John S. Boyce became the new director. Boyce, a graduate of the University of Nebraska, with master of forestry and Ph.D. degrees from Stanford University, had served a couple of years with the Forest Service, then joined the Bureau of Plant Industry, where he served 15 years as a pathologist. His term as director was brief, for he left the Station in 1929 to become professor of pathology at the Yale University School of Forestry.

Reginald D. Forbes.

John S. Boyce.

The Allegheny Station

Legislation to establish the Allegheny Forest Experiment Station was passed by Congress in 1927. This Station was created to tackle the forestry-research problems of the Middle Atlantic States: New Jersey, Pennsylvania, Maryland, and Delaware.

Reginald D. Forbes was appointed director. Forbes, who graduated from Williams College and took his master's degree in forestry at Yale, had field, research, and administrative experience in forestry. He had served 3 years with the U.S. Forest Service as forest assistant on the Tonto, Carson, and Pisgah National Forests; and 2 years as Assistant State Forester of New Jersey. He was the first State Forester of Louisiana (1917-21) and the first director of the Southern Forest Experiment Station (1921-27).

His first tasks were to establish a headquarters, recruit a staff, find research facilities, and get a research program started. After touring the four-state region by train (automobile travel was slow and inconvenient in those days) to consider various locations for a headquarters, Forbes and Chief Forester Clapp decided on Philadelphia, then railroad center for the region.

The University of Pennsylvania offered the use of a three-story building on its campus and erected a greenhouse on nearby University property for the Station and its collaborators from the Bureau of Plant Industry. The university atmosphere stimulated the Station staff's early interest in fundamental research, manifest in A. B. Hatch's study of mycorrhizae, in staff studies of virgin forests, and in systematic meteorological and phenological observations.

The initial staff was small: silviculturists Ashbel F. Hough, Harold J. Lutz, G. Luther Schnur, O. M. Wood, A. B. Hatch, and Harold F. Morey. Within a few years, Carl Ostrom, J. E. Hetzel, and William Mollenhauer, Jr., had joined the staff. The Bureau of Plant Industry assigned K. D. Doak, L. W. R. Jackson, and Bailey Sleeth to the Station as collaborators. Cooperation later came also from the Bureau of Entomology.

The Station's first research facility was a tract of 340 acres near Medford, New Jersey, lent by the Y.M.C.A.'s Camp Ockanickon. The Station's annual budget at this time was $30,000. By mid-1928, the Station had field work under way. Within a few years, field headquarters were moved to New Lisbon, New Jersey, where the New Jersey Department of Conservation and Development set aside a tract on Lebanon State Forest for permanent use by the Station. Grants of WPA funds enabled the Station to erect an office building and field quarters.

In 1930, the 2,000-acre Kane Experimental Forest was established in northwestern Pennsylvania, on land provided by the Allegheny National Forest. Here too, WPA funding made it possible to build a headquarters office and three dwellings. One hundred acres of the experimental forest were to be preserved for studying the natural forest cycles. The forest also included "thoroughly wrecked cut-over land" and timbered areas suitable for the production of sawlogs and chemical wood (for charcoal and chemical derivatives).

The Allegheny National Forest also made available to the Station an area called Heart's Content, 20 acres of virgin forest dominated by white pines 275 years old. Through promotion by the Pennsylvania Forestry Association, the Federal Government in 1934 purchased the 3,100-acre Tionesta Natural Area, a forest of virgin hemlock and hardwoods on nearby Tionesta Creek, for use in Station research.

About 1937, two other research areas were made available through Department of Agriculture depression programs: the Standing Stone Experimental Forest in central Pennsylvania near State College, and the Beltsville Experimental Forest in Maryland near University Park. The WPA provided funds for buildings on both.

Station research foresters examine one of the early clearcut plots in northern hardwoods on the Bartlett Experimental Forest in New Hampshire. September 1937.

PUBLIC SUPPORT AND GUIDANCE: THE ADVISORY COUNCILS

One of the first concerns of the new forest experiment stations in the Northeast was their relationship with other forestry interests —the universities and colleges, the state forestry agencies, the agricultural experiment stations, the forest-product industries, and the forest-land owners. To fit Forest Service research into the pattern of pre-existing activities called for skilled diplomacy.

Dana devoted much time and attention to public relations, making contact with research groups and timberland owners. He has said that one of his most useful activities in those early years was in establishing a rapport with the region's agricultural experiment stations. The avenues of communication he opened up helped greatly in the administration of the Station.

To gain the support and cooperation of the diverse forestry interests in the region, and to coordinate the Station research program with their activities, Dana organized the Northeastern Forest Research Advisory Council. It held its first meeting on 3 April 1924 in Memorial Hall on the Massachusetts Agricultural College campus at Amherst.

The scope and purpose of the advisory council were defined early. At its first meeting, the Northeastern council decided "that the usefulness of such a committee might be greatly increased by making it an advisory body not only to the Forest Experiment Station, but to other investigators as well."

Such a wider scope, it was believed, would facilitate the coordination of current and future forest research, encourage increased research, and concentrate attention on the problems of greatest scientific and practical importance. Council decisions could not be made mandatory, but would perhaps command sufficient respect to secure better coordination of forest research in the region than had existed before.

The advisory council idea was copied by many other Forest Service experiment stations. One of the first was the new Allegheny Station, where Director Forbes, with the help of Jacob G. Lipman, director of the New Jersey Agricultural Experiment Station at New Brunswick, set up what he calls "an infinitely loyal advisory council" to get cooperation from state, industrial, and private forestry interests in the region. It held its first meeting on 27 March 1929.

Both the Northeastern and Allegheny Councils functioned almost as envisioned by Dana. Each Council consisted of 12 to 15 representatives of colleges and universities, museums and other private institutions, state and federal experiment stations, state executive agencies, wood-product industries, landowners, and a few public-spirited individuals interested in forestry. Membership terms of 4 years were staggered to maintain continuity.

Year after year the councils met to review the Stations' research programs and to give their recommendations to the Station directors. The councils also advised the state legislatures and the U.S. Congress of the legislative and budgetary needs for forestry research in the region. The councils were firm supporters of the Forest Service's efforts to obtain passage of the McSweeney-McNary Act of 1928.

When the two experiment stations were merged during World War II, the two advisory councils were combined. This consolidated council was especially effective in the post-war 1940s in persuading the Congress to greatly expand Forest Service research in the Northeast.

In 1963 the Northeastern Forest Research Advisory Council was renamed the Northeastern Forestry Research Advisory Committee. Its purposes did not change.

The Advisory Committee has continued to the present as a strong and helpful complement to the Experiment Station's research effort. It has helped the Station respond to the needs of the region and has improved relations between the Forest Service and private owners. It has helped to promote increased appropriations for research. It has played a role in getting research results put into practice by forest-related industries and landowners.

THE FIRST RESEARCH PROJECTS

The Northeastern Station

Dana and his colleagues from the beginning saw a need to focus on the most urgent problems. Their first priority was to maintain and strengthen the forest industries of New England and New York so they could provide the lumber needed for present and future demands. Research in the early years focused on the timber-management problems: silviculture, mensuration, and protection from fire, insects, and diseases.

The character of research projects in the 1920s was determined by the management problems in the major forest areas of the region.

In northern New England and New York the spruce-fir and northern hardwood types prevailed. Sparsely settled wild lands contained the bulk of merchantable timber in the region. The hardwood industry suffered from lack of markets, and the softwood lumber industry had given way in large part to pulpwood production, which required accelerated growing of spruce.

A densely populated industrial area, comprising all of Connecticut and Rhode Island, southeastern New York, and most of Massachussetts presented its own set of forestry problems. Here chestnut had once been an important commercial species; but the blight had killed the chestnut, until white pine (always important and dominant in some areas), oaks, and other species predominated. New growth was being cut for portable sawmills, and fires took their toll every year. This area had great potential for recreational and watershed uses.

A third kind of forest zone consisted of scattered farm woodlots and old-field forests. These were areas where abandoned farms had reverted to forest and had been subjected to repeated cuttings. Small inferior growth was common. Because ownership was fragmented, research in forest economics was as important here as timber-management research. Small wood industries existed here, and transportation facilities were available.

In the 1920s, the Station concentrated on the spruce-fir and hardwood forests of the northern wild lands. The spruce-fir of northern New England supplied most of the pulpwood produced in the Northeast. In the 1920s, the Station's silvicultural research on spruce-fir was mainly the work of Meyer and Westveld. Meyer compiled yield tables for even-aged stands of spruce-fir. Westveld's work, begun in 1923 and continued until his retirement, focused on the management of spruce and balsam fir. Through the study of cutting methods, natural reproduction, slash disposal, and cultural methods, Westveld sought ways of obtaining higher pulpwood yields. By 1935 research in the management of spruce indicated that selective cutting usually was, silviculturally, the best way to harvest spruce.

Two experimental forests on the White Mountain National Forest were used for research in spruce-fir and northern hardwoods. One was the 3,350-acre Gale River Forest in New Hampshire, a burnt-over tract—half flat, half slope—of spruce and balsam fir, with hardwoods and some pine. The 5,100-acre Bartlett Experimental Forest at Bartlett, New Hampshire, was ideal for experiments with northern hardwoods. The Station also used the Massachusetts Agricultural College's Mt. Toby Forest and the Harvard Forest at Petersham, Massachusetts.

Several forest-fire studies were made by the Station in the late 1920s and 1930s. Dana compiled and analyzed fire tables. Paul W. Stickel worked for several years on fire weather research, a field pioneered by the Northern Rocky Mountain Experiment Station. Early fire studies were made mainly in the northern portion of the region.

Insect research was important at the Station from the beginning. Of the insect infestations that plagued the Northeast, the greatest and most persistent threat was the spruce budworm. H. B. Peirson, assigned to the Station as a cooperator by the Maine Forest Service, was one of the first to investigate means to stem the epidemic that threatened spruce-fir forests in both New England and Canada. The Station and the Bureau of Entomology also cooperated in the 1920s on research aimed at attacking the white-pine weevil infestation, but with little success.

Few of the Station's cooperative projects proved as rewarding as that carried on, from 1925 into the 1930s, by Perley Spaulding, a forest pathologist from the Bureau of Plant Industry who investigated the fungi involved in the decay of slash. In the West, it was generally necessary to dispose of logging slash by burning or other means to reduce the fire hazard, and many assumed that this would be a necessary or desirable practice in the East as well. Spaulding's work demonstrated that hardwood slash in the Northeast would decay naturally in a reasonable length of time; thus the bother and expense of slash disposal could be avoided. Spaulding also did some of the basic research on white-pine blister rust, and he studied a number of other tree diseases.

Another early project of note was Behre's development of universal volume and taper tables, based on a formula that would give volume for any species from taper and certain other measurements. A modification of Behre's system was adopted in the South.

The Allegheny Station

In its early research, the Allegheny Station followed a pattern similar to that of the Northeastern Station. To increase the timber available for local utilization, the Station emphasized silvicultural research in the dominant lumber-producing forest areas.

In the Allegheny region too, the character of the research projects was determined by the management problems of the different types of forest in the region. There were sparsely settled inland areas of hardwood forest; coastal oak-pine forests; and forest lands associated with the heavily settled metropolitan areas in Pennsylvania, Maryland, and New Jersey.

From 1927 to 1929 the Station staff studied regional problems, evaluating needs and starting research on the most pressing problems. The staff estimated that Delaware, Maryland, New Jersey, and Pennsylvania contained 13 percent of the United States population but only 3.8 percent of the forest area. The region's lumber consumption outran production eight to one.

The staff calculated that, with intensive management, the area could eventually supply itself. To do so would require the production of 176 board feet per acre, and most of the land was believed fertile enough to produce at this rate. However, because the forests of these four states had suffered severely from cutting and fires, it might take more than three-quarters of a century to restore them.

The Allegheny Station's research began in New Jersey, on the Ockanickon tract. L. L. Lee of the New Jersey Agricultural Experiment Station mapped the soils of the area. O. M. Wood of the Station staff studied the various forest types of southern New Jersey.

In the summer of 1928 the entire staff joined in a study of virgin forest at Heart's Content on the Allegheny Plateau in Pennsylvania. Forest soils were studied intensively. Forest types were studied: in those days forest types had not yet been thoroughly classified. By early 1930, the research of the Station, plus work by the Allegheny Section of the Society of American Foresters, had produced a system of seventeen forest types. Late the same year the number was reduced to fourteen.

Meanwhile, Station scientists were acquiring more sophisticated research skills. Luther Schnur was in Washington studying mensuration and statistics. Later, Clement Mesavage, at the Station's center for research in the Anthracite Region, at Kingston, Pennsylvania, studied mensuration under James Girard (who had cruised the Tionesta Natural Area before its purchase for the Station). Mesavage later served at the Southern Station and became a leading Forest Service mensurationist.

The largest project carried on by the Allegheny Experiment Station from 1927 through the 1930s, consuming at times two-thirds of the Station's annual budget, was on the silviculture and management of the commercially important Allegheny hardwoods.

Here Hough began his career-long study of the Allegheny Plateau forests, pioneering research on the ecology, silviculture, and management of the Allegheny hardwoods.

By 1930 the Station had differentiated the main subtypes of this Allegheny hardwood-hemlock forest and had established tentative ecological relationships, the requirements of the principal species for light, moisture, temperature, and other environmental conditions had been studied, and growth habits of the principal species had been described. The reproductive habits, except those of hemlock, were well understood.

As late as 1929 silviculturists generally thought that this hardwood type included white pine. However, the studies on the old-growth Heart's Content preserve revealed that white pine does not reproduce under forest cover and cannot be included in the northern hardwood forest type. Cutting or natural catastrophes such as fire, disease, or insect infestation are required for the growth of white pine even-aged stands. Early research on the northern hardwood-hemlock type—which includes hemlock, yellow birch, beech, sugar maple, red maple, and black cherry—seemed to show that selective cutting was preferable to clearcutting.

The Station had three other dominant projects during these early years. Forest management for southern New Jersey was studied with the hope that forest lands there could be restored to greater productivity. The principal tree species of the Jersey coastal plain were chestnut, white, and black oaks, and pitch and shortleaf pines. All these except shortleaf pine sprout from the stump, so they persist after cuttings and fires, although they are progressively inferior in subsequent generations.

A way had to be found to supplement sprout growth with trees grown from seed. Considerable data were gathered on the relative values of different oak and pine species, the use of fire to increase the production of pine, and the characteristics of sprouting. Many data were gathered on seed production and germination and the detrimental effects of animals, birds, root rots, and injuries above ground.

The Station also accumulated information about the growth of loblolly pine in eastern Maryland. Effects of stand density and age on the diameter distribution of loblolly pine were measured on 73 sample plots that had been established in 1906 by the Maryland Forest Service on private land in Maryland.

One outstanding work in these early years was on mycorrhiza, a symbiotic or parasitic association between soil fungi and tree roots, found on practically every species of tree and woody plant in the Allegheny territory.

Marinus Westveld (left) and Director Behre discuss a spruce-fir pulpwood cutting on experimental plots on the Gale River Experimental Forest. September 1937.

On the Dartmouth Trail thinning plots in a 130-year-old spruce stand on the White Mountain National Forest. The stand as thinned from below in 1933. September 1937.

THE DEPRESSION YEARS
1929 TO 1940

The Depression brought hard times to the Northeastern and Allegheny Forest Experiment Stations. Regular funding was inadequate for the work to be done. Both Stations trimmed and tightened their programs to focus their efforts on the most urgent problems. Economic forestry problems received primary consideration.

In 1929 Behre succeeded Boyce as director of the Northeastern Station. A graduate of the Yale School of Forestry, Behre had served at the University of Idaho as associate professor of lumbering, specializing in mensuration. He had joined the Station at its beginning, as an associate silviculturist.

By 1930 the scientific staff had increased to eight. Westveld was doing research in silviculture, Stickel in fire, and Victor S. Jensen in mensuration. In addition to them, the Station provided office space and facilities for three scientists from cooperating agencies: H. J. MacAloney of the Bureau of Entomology, doing research on forest insects; Perley Spaulding of the Bureau of Plant Industry, working in forest pathology; and J. Paul Miller, a forest biologist from the Biological Survey.

In 1932 the Northeastern Station moved its headquarters from Amherst to New Haven, Connecticut. At that time the Massachusetts Agricultural College was growing and urged the Station to find other quarters. Henry S. Graves, dean of the College of Forestry at Yale University, told Behre that a fine property on Prospect Street had been offered to the University but that the trustees were hesitant about accepting it. "This is not going to be a white elephant," Dean Graves told them; "this is just a challenge to your imagination." So the Northeastern Station moved into Farnum House in New Haven.

C. Edward Behre.

Money Problems

Upon his appointment, Behre worked to expand the Station's program. He pointed out that the Northeastern Station had not received the "substantially enlarged appropriations" that most other Forest Service experiment stations had received. The result was the narrowly prescribed lines of the Station's investigations, most of them oriented toward spruce silviculture and management. Even this limited program, Behre suggested, suffered from lack of coordinated studies by entomologists, pathologists, and biologists. He cited the minimal development of branch stations as a further weakness.

The McSweeney-McNary Forest Research Act of 1928 authorized expanded funding. By 1930, however, the Northeastern Station had not benefited from the increased appropriations stimulated by this act. Behre resolved to seek, under the act, support sufficient "to meet the needs of the Region and keep abreast of development at other stations."

The Allegheny Station had fared little better. Its initial budget of $30,000 in 1928 increased to only $30,845 in 1931, although in

1930 a $10,000 appropriation in accordance with the McSweeney-McNary Act authorization had enabled the Bureau of Plant Industry to assign two pathologists to the Station.

Despite the McSweeney-McNary Act, appropriations did not increase appreciably during the 1930s. The depression and the economy cuts of 1933 and 1934 reduced the Northeastern Station's regular budget one-fourth and the Allegheny Station's one-third. The depression was not, however, totally responsible for the funding problems that plagued the two Stations.

Emergency appropriations of the 1930s, although unpredictable, did much to offset the financial troubles. Relief funds peaked between 1936 and 1939, then dwindled. The Northeastern Station's annual report for 1940 noted that the previous decade had been an era of "dwindling allotments." "Faced with successive reductions in allotments," in a period during which it "had been called upon to widen the scope of its activities", the staff found it "necessary to re-evaluate and concentrate its research efforts."

In 1939 the Allegheny Station's budget was smaller than that of the Northeastern Station. Hough lamented the reduction of research to timber-management problems, ignoring the forest economic, recreational, wildlife, and watershed needs of the region.

There were reasons for this. First, non-federal expenditures for forest research were higher in the Northeast than in any other region, making federal involvement less urgent.

Second, the forestry problems of the Northeastern and Allegheny regions seemed to be less acute than those elsewhere. In forest types that had been exploited in relatively recent years, such as spruce-fir and northern hardwoods, the forests usually recovered after heavy cutting. And in types that had been utilized severely since Colonial times, such as the forests of Connecticut and New Jersey, forest conditions had improved in many areas—mainly because the availability of coal had lessened the need for wood for fuel.

Third, forest economic conditions seemed less dire in the East than in other regions that were experiencing timber shortages for the first time. The people of the Lake States and the South felt, during the 1920s, the effects of the migratory character of the lumber industry. Local depression was new and severe. The New England and Middle Atlantic States had already gone through this stage, in some areas as early as the 1700s. Industrialization and agriculture had grown up, stabilizing local communities. Communities that had depended upon departed timber industries had either found new economic bases or had become ghost towns.

Fourth, the percentage of America's total lumber consumption that the Northeastern and Middle Atlantic States could supply, even under ideal conditions, was smaller than the real and potential output of the South or the Pacific Northwest. Problems of trespass, fire, grazing, and watersheds did not demand sizable federal appropriations in the East, as they did in the West—and the northeastern states had sizable budgets for fire prevention and protection.

Land-ownership patterns complicated the problems of timber management in the Northeast. More than two-thirds of all commercial forest land in New England and the Middle Atlantic States was owned in tracts of less than 5,000 acres. Federal investments in research for Northeastern forests could not be counted upon to yield returns as large as similar investments in southern pine or Douglas-fir forests.

Appropriations for the Station waned in the 1930s. The seriousness of the funding decline in an era when problems were increasing had been hidden by federal and state emergency relief money and manpower as well as by funds for the flood-control survey begun in 1936. From 1937 to 1940, Civilian Conservation Corps allotments decreased to almost nothing. In 1941 the Work Projects Administration program was curtailed, and the flood-control survey was transferred to the Allegheny Station.

Steps Ahead

Despite financial handicaps, the two Stations accomplished a great deal during the 1930s. Declining values made land available to the Forest Service either through donation or at a very low price. National forests and experimental forests were expanded.

By 1936 the Northeastern Station had added four new tracts to the two it had previously established (the Gale River and Bartlett Experimental Forests). The Massabesic Experimental Forest, 2,500 acres in Maine, was purchased from Bates College by the National Forest Reservation Commission for experiments in white pine. The Lawrence Hopkins Memorial Experimental Forest, 1,635 acres near Williamstown, Massachusetts, was a gift from Williams College. A forest of about 600 acres of spruce and hardwoods in the Adirondack Mountains was deeded by Finch Pruyn and Company to Cornell University, which in turn allowed its use by the Station under cooperative agreement. The Chenango Experimental Forest, 534 acres of open farmland in New York, was made available by the State of New York for reforestation research.

By this time the Allegheny Station had acquired three other experimental forests through the Resettlement Administration: the Standing Stone Forest of 1,800 acres in central Pennsylvania; a tract on the Western Shore of Maryland; and 1,000 acres of pine on the Eastern Shore of Maryland.

In the depression decade the two Stations received emergency relief funds and labor. Between 1935 and 1940, the Emergency Relief Administration and the Emergency Conservation Work funneled $30,000 to $80,000 a year into the Northeastern Station's budget. The Allegheny Station received $20,000 to $30,000 per year.

Restrictions on the use of these funds and their uncertain duration meant they could not be used to employ highly trained scientific personnel or to carry on long-term projects. Clerks, draftsmen, stenographers, and laborers were hired instead. These new employees permitted rapid development of sample plots and experimental forests. Capital improvements included the construction of offices and living quarters, roads and fire lines, and electric, sewage, and water plants. Sample plots were marked and trees were cut, pruned, or weeded. With New Deal funds, inventory cruises were made on the experimental forests and records of precipitation and other environmental data were kept.

The Farm Woodlots

During the depression decade, the scope of the Northeastern Station's activities shifted to include forest economics—forest taxation, land use, and forest-fire insurance. The Station ventured into a new economic zone: the farm woodlot areas, predominantly of the white pine and hardwood types.

Economic problems caused by fragmentation of ownership were major obstacles to good forestry on these woodlot lands. There was a variety of small industries, producing box boards, maple sugar, cooperage, and native woodcrafts. But these industries were seldom profitable for the timber grower. Farmers often disposed of the products of their small woodlots unwisely, selling their timber for fuelwood or to inefficient, low-paying portable sawmills. The channel of trade from stump to market needed improvement.

Although the problems of the farm woodlot owner had existed throughout the 20th century, funding for research in this area reached its high point in the 1930s. Behre believes that the sudden spurt in economic research in the mid-1930s was part of the gradual expansion of the Station's programs and not a response to the depression.

There is no question that the Station staff had been aware of the economic troubles of small woodlot owners before the 1930s. Economic research, however, was particularly relevant to the harsh financial realities of the 1930s. In the rural areas of the Northeast, mortgage debts were increasing, relief rates were rising, per-capita income was decreasing, and entire communities were declining. Federal appropriations for economic research in farm forestry were not provided until the Norris-Doxey Cooperative Farm Forestry Act of 1937 and the Bankhead-Jones Farm Tenant Act of 1937.

The Northeastern Station's farm-forestry research program embodied the Forest Service's concept of regional experiment stations as local research coordinators. Even in the early 1930s, the Station coordinated its farm forestry program with state and county planning efforts. The Norris-Doxey Act accelerated this trend by authorizing cooperation between federal and state forestry agencies to aid farmers in managing their woodlots. The Station participated in this program by conducting demonstration projects. The Station's responsiveness to forest problems of local farmers included assistance to farm cooperatives.

One of the most important sources of the Station's federal funding for economic studies during the 1930s was the Bankhead-Jones Act. This legislation established the Farm Security Administration, which in turn financed loans to cooperatives.

The Otsego Cooperative

The cooperative movement was gaining strength at this time, and in some activities cooperatives had been very successful. The Northeastern Station staff believed that the answer to the economic problems of the small woodlot owner might "lie in cooperative logging and milling facilities as well as primary manufacturing facilities . . ." Such control might enable the timber grower—not just the manufacturer—to profit.

The Otsego Forest Products Cooperative Association was established in 1936 at Cooperstown, New York. Its purpose was to help local woodlot owners manage their forest land, harvest their timber, and sell their forest products at a profit.

The Otsego Cooperative grew out of the interest of local people, encouraged by the Northeastern Station's staff, which hoped to serve as a catalyst for local action. Local interest came from many sources during 1935 and 1936, such as the traveling grocery-store proprietor who promoted the Cooperative and later became its manager.

The first 2 years were spent obtaining local support. Eleanor Roosevelt facilitated a federal loan from the Farm Security Administration. Through a small research unit established in Cooperstown in 1936, directed by Charles R. Lockard, the Northeastern Station supplied technical and administrative assistance to the Cooperative and administered the federal loan. M. B. Dickerman, specialist in the economics of private forestry, left the Station in 1940 to manage the new venture for a few years.

The Cooperative built a sawmill for processing forest products, inaugurated a program of forest management, established sales outlets, and developed membership. Despite financial difficulties, the Cooperative had 765 members by 1942 and seemed to be going strong.

Forest Economics and The Anthracite Region

The Allegheny Station also ventured into forest economics in the 1930s. Aware of the social and economic troubles of its region, the staff proposed studies of the dollars-and-cents value of the forests for recreation and watershed protection, the marketing problems of the small wood operators, and the opportunities for forest employment in the coal-producing regions.

In 1939, the Station obtained $18,000 for research on forest employment in the Anthracite Region of Pennsylvania. Prodded by Stanley Mesavage, a self-taught forester, the Wyoming Valley Chamber of Commerce interested Senator Joseph Guffey in the needs of the region.

Ashbel F. Hough measures a 36-inch hemlock in the Tionesta Scenic Area, a virgin hemlock-beech forest in the Allegheny National Forest. April 1934.

In the 15 counties of the Anthracite Region, the total population of 1,600,000 was dependent upon coal. From 1917 to 1940 coal production had decreased by half, and unemployed miners numbered 50,000. There was little likelihood of their reemployment in the mines, and state and county authorities were unable to find suitable relief work projects to effectively combat the serious level of unemployment.

The Station's goal was to use this labor to build up the 2,877,000 acres of depleted forest land in the region to provide raw materials for permanent wood-using industries and esthetic surroundings attractive to recreationists. A plan of action was necessary to bring these two resources–men and trees–together to create a stable forest economy. The Station's first recommendations were for public acquisition of forest lands and a resource inventory of the Region.

The onslaught of World War II halted the project. War-related research needs took precedence over economic research. Unemployment declined in the Anthracite Region.

Genetics Research Begun

The offer of the Oxford Paper Company to transfer its thousands of hybrids and all records of its poplar breeding project (started in 1924) to the Forest Service led to an appropriation for initiation of the forest genetics project at the Northeastern Station in 1936. This Congressional action resulted from the efforts of Director Behre; the late Dr. C. C. Heritage, director of research at Oxford Paper Company; and the late Dr. A. B. Stout, director of laboratories at the New York Botanical Garden.

The appropriation provided not only for continuation of the research with hybrid poplars, but also for genetic research on the improvement of other important northeastern species. The additional funds were sufficient to finance a staff of three professionals–Ernst J. Schreiner, project supervisor, Albert G. Snow, Jr., and John W. Duffield–two subprofessionals, and a clerk-stenographer. PWA and CCC labor was available for routine laboratory and field work.

Drought and Floods

In the 1930's, the need for research in watershed management became apparent, particularly at the Allegheny Station. The Allegheny territory is characterized by three centers of extreme population concentration–Philadelphia, north Jersey, and Baltimore. The task of supplying water for municipal use was stupendous. Little of this supply came from the large rivers, because they were insufficient and polluted. Underground waters were not considered a viable alternative. Populated areas had to draw upon the distant headwaters of major and minor streams.

A severe drought hit the major eastern cities in 1930. Scientists at the Allegheny Station recommended research into the impact of vegetation on streamflow, especially the flow into reservoirs under construction. Some watersheds would have to be planted. The Station believed it would need at least four men for watershed management research.

More disasters occurred before federal appropriations for surveys or research were made available. In the spring of 1936 the flooding of all the major rivers of the Northeast caused an estimated damage of $500 million dollars and uncalculated human suffering. In 1937 another flood, originating in the Allegheny region, ravaged the Ohio Valley. The Flood Control Acts of 1936 and later years authorized the Department of Agriculture, in cooperation with the Army Corps of Engineers, to survey the watersheds of the principal streams of the Northeast to ascertain whether or not the condition of the watershed vegetation had contributed to the floods.

Between 1937 and 1941 the Allegheny Station had been given primary responsibility for the Passaic and Pequest River surveys and the Connecticut River survey and participated in field work on the Allegheny River, the upper Susquehanna River, and Solomon Creek. Arthur Bevan was in charge of these surveys. In 1940 the Allegheny Station took over the Northeastern Station's small flood-control survey program.

The Connecticut study revealed techniques of agricultural land management that could be used to alleviate the conditions that produce flood runoff and erosion. The Station found that forest soils have a significant capacity to take up water rapidly during periods of excessive rainfall and to give it off slowly. The Station's participation in the flood-control surveys was curtailed in 1942 because of the war. Responsibility for these surveys was transferred from research to the Regional Office in 1953.

The Hurricane of 1938

The catastrophic hurricane of September 1938, which severely damaged a wide swath across New England, swept the Northeastern Station into 2 years of disaster emergency activity. Cleaning up blown-down timber was a great challenge for the many public and private agencies that cooperated to tackle the job. The Station's main contribution was to prepare slash-disposal standards based on silvicultural considerations. These standards were used in the cleanup of the hurricane zone. The Station also studied the economic impact of the hurricane on the local communities.

Salvage of timber blown down by the hurricane disclosed three facts about New England: the low quality of its second-growth timber; the low level of its forest-product manufacturing operations; and its marketing problems. As a result, the hurricane stimulated the interest of the Station and other agencies in planning a regionwide forest policy plus a program of state regulation.

The hurricane was a blow to the Station's own research program. Almost 70 percent of the 663 sample plots on the Gale River and Bartlett Experimental Forests were damaged. Many had to be abandoned. Years of study were lost, and months of inventory and cleanup were necessary.

Hurricane damage on the Gale River Experimental Forest. September 1938.

A Change at The Allegheny Station

Forbes left the Allegheny Station in 1939 to go into private business in forestry consulting, teaching, writing, and editing. He had organized the Station, recruited a staff, formed an Advisory Council, acquired research facilities, and initiated a research program.

Hardy L. Shirley succeeded Forbes as director of the Allegheny Station. Shirley, a graduate of the State University of New York College of Forestry, with other degrees from Indiana University, Yale University, and the University of Helsinki, had taught for several years before joining the U.S. Forest Service as a silviculturist.

Hardy L. Shirley.

THE WAR YEARS 1941 TO 1945

Northeastern Station at New Haven Closed

World War II hit the experiment stations of the Northeast very hard—after they had already been struggling through the Depression with inadequate financing. The Forest Service—trimming its sails to the winds of war—decided to close down the Northeastern Station at New Haven.

On 30 June 1942, Director Behre announced that the Station was closed "for the duration or longer". The research scientists, some of the clerical staff, files, property, and the three most important research projects were transferred to the Allegheny Station in Philadelphia.[3] Behre went to Washington to take up new duties for the Forest Service.

The New Northeastern Station

The new combined unit at Philadelphia was renamed the Northeastern Forest Experiment Station. It was to be responsible for federal forestry research in the New England and Middle Atlantic States. Thus began the present Northeastern Station.

About this time the Station moved its headquarters from the University of Pennsylvania campus to larger quarters in central Philadelphia.

Director Shirley was confronted at once with a diplomatic problem: many of the supporters of the old Northeastern Station, including some of the Advisory Council, were disgruntled at the closing of the New Haven office. Shirley and Westveld toured New England, seeking continued support, and they received a generous response. The Advisory Council was reconstituted to include representation from the entire region; and this Council has operated effectively ever since.

These were trying times. All but the major projects were placed on a mere maintenance basis. Many men from the Station joined the armed forces, including George Fahnestock, Robert Gregory, and John McGuire. G. R. Trimble went to the upper Amazon to work on production of cinchona bark, source of quinine. The Station went onto a 6-day 48-hour work week. Gasoline rationing added to the strain. But the work went on.

Wartime Research

Timber for war use became a major concern. A small program had already been begun in cooperation with the Forest Products Laboratory to expedite logging, lumber manufacture, and secondary timber processing. Fred C. Simmons was appointed to work on logging and milling, and Roy M. Carter on secondary processing. Their work helped many new loggers and sawmill men who, stimulated by high wartime prices, went into the lumber business.

Silas Little—one of the first foresters to anticipate the use of fire as a silvicultural tool, not only to minimize damage from wild fires, but also to control species composition—carried out research on prescribed burning in New Jersey, in cooperation with state foresters. This work was impelled partly by the need to control fires around military bases in the New Jersey Pine Barrens. Some of the old-line firefighters objected to this use of fire, but subsequent research confirmed the effectiveness of controlled burning as a silvicultural tool.

A survey was made of the forest resources of the Anthracite Region of Pennsylvania, which were found sadly depleted. Soils were thin, impoverished by fires and erosion. This survey laid the groundwork for later forest-survey work. Miles Ferree, Earl Rogers, and Roland Ferguson developed the use of aerial photos for survey work and contributed toward techniques that aided in developing the present forest-survey system.

The Station also studied the problems of rehabilitating coal-mine spoil banks in the Anthracite Region, anticipating the present growing concern for the environment. William E. McQuilkin of the Station staff worked on this project. J. R. Schramm of the University of Pennsylvania Botany Department encouraged this work and supported it. The problems involved much more than rock and coal wastes: acid in water from mines and mine spoils, black soils that reached temperatures lethal to plants, and absence of soil flora and fauna to help break down the minerals to create conditions favorable for tree growth.

The Station owed much at this time to Clement Mesavage and his brother Stanley, who had a passion to better the environment and economic welfare of people in the Anthracite Region. Their efforts helped gain Congressional support for the Station's work in the war years.

One highlight of the war years was the work of Ash Hough, who studied reproduction of hardwoods on the Allegheny Plateau. He found that good reproduction of valuable species like black cherry came in after the first clearcutting of old-growth timber, but that repeated cutting of second- and third-growth pole stands for chemical wood led to rapid deterioration of the forest stand. Hough also contributed to the understanding of old-growth natural stands.

The Beltsville Experimental Forest in Maryland was built up during the war. Little money was available, but with the help of conscientious objectors assigned to wartime work with the Forest Service, the facilities were improved and research work was pushed ahead. Studies were made of waxy sprays to increase survival and growth of tree seedlings by reducing transpiration, and dressings to speed the healing of tree wounds were tested.

The Station continued to support the Otsego Cooperative. The Cooperative was helped by high wartime lumber prices, and despite financial and managerial problems, looked promising. But after the Station discontinued its Cooperstown unit in 1948, the Cooperative began a slow decline and eventually failed. Later studies showed that the Cooperative's greatest success was its sawmill operation—not its forest-management program.

The staff also contributed to miscellaneous war-time studies such as methods and materials for camouflage.

A Civilian Conservation Corps crew cutting stump sections for study after logging of virgin hardwood forest near Ludlow, Pennsylvania. August 1936. During the depression years, the CCC provided manpower for Forest Service research.

A CCC crew plants red pines for a seed-source study at the Kane Experimental Forest in Pennsylvania. April 1937.

EXPANSION
1945 TO 1973

The war ended. The nation turned its attention back to domestic problems. An era of expansion in forestry research began.

In 1945, Hardy Shirley left the Northeastern Station to become assistant dean, and later dean, of the State University of New York College of Forestry at Syracuse. Shirley had consolidated the two old experiment stations into the new Northeastern Station, kept it going productively through the war years, and now left it "in tidy order for my successor".

Verne L. Harper was his successor. Harper received his bachelor's and master's degrees in California and his Ph.D. at Duke University. From 1927 to 1937 he served at the Southern Forest Experiment Station, mainly on naval-stores research, advancing to chief of forest management and forest influences. From 1937 to 1943 he served as assistant chief of the Division of Silvics in the Forest Service Washington office, and from 1943 to 1945 he was chief of the Division of Forest Economics Research.

Verne L. Harper.

A New Era Begins

Harper foresaw "a new era in forestry research." He predicted that the growing population of the Northeast would put increasing pressures on the forest resource. A broader concept of forestry was needed. "Forestry," he said, "embraces much more than planting and growing timber and protecting it from fire."[4]

In 1946, peace-time forest needs assumed a priority they would hold despite the Korean War emergency of the early 1950s. Mid-century America was faced with sustained international tensions that prompted intensive research into the nation's long-term forest needs.

Harper put high priority on working closely with individuals and groups throughout the Northeast to bring about the new era in forestry research. These groups included the Station's Advisory Council; heads of universities; agricultural experiment stations and forestry schools; state forestry and conservation departments; river-basin councils and watershed associations; sportsmen's clubs; and state and federal legislators.

The first task, which absorbed most of Harper's time beyond his internal duties as director, was to build a widely shared awareness of the many benefits to be gained from the region's richly endowed forest land under a program of advanced management and use, and of the contributions that could be made to proper management and use through adequate forestry research. The second task was to translate awareness into *public response* that would lead to increased federal funding of the Station's programs.

Results were not long in coming. In 1946 flood-control surveys were resumed to cover, over a period of years, all the major river basins in the Northeast.

In that same year the national Forest Survey for the first time was brought to the Northeast with a commitment to the Station for the employment of a permanent survey organization to make periodic inventories for keeping up-to-date information on timber volumes, quality of wood, and associated forest conditions.

Forest economics research, closely associated with the Forest Survey, was strengthened in 1946 and subsequent years. New programs were launched in logging and timber utilization and marketing studies. Timber-management programs received a substantial increase in 1946 and subsequent years to enable the Station to launch a steady silvicultural research push in each of the region's principal forest types.

Forest-genetics research was strengthened. Watershed research, previously funded on an emergency or survey basis, got regular sustained funding, beginning in 1947, that permitted the establishment of projects in West Virginia and Pennsylvania. Wildlife-habitat studies were undertaken in 1947 in West Virginia in cooperation with the State's Department of Conservation.

By then the Station's headquarters offices in Philadelphia had become crowded with people and activity. In May 1948 the offices were moved to more spacious quarters in Upper Darby, Pennsylvania, a suburb of Philadelphia.

In 1949 a severe drought occurred in New York and northern New Jersey. That same year, two serious floods occurred, one in New York and Connecticut, the second in Virginia and West Virginia—both attributed to runoff from overgrazed, burned, logged lands that could not absorb the heavy rainfall. Flood-control surveys were extended.

Urged by the Station's Advisory Council, the Delaware River Basin Council, and other local groups concerned about water problems in the postwar 1940s, watershed-management research was broadened as a regularly funded part of Station research in New England and the Middle Atlantic States. Research programs begun in 1946 and continued in the 1950s and 1960s helped to bring improved knowledge of forest-watershed management, more secure municipal water supplies, and greater soil stabilization in the region.

Equally significant to research progress, the Station began programs of research-facility-improvement and personnel development. Enlarged headquarters of the Station were equipped with the latest models of data-processing equipment, and new aerial-photograph techniques were pioneered. Laboratory and office space was renovated or newly constructed at the Station's field centers.

A personnel-development program was begun that stressed advanced training and assignments calculated to enhance scientific skills and research performance. Many of the Station's scientists recruited during the postwar 1940s later went on to higher positions elsewhere.

For example, Thomas F. McLintock, recruited in 1946, directed the Station's timber-management research in the spruce-fir type, then went back to school to acquire his Ph.D. After several assignments at other stations, he was called to Washington as director of the Forest Service's Division of Environmental Research.

Herbert C. Storey, who came to the Station in 1948 to establish the new watershed-research project in Pennsylvania, became chief of watershed-management research at the Station, and then went to Washington as director of Forest Service watershed research for all stations and, later became associate deputy chief for research.

And John R. McGuire, recruited in 1946 to establish the Station's white pine management program, took advanced training in economics, became head of the Station's economic research, became director of another station, and in 1972 was appointed Chief of the Forest Service.

Continued Progress

In 1951, Harper left the Northeastern Station to go to Washington as Forest Service Deputy Chief of Research, later becoming Chief of Research. He had directed the Station through its period of greatest growth, from the smallest station in 1945 to one of the largest in 1950. At the Station, and later at the Washington office, he laid the foundations for future

Ralph W. Marquis.

research by all the Forest Service experiment stations.

Ralph W. Marquis succeeded Harper as director in 1951. Marquis, a graduate of the University of Washington, with M.A. and Ph.D. degrees from the University of Wisconsin, was an associate professor of economics at Rochester University before joining the U.S. Forest Service in 1940 as a forest economist on the Washington office staff.

The "new era in forestry research" that Harper had predicted came to pass. America's transition from a nation with a surplus of raw materials to an importer of raw materials forced recognition of the need for resource conservation. Domestic consumption of wood products soared. Forest land values increased dramatically. Profits rose in the forest industries. More effective and efficient methods of timber production, utilization, protection, and regeneration became imperative.

Pressures on the forest resource increased steadily. Forest uses other than timber production came into prominence, causing conflicts. Urban centers grew. Forests became even more essential for municipal water supplies, flood control, recreation, and wildlife habitat. In some places these uses became more important than timber production.

Since its inception, the Forest Service had assumed responsibility for research into all forest uses. During the 1950s and 1960s, responding to consumer and environmental needs, the Forest Service articulated its multiple-use policies. In 1960 Congress passed the Multiple Use-Sustained Yield Act, defining multiple use as management of "all the various surface resources" of the forests so they are "utilized in the combination that will best meet the needs of the American people."

Following this policy, the Northeastern Station expanded its activities to coordinate development of research on all forest uses. Timber management and associated protection and utilization, emphasized at the start of Forest Service research in the Northeast, remained prominent in the program. But watershed management and forest economics, explored in the 1930s and tackled in earnest in the postwar 1940s, assumed equal importance. And in 1959 wildlife-habitat and recreation research became regular parts of the Station program. Environmental considerations caught increasing attention from Station scientists in the 1960s.

In both the older and newer research fields, new techniques and approaches were tried. Chemicals were discovered that proved valuable to the forester for disease, insect, and fire control as well as stand improvement. Biological controls and radiation were tried for the first time in the forest. Use of aircraft revolutionized inventory surveys, fire suppression, and disease and insect control.

Use of high-speed electronic computers made it possible to store great amounts of data and to sort them and retrieve information quickly and easily. New mathematical models were applied in all fields from timber management to recreation. Researchers probed problems with behavioral models, simulation procedures, and systems analysis.

As research needs and capability increased, so did Station facilities. Funding increases in the 1950s allowed laboratory construction and larger staff. Despite some budgetary limitations in the 1960s, Station programs continued to grow. Old projects were completed and new ones begun, many of a kind not visualized in earlier years.

Administrative Changes

To cope with the increasingly complex research programs and problems, the organizational structure of the Station was modified.

When, in the late 1940s, the Station organized research centers, these were seen mainly as locations for timber- and watershed-management research--though a few special centers were devoted to other projects such as genetics. Most of the other research activities were centered at the Station's headquarters.

The research centers were like miniature experiment stations, each with its leader who was responsible for all projects. As the 1950s passed, it became obvious that this arrangement had its disadvantages. The research center leader was overburdened with administrative chores, and the setup clamped a low ceiling on grade advancement of project scientists.

It became obvious that further decentralization was desirable for expanding programs in forest product marketing, forest engineering, and wildlife habitat—especially as the nationwide program of laboratory construction got under way.

In the servicewide reorganization of research in 1959, a new structure was adopted. By 1960 the Northeastern Station—like all the other stations—had decentralized so that the basic unit became the project.

Each project leader was responsible for his research work unit. He looked to an assistant director at headquarters for direction and coordination. Meanwhile, administrative people were assigned to the field units to relieve the scientists of most administrative chores. This was in line with the national policy to deemphasize administrative layers and to emphasize the training and advancement of project scientists.

The number and locations of the field units varied in the 1950s and 1960s in response to changing needs and appropriations. In 1958 there were 11 centers. This number increased until 1965 and 1966 when budgetary cutbacks placed a ceiling on the number of employees. Then the Station began to consolidate field locations. There are now 14 project locations—all different from those of 1958.

In a Department of Agriculture reorganization in the early 1950s, forest insect and disease research was transferred from the Agricultural Research Service to the Forest Service. The Northeastern Station assumed direct responsibility for such research in its region. The Station's insect and disease research is now carried on at modern laboratories at Hamden, Connecticut; Delaware, Ohio; and Durham, New Hampshire.

In 1966, Ralph Marquis left the Station, called to the Washington office to serve as assistant to the Deputy Chief for Programs and Legislation. Marquis had steered the Station through changing times and continued expansion. He was concerned with expansion to encompass the many new facets of research required by the multiple-use concept, laboratory construction, and the shift from the research-center-leader concept to the project-leader organization. Marquis died the day after he retired from the Forest Service, 14 December 1966.

Richard D. Lane succeeded Ralph Marquis as director. Lane took his bachelor's and master's degrees at Iowa State College and joined the Forest Service at the Central States Forest Experiment Station, served a while in National Forest Administration, then returned to the Central States Station, where he headed the Carbondale research center in 1947-56. He served at the Northeastern Station in 1956-59 as chief of the Division of Timber Management, then on the staff of the Timber Management Research Division in Washington for 1 year and back to the Central States Station, where he was director in 1960-66.

Lane came back to the Northeastern Station as director early in 1966, when the Forest Service reorganized its eastern experiment stations. In this reorganization the Central States Station, headquartered at Columbus, Ohio, was closed; and its personnel and projects were divided between the Northeastern Station and the North Central Station. The Northeastern Station took on added responsi-

Richard D. Lane.

bility for federal forestry research in Ohio and Kentucky, which increased its area of responsibility to 14 states.

At this time, the Northeastern Station's headquarters were moved to their present location at 6816 Market Street in Upper Darby, to occupy the same building as the State and Private Forestry Northeast Area office.

With this reorganization, the Northeast became the only place where the Forest Service has headquartered a regional State and Private Forestry director's office with an experiment station, separate from national forest administration. This emphasized that a major task of State and Private Forestry is to promote the adoption or implementation of research findings by the states and private industry.

This realignment strengthened cooperative forestry programs on state and private lands and provided a closer link between these programs and the research of the Forest Service in the East.[5]

Director Lane left the Station in 1970. During his time as director, he worked to coordinate the activities of the Station with the State and Private Forestry organization. The development of cooperative relations was important among his activities. To promote the nationwide policy for cooperation with State and Private Forestry to get research results into use, he established an information service in the Station, to disseminate research findings through the mass media of radio, television, and the press. In 1970 Lane transferred to the Agricultural Research Service and took an international assignment in forestry in New Delhi, India.

In 1970, Warren T. Doolittle succeeded Lane as director. A silviculturist and soil scientist by training, Doolittle took his bachelor's degree at Iowa State University, a master's degree at Duke University, and a Ph.D. at Yale. He served as a research forester at the Southeastern Forest Experiment Station in 1946-57, at the Washington office in 1957-59, and came to the Northeastern Station in 1959 as assistant director for research in timber management, watershed management, engineering, recreation, and wildlife habitat. In his 2 years as director he has worked to strengthen the research effort in general. In particular Doolittle has promoted the development of environmental forestry research.

Warren T. Doolittle.

SOME HIGHLIGHTS OF RESEARCH ACTIVITIES AND ACCOMPLISHMENTS

Timber Management

The Northeastern Station's timber-management program has revolved around the silviculture of the five dominant forest types of the Northeastern Region.

The spruce-fir forests occur in northern Maine, northern New Hampshire, the Adirondacks of New York, and to a minor extent in the mountains of West Virginia. Research on this forest type is centered at Orono, Maine, where Station researchers are studying problems of reproduction, cutting methods, growth, soil nutrition, and protection against animal damage. Acceleration of spruce regeneration has been a major consideration, crucial to the pulp and paper industry, one of the leading forest industries of the region.

Northern hardwoods—beech, yellow birch, and sugar maple—are found predominantly in New England, New York, and Pennsylvania. Although these hardwood forests regenerate naturally, maintenance of stand quality is difficult. After cutting and burning, some areas may be taken over by aggressive and less desirable species such as aspen, pin cherry, or gray birch.

Research on stand quality has been under way for many years on the Bartlett Experimental Forest and is now conducted from the laboratory at Durham, New Hampshire. Researchers concluded long ago that artificial regeneration, through planting or seeding, is uncertain and expensive.[6] Early elimination of competitors is preferable for favoring the desirable species that seed in naturally. Station researchers found methods of killing the fast-growing weed species, including the use of herbicides, tree girdling, and weeding. The Station also maintains a project, now centered in Burlington, Vermont, for studying methods of increasing sugar maple sap production.

The white pine-hardwood forest type is found roughly in the middle of the Northeastern Region—southern Maine, New Hampshire, Massachusetts, Connecticut, New York, and Pennsylvania. White pine is a desirable commercial species that does not always reproduce well naturally.

In 1955 the Station broadened its white pine project, begun in the 1940s, into a comprehensive program embracing many facets of forest production. One problem was to establish white pine reproduction free of hardwood and brush competition.[7] By 1969 part of this problem was solved with a direct-seeding method that proved practical: the seeds were planted in furrows with a tractor-drawn machine.

The oak—yellow-poplar forest type is found in southern Connecticut, parts of New York, most of New Jersey except the Pine Barrens, southern Pennsylvania, central and western Maryland, and nearly all of West Virginia. The composition of this forest type varies greatly according to elevation, latitude, and soil. Research on this forest type, though focusing on regeneration, has ranged from a search for methods of protecting planted acorns of the coastal oaks to studies of stocking for the upland hardwoods—oak, yellow-poplar, maple and hickory—in Ohio.

In 1971, after 20 years of study, the Station was able to make confident recommendations for the management and silviculture of these upland oak stands.[8]

The need to improve conditions of the long-abused forests of the Coastal Plain was urgent because of their proximity to large population centers. The research center at New Lisbon, New Jersey, had success in regenerating yellow-poplars of the Coastal Plains and Piedmont.

The yellow pine-hardwood forest type—a relatively minor one—is found along the coastal areas of Massachusetts, New York, New Jersey, and Maryland. The yellow pines include pitch, loblolly, shortleaf, Virginia, and pond pines. The most common associated hardwoods are oaks, hickories, red maple, white-cedar, blackgum, sweetbay, sweet gum, and holly.

Pines are the preferred species on most sites, but Atlantic white-cedar is preferred in the swamps. Silas Little, at the research unit at New Lisbon, New Jersey, did outstanding research on the ecology, silviculture, and management of white-cedar and its associated species.

Studies of the pine-hardwood forest type in New Jersey before 1950 dealt with methods of obtaining natural reproduction through using fire or machinery for seedbed preparation, and prescribed burning for reducing fuels on the forest floor to protect the forest from wildfires. After 1950 similar studies were made in eastern Maryland, as well as allied studies in both states on types and techniques of herbicide treatments for controlling undesirable hardwoods in different forest conditions, effects from different kinds of thinnings, growth of pines from different geographic sources, methods of direct seeding, and effects of planting methods on stem growth and root systems.

Silvicultural Systems and Cutting Methods

During the past 50 years, the Station has tested many methods of intermediate and harvest cutting in different forest types, in a search for the kinds of silviculture that will keep the land producing high-quality timber of the most desirable species. Studies covered both uneven-aged management with many intensities of selection cutting, and even-aged management with various forms of regeneration cutting, including clearcutting.

The concept of selection cutting was brought to this country by foresters trained in Europe early in the century. In this kind of silviculture, periodic inventories are used to keep track of stand growth, and individual trees or small groups of trees are selected for harvesting at relatively short intervals to conform to the stand growth rate. The objectives are to remove products at only the rate at which they are grown (or at a somewhat lesser rate if it is necessary to build up growing stock) and to keep on the land a continuous, well-stocked forest cover in which all age classes of trees, from saplings to maturing sawtimber, are heterogeneously intermingled.

In even-aged management, age classes are kept separate. The forest is regulated to contain all age classes of trees distributed among many stands, but in any one stand the trees are all the same age. Each stand is treated as a unit while the trees within it grow from saplings to sawtimber. At maturity the stand is regenerated as a unit by one of the types of regeneration cutting, all of which have one thing in common: for a short period after the final cut, the stand is devoid of any large tree cover, though seedlings and small saplings may be numerous. In even-aged management, sustained yield is ensured by controlling the amount of area in each age class and by proper timing of the regeneration cutting.

As time passed, evidence from Station studies (some begun as early as the 1930s) showed that single-tree selection cutting would successfully regenerate sugar maple and beech, but failed as a regeneration method for many desirable species such as yellow-poplar, paper birch, and black cherry, which require plenty of light to survive and grow. Selection cutting by groups will satisfactorily regenerate these and other species, but under group-selection cutting, unless the groups are very large, regulating the rate of cutting for sustained yield on large forests is difficult and costly.

Research by the Station also showed that several forms of even-aged regeneration cutting are highly successful in regenerating most species of hardwoods when proper conditions exist.[9] Shelterwood cutting and clearcutting—either in blocks or in narrow strips or small patches—can be used successfully to regenerate almost all our northeastern hardwood species. But the proper conditions necessary for success vary for different species and may vary in different parts of the species' range.

In some areas recreation and esthetic values may preclude even-aged management entirely. In such cases single-tree selection cutting or group-selection cutting will perpetuate the forest, though with possible loss of efficiency in timber production and less benefit to some species of wildlife.

In the 1950s and 1960s, as demand for lumber grew, logging costs became more of a problem than before. The Station responded with attention to the financial problems of the logging industry, making cost-and-return studies through the use of simulation techniques applied to stands on the experimental forests. Applied on areas of commercial size, these new techniques simulated industrial operations.

The impact of cutting method on watersheds and wildlife was also taken into account. At the Fernow Experimental Forest on the Monongahela National Forest in West Virginia, Station scientists studying the impact of clearcutting on streams found that well-planned cutting of hardwood forests did not cause flooding or severe erosion. Erosion reflected the care taken in logging rather than the cutting practice. When properly applied, clearcutting tended to bring about a more dependable streamflow.[10]

The impact of clearcutting on wildlife has been another facet of the Station's growing research focus on the interrelation between forest cover and wildlife habitat. Studies were made to determine the impact of timber harvesting on forest animals. Means were explored of reducing the destructive effects of browsing animals, such as deer, on forest regeneration.[11]

Forest Genetics

Station research in forest genetics—a basic component in timber-management, entomology, pathology, and environmental research—was begun in 1936 at New Haven. Leader of the project, from then until he retired in 1972, was Ernst J. Schreiner.

Schreiner had previously worked in the pioneering Oxford Paper Company project of the 1920s to create hybrids that would produce wood fiber fast. After joining the Station he won international fame for his work in forest genetics, especially for developing fast-growing hybrid poplars.

In 1942, the project was centered at the University of Pennsylvania's Morris Arboretum in Philadelphia, though Schreiner, still project leader, served in 1945-50 as leader of the work center at Beltsville, Maryland. In 1963 the project was moved from the Morris Arboretum to the research unit at Durham, New Hampshire.

The project's objectives, briefly summarized in 1937, are: "The development of superior forest tree types adaptable to a wide range of environmental conditions and capable of producing a diversity of high-quality products in the shortest possible time, and analogous improvement of the inherent quality of natural forest stands by the application of knowledge derived from genetical research."

This project included the need for developing genetically improved trees particularly suited for both intensive and extensive forestry, for flood control and soil conservation, for wildlife conservation, and for amenity uses.

Hybrid poplars.—Cuttings of selected hybrid poplars have been distributed worldwide. Some of these hybrids have come into commercial use in several European countries, and additional hybrids are included in commercial trials in other foreign countries.

Cuttings of 60 selected hybrid poplars were distributed in the United States for cooperative clonal tests between 1938 and 1941. Results were doubtful because few of the cooperators followed instructions for site preparation and first-year cultivation. In 1955, cuttings of 70 promising hybrids were distributed to approximately 3,500 individuals throughout the country in a nationwide cooperative test. Some of these have shown outstanding possibilities in many parts of the country, with particular promise for revegetation of strip-mine banks in Pennsylvania.

Forty hybrids, selected on the basis of their growth in 15-year tests at the Hopkins Experimental Forest in Massachusetts, were released in 1970 and 1971 through State and Private Forestry for commercial trials in the Northeast. They were rated on growth rate and disease risk for use in plantations for mini-rotation fiber, boltwood, or timber production.

Breeding with other species.—Selfing, intraspecific breeding, and interspecific hybridization with six important genera (maple, birch, ash, spruce, pine, oak) to determine self-compatibility, species crossability, and characteristics of species hybrids, have been a major part of the genetics work since 1937. As a result of this extensive breeding work, more than 30,000 seedlings have been outplanted in plantations scattered throughout the region.

Provenance tests.—The project has three provenance studies under way (with *Fraxinus americana, F. pennsylvanica,* and *Pinus strobus*) and two cooperative studies with *Picea abies* (IUFRO) and *Pinus echinata* (Southern Forest Experiment Station).

Search for superior genotypes.—The search for genetically superior individuals of our native species is a continuing job. Potentially high sugar-producing sugar maples are under test by geneticists at the Burlington, Vermont, laboratory. Promising white pines are being tested for weevil resistance at Durham, New Hampshire. Several techniques have been used in the white-pine weevil resistance work: the determination of density of resin ducts at the feeding sites, rate of resin crystallization, and—most recently—the investigation of chemicals such as terpenes and resin acids in attacked and unattacked trees.

All these approaches have indicated the complexity of this research. In addition to the search for resistance in eastern white pine, exotic species and species hybrids are being tested.

Watershed Management

After World War II, interest in and support for watershed management increased. The Station's main research efforts in this field have been on the Delaware-Lehigh Experimental Forest in Pennsylvania (established in 1948 by the Pennsylvania Department of Forests and Waters), the Fernow Experimental Forest in West Virginia (starting in 1949), the Hubbard Brook Experimental Forest in New Hampshire (established in 1955), and recently on the Newark, New Jersey, and Baltimore, Maryland, municipal watersheds.

Fundamental relationships of the forest and forest practices to flood runoff, water yield, erosion, and sedimentation have been determined and widely published. Possibilities for increasing water yield by cutting trees have been demonstrated. Also, it was shown that the construction and use of roads and trails rather than the cutting of trees were the causes of erosion during timber harvest; practicable methods for controlling erosion during and after logging were developed and demonstrated to landowners and operators.

This knowledge has proved invaluable as an input to multiple-use forest management. Howard W. Lull, who headed this work from the early 1950s to the late 1960s, earned an international reputation as a forest hydrologist.

Of special interest in this age of the environment, recent work at Hubbard Brook—and also on the Fernow Forest—has provided a start in determining the relationships of forest-management practices to the discharge of nutrients in streamflow and to the nutrient cycle in the ecosystem. The Station's research in forest hydrology and other aspects of watershed management has provided a much needed base for current work on municipal watersheds and on forest influences in the urban-suburban environment.

Surface Mine Reclamation

Since World War II, strip-mining for coal has increased tremendously. Strip-mining can have a devastating impact on the environment —especially on the visual appeal of the landscapes, on streamwater quality, and on land productivity.

The Station has an active effort in surface-mine reclamation. It started as a modest timber-management program at Kingston, Pennsylvania, in the late 1950s. When the Central States Experiment Station was phased out in 1965, this research effort was consolidated with a larger project at Berea, Kentucky.

Carried on as a watershed-management project, this effort is actually a multi-functional research unit with responsibility for all Forest Service surface-mine reclamation research in the eastern United States: In cooperation with the states and industry, it has concentrated on the revegetation of mined areas, but work on hydrology and engineering has been included.

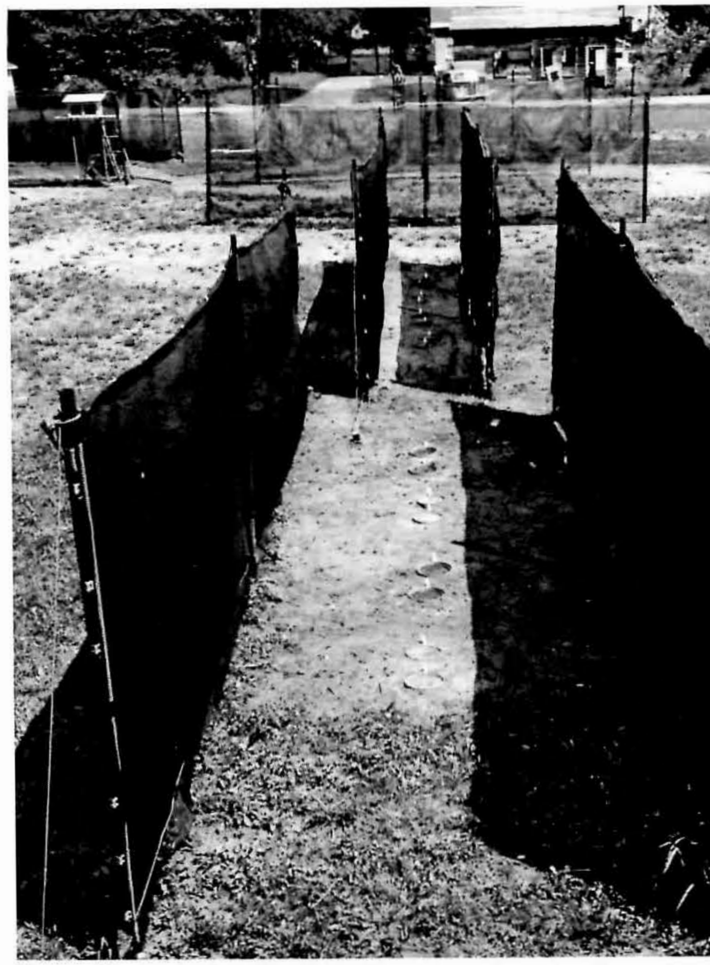
Results of this work have been incorporated into regulations of the state agencies and have been put into practice by industry in all the Appalachian coal-mining states.

Utilization and Marketing

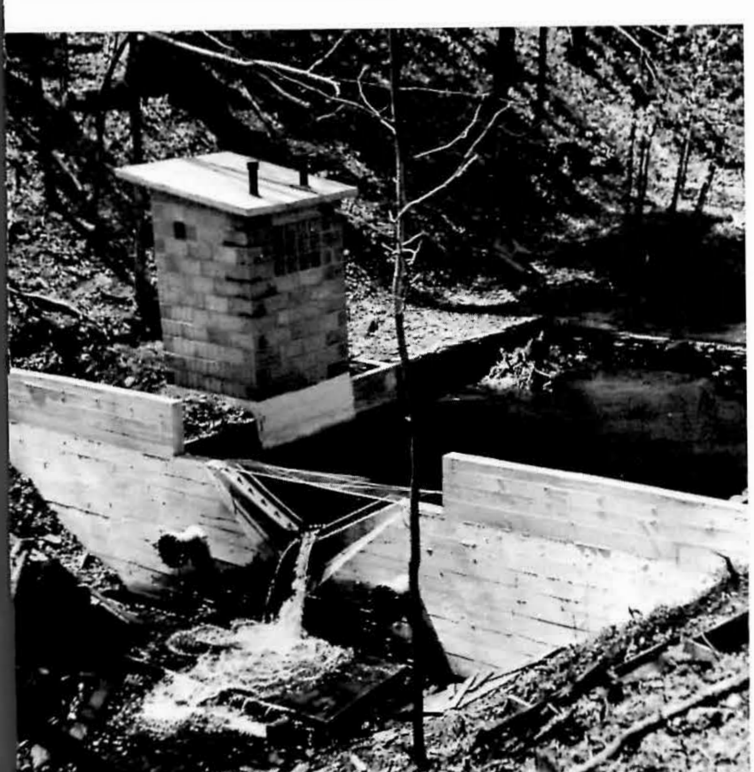
The Northeastern Station first edged into utilization activities during the timber salvage cleanup after the New England hurricane of 1938. During World War II, the Station got into utilization for good. Getting out timber for wartime use became a major Forest Service task.

After the war, a Forest Utilization Service was established to bring utilization problems to the attention of the Forest Products Lab-

Prescribed burning in New Jersey. A 100-foot safety strip is being burned along the boundary of the Lebanon Experimental Forest to reduce fuel on the forestfloor. March 1937.



Screen tests at Bartlett, New Hampshire, for determining the light requirements of northern hardwoods for regenerating strip cuttings.



The weir on a gaged watershed on the Fernow Experimental Forest in West Virginia. A continuous record of watershed behavior will show how forestry measures and logging affect the water resource. An automatic recorder in the gage house charts the behavior of the stream.

oratory for research, and to help get Laboratory findings put into practice. James C. Rettie headed this project, later succeeded by Charles R. Lockard.

At this time, a revolutionary change was taking place in logging, milling, and utilization. Before the war, most logging had been done with hand tools and horses. Now the gasoline chainsaw came onto the scene. Other new machines and methods were being developed fast —skidders, loaders, automated sawmills, short-log bolter and sash-gang saws, and new lumber-drying and handling methods.

The Station's Forest Utilization Service was in the forefront of this revolution. Though much of the work was by nature more extension than research, considerable research was done that resulted in significant findings.

Fred C. Simmons wrote hundreds of articles and papers to help loggers and mill owners make the transition from the old ways to the new. His USDA bulletin on *Logging Farm Forest Crops in the Northeast* (1949) became a bible for the farmer who had woodlot timber to harvest. His *Northeastern Loggers' Handbook* (1951) was one of the Station's all-time best sellers. Translated into foreign languages, it was used widely abroad, especially in underdeveloped countries. After his retirement from the Station and a United Nations mission in South America, Simmons became editor of the trade journal, NORTHERN LOGGER, and Executive Secretary of the Northeastern Loggers Association.

Meanwhile, Lockard had much to do with the development of the log and lumber quality studies that gave sawmill operators a means of determining timber quality and value. These studies, continued by Myron D. Ostrander and Roswell D. Carpenter culminated in the publication of sawlog grades for both hardwoods and eastern white pine.

In 1961 the Station expanded its program of research on timber marketing and utilization. Most of this research was concentrated at a new Station facility, the Forest Products Marketing Laboratory at Princeton, West Virginia. In addition to the main laboratory building, a methods-testing plant was built. The scientists at this laboratory tackled the utilization and marketing problems of wood-based industries of the Appalachian hardwood region.

Appalachian sawmill operators faced rising stumpage and harvesting costs and diminishing supplies of high-quality sawtimber in the 1960s. To help solve this problem, Station scientists sought ways to improve the utilization of high-grade timber. At the same time, they sought expanded uses for low-grade timber.

For example, they developed a computer program called SOLVE, which shows how much sawmill operators can afford to pay for logs, and how they can allocate costs among their production processes. Many operators now use this program for evaluating their operations.

Marketing research has also demonstrated the economic feasibility of low-temperature lumber drying with the accelerated kiln-drying methods developed by the Forest Products Laboratory for hardwood lumber. These drying methods permit a substantial reduction in the lumber inventory a mill must have to assure users of an adequate supply of dry lumber.

Forest-products technologists at the Princeton Laboratory developed a new mill process through which low-grade tree-length logs can be economically converted into high-quality pallet parts and pulp chips. Marketing analysts determined that new highly automated sawmills with relatively small-scale operations (10 to 15 thousand board feet per day) are more efficient and profitable than larger band and circular mills in the production of lumber from low-grade logs.

Market researchers developed and patented a quick leveling method for rehabilitating floors in urban rehabilitation projects. In this system a quick leveling device holds 2 X 2-inch wooden screeds in a level position over old sagging floors while a quick-hardening urethane foam is sprayed underneath to fill the gaps and bond the screeds to the old floor. The screeds provide a good base for a new level floor.

A study on the use of wooden pallets, done in cooperation with the National Wooden Pallet and Container Association and Better Management Services, showed that unit-load handling with wooden pallets can provide substantial benefits to the transport industry. For example, the cost of handling a case of food products can be reduced from 25 cents to 6 cents by handling pallet loads rather than individual cases. Expanded use of pallets by the food industry alone could provide a profitable outlet for much of the low-grade timber available in the United States today. Research demonstrated that a pallet-exchange program among the food-industry firms would further reduce costs of food shipment.

Other marketing and utilization innovations that have been evaluated and found potentially profitable include the production of structural grade plywood from low-grade hardwood timber and the use of small mobile post-driving machines that make it feasible for wooden posts to be used as effectively as steel posts in highway guardrail systems.

Insects and Diseases

When the experiment stations were established in the Northeast in the 1920s, one of their major missions was to find ways to protect forests from fire, insects, and diseases. At the beginning, insect and disease research was done by scientists assigned to the Station by the Bureau of Entomology and the Bureau of Plant Industry. These people worked as part of the Station staff.

In 1954, the Department of Agriculture transferred forest insect and disease research to the Forest Service. Raymond C. Brown and John R. Hansbrough were appointed Station division chiefs for insect and disease research. Since then this research has been a regularly funded part of the Station program.

When the present Northeastern Station headquarters were set up in Philadelphia, the old Station headquarters on Prospect Street in New Haven became the center for insect and disease research. After this building burnt down in 1964, the staff occupied temporary quarters in West Haven till the new laboratory at Hamden was completed. Insect and disease research is now being done at laboratories at Hamden, Connecticut; Delaware, Ohio; and Durham, New Hampshire.

One of the most persistent pests the Station has dealt with is the spruce budworm. In the 1940s a budworm epidemic swept through the spruce-fir forests of Canada into Maine, defoliating and killing timber on vast areas. Silvicultural methods were tried, by identifying high-hazard areas and cutting them first.

DDT was found to be effective against the budworm, and methods of airplane spraying were developed that eventually helped to bring the epidemic under control. Research continued into the 1960s, to refine control methods. The chemical Zectran was found to be an effective alternative to DDT.

The gypsy moth defoliates both conifer and hardwood trees, especially oaks. Introduced from Europe in the 19th century, this pest multiplied beyond control and severely damaged forests in southern New England. For some years it seemed fairly quiescent; then the populations swelled; but now it is spreading west and south, threatening great damage.

In the 1950s, DDT was used to combat outbreaks. In the 1960s, chemicals with less persistent toxicity than DDT were tried. In the search for a control method, Station researchers tried sterilizing males with gamma radiation; they tried predators, parasites, and virus and bacterial diseases of the moth. A computer model was developed for predicting the course of a gypsy moth epidemic.

Despite all these efforts, the gypsy moth continues to plague the region; and in 1971 an intensive 5-year program was begun in a search for a way to control this pest. A special program was set up at the Hamden Laboratory to carry on this work.

Many other pests have been studied in efforts to control them or lessen the damage, including the white-pine weevil, balsam woolly aphid, southern pine beetle, European sawfly, and various scale insects.

Also doing great damage is the Dutch elm disease, which is estimated to have killed 400,000 elm trees annually through the 1960s. The carrier of the fungus that causes the disease has been identified as a beetle. Spraying with chemicals was found to have only a stalling effect on the beetles. Wasp parasites imported from France were first released in 1967, and populations have become established in some areas. It is still too early to determine their impact on beetle populations.

A possible weapon against the beetle was found in 1970. Researchers at our laboratory at Delaware, Ohio, discovered that the female beetle secretes a chemical sex pheromone that attracts the male; and they speculated that this might be used to lure and kill the males or disorient them to prevent mating. And in 1972, a method and equipment were developed for injecting trees with a fungicide, benomyl, for both preventing and arresting the disease. This seems like a real breakthrough; however, it is still under test.

In forest pathology, Station scientists have tackled a number of forest tree diseases. Perley Spaulding, one of the first plant pathologists in the United States, studied white pine blister rust and devised a control method in which the alternate hosts of the fungus pathogen, Ribes (currants and gooseberries), were eradicated to keep the disease from the pines.

One of the early forest-pathology problems investigated by Station scientists was the chestnut blight, which all but wiped out the American chestnut, once one of the most plentiful and commercially valuable of the eastern hardwoods. No control was found for this disease; yet for years the Forest Service continued efforts to bring back the chestnut by selecting and breeding resistant varieties.

Jesse D. Diller, leader of this project for the Station, scoured the East looking for survivors that might have genetic resistance to the disease. Some were found, some that survived long enough to bear fruit; but none proved completely resistant.

Resistant chestnut species were imported from China, Japan, and other countries and tested in various parts of the United States. Some of these survived our climate and were resistant, but none had the true forest tree form of our native chestnut. Crosses were made between the resistant Asian varieties and our American tree. One of these, the "Clapper" chestnut, shows promise, but further tests are needed to verify its resistance and produce clonal material for outplanting.

Oak wilt, which threatened the oak forests of the region, was also studied. It was found that one way the pathogen was transmitted was through root grafts; and sanitation methods—cutting to isolate diseased trees—proved to be of only limited effectiveness in tests in Pennsylvania and West Virginia.

Dieback and decline diseases of several species have been studied. Some of these were attributed to environmental stresses such as unfavorable temperature or soil moisture. Other diseases studied included white pine basal canker, nectria canker, the beech bark disease, and root rots such as those caused by *Fomes annosus* and *Armillaria mellea*.

Studies at our laboratory at Delaware, Ohio, showed that stunted growth in Christmas tree plantations, and a yellowing of tree needles—called the chlorotic dwarf disease—was caused by air pollution. Sick trees, protected from the pollution, recovered; healthy trees became sick after exposure to polluted air. The studies suggested that some trees may have genetic resistance to air pollution.

A radical new concept of discoloration and decay in trees was developed by using a chainsaw to dissect thousands of trees to study what happens inside the living tree after it has been wounded. The results upset conventional theory. After a tree has been wounded—say by a branch breaking off—a complex sequence of events occurs. First the tree has a protective chemical reaction to the wound; then organisms may invade it. Then come bacteria and non-decay fungi, which may—but do not always—pave the way for fungi that cause decay —a *succession* of microorganisms. The tree, however, reacts by sealing off the infected area so that the column of discolored or decayed wood is no larger than the tree was at the time of wounding: new growth put on later is clear and uninfected.

In new studies at Delaware it has been discovered that certain diseases such as elm phloem necrosis, walnut bunch, and black locust witch's broom are probably caused by mycoplasmas and not by viruses as previously thought. Although known for many years to cause disease in animals, organisms of this group were first found in plants just a few years ago. They are the smallest living organisms, only slightly larger than viruses, and are found in the phloem tissues of diseased trees.

Forest Economics

The economics of foresty became important in the programs of the forest experiment stations of the Northeast at the beginning. We have already mentioned the old Northeastern Station's concern for small woodlot owners and its sponsorship of the Otsego Forest Products Cooperative and the Allegheny Station's studies of the depressed Anthracite Region of Pennsylvania in relation to the forest resource.

Upon consolidation of the two older experiment stations into the present Northeastern Station in 1945, a Division of Forest Economics Research was established, headed by Frank A. Ineson. Director Harper broadened the economic research program, and subsequent directors broadened it further.

The Station's small staff of forest economists have investigated many aspects of forestry economics, including taxation of forest land, forest-yield taxes, and forest insurance. A number of studies have been devoted to identifying and evaluating various opportunities for profitable investment in growing timber.

Station economists have provided guidelines for the establishment and expansion of forest-based industries. They have developed budgeting systems for allocating funds to forestry programs at state and local levels. They have established more efficient systems for grading, harvesting, processing, and marketing forest products, from woodlot to consumer.

Economic analyses have been applied to many other Station research programs. Station economists have provided economic decision-making criteria for programs of insect and disease control, watershed management, genetics, and other activities.

The Forest Survey

As part of the nationwide forest survey conducted by the Forest Service, the Northeastern Station has conducted a continuing series of forest surveys of the Northeastern States to provide up-to-date information about the timber resource and analyses of trends in forest-land area, timber volume, annual growth, and timber removals as a data base not only for state and industrial forestry interests, but also as an aid to national and regional policy decisions.

The first forest survey of the Northeast was begun in 1946. State by state, this survey covered the Northeast—some 82 million acres of forest land in 12 states, from West Virginia to Maine. Findings were published for each state as soon as data had been computed and analyzed. The field work for the initial survey was completed in 1958.

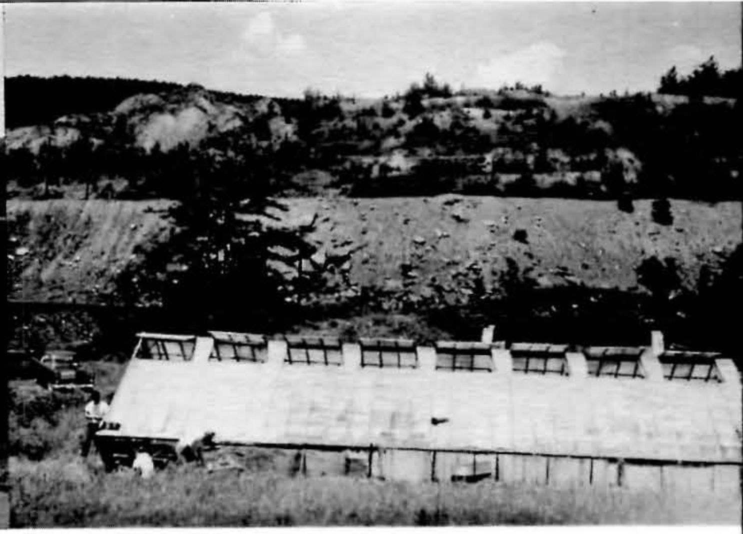
The initial survey utilized a double-sampling system devised by C. Allen Bickford. Photo sample plots were printed on aerial photos for each state. Each plot was photo-interpreted and classified into volume strata. A sample of photo-interpreted (P.I.) plots in each volume stratum were established in the field as ground plots. Then field crews went into the woods to locate each sample ground plot and record data on tree species, tree measurements, other tree characteristics, land use, and other area attributes.

Research in techniques in the late 1950s and early 1960s resulted in the implementation of a sampling design known as *Sampling with Partial Replacement* (SPI). This calls for the remeasurement of only a portion of the ground plots in a state from the initial survey and the utilization of new photos with new P.I. plot stratification and new ground plots. Thus, with the regression technique, there is full utilization of all the photo and ground plot information from the previous surveys.

During this time, Station personnel developed a sophisticated data-processing system, FINSYS, to process, compile, and analyze the large volume of forest-inventory data. The new sampling design and data-processing system were first used by the Station in the resurvey of West Virginia. Now FINSYS is used throughout the Americas and Europe in the processing of forest-inventory statistics.

Development of the necessary programs and personnel capability for electronic data processing has made it possible for the forest survey to calculate quickly and efficiently forest-area and timber-volume statistics and the associated sampling errors for each statistic. This was done for the resurvey of each state. The resurvey of all 14 states in the Northeast (100,300 acres of commercial forest land) was completed in 1972. The third survey of the Northeastern States is now under way.

The forest survey has been helped by cooperation from state agencies and forest industries, who have provided funds, manpower,



Forestry esthetics. The bank of trees (left) screens from sight the coal-mine spoils around this Anthracite Region town in Pennsylvania. Step through the screen of trees and you will see (right) the barren spoil banks.

To speed installation of new flooring in urban rehabilitation, a floor-leveling device was developed at the Laboratory at Princeton, West Virginia. New floor screeds are held in place over the old sagging floor, and plastic foam is sprayed under them to hold them in level position and bond them to the old floor.

The first research facility of the Allegheny Station. Built on the Ockanickon tract, this building was later moved to the Lebanon Experimental Forest in New Jersey. 1937.

One of the Northeastern Station's modern facilities. This is the Forest Insect and Disease Laboratory at Hamden, Connecticut.

aerial photographs, and information about forest-land ownership and timber-product output.

As a supplement to the forest-survey reports, the survey staff has made periodic reports on timber industries of different states, comparing industrial wood-use statistics with previous surveys and noting important trends in industrial development and wood use. Also, the staff compiles, analyzes, and reports the annual pulpwood production by states.

Forest Engineering

Forest engineering has long had a place in Station research. In his early work in logging and sawmilling, Fred Simmons incorporated many aspects of forest engineering: construction of logging roads, cable-logging systems, and the many devices and machines used in logging and sawmilling.

Forest engineering research was formally made a regular part of the Station program in 1964, when a forest engineering research unit was established in cooperation with West Virginia University at Morgantown, West Virginia, where, a few years later, a research laboratory was constructed.

The Station's forest engineering unit was established to study problems in getting logs from the woods to the road. Research has been concerned both with reducing logging and hauling costs and reducing the impact of logging on the environment.

Much of this research has centered on machines. Studies have been made to compare different types of commercially available tractors, to determine the tractor characteristics most desirable for skidding logs. Another problem tackled was rubber tractor tires—one of the big costs for loggers.

One logging device now under test at the Morgantown Laboratory is the CHUBALL. which was invented at our Princeton, West Virginia Laboratory for hauling logs up steep slopes. The CHUBALL is a large split steel ball—like a giant yo-yo—that can be rolled down the slope to where the logs are, dragging with it a cable from the tractor on the landing above. Then the ball and logs are hauled up the slope around trees and stumps and over brush to the landing. The engineers believe the CHUBALL has promise and may require only half the logging roads needed for conventional systems—an environmental plus.

Wildlife Habitat

The first full-fledged wildlife-habitat research project was centered at Warren, Pennsylvania in 1959, and after 1965 at Morgantown, West Virginia. In the 1960s the Station's research revealed that, with certain precautionary measures, some wildlife, like deer and wild turkeys, actually benefit from a mixture of forest and openings created by cutting. The coordination of wildlife-habitat and timber management has helped to minimize browsing damage to forest reproduction.

A major concern is the relationship between timber and wildlife, and methods needed to coordinate the management of these two resources are being studied. Most studies so far have been concentrated on deer (at Warren) and on turkeys and squirrels (at Morgantown). In some of the early research, methods for studying these animals were developed.

One study now under way deals with the ecology of woody plants that provide food and cover for wildlife. Wildlife research is being more closely integrated with research in the other forest-resource disciplines—timber, water, recreation, and economics.

Recreation

As early as 1938, the Allegheny Station staff saw a potential for recreation use in the forests of the Middle Atlantic States. They recommended that methods be developed for expressing in dollars and cents the "so-called intangibles of forest value—the services rendered from the forest as recreation grounds and watershed protection," as a basis for decisions about forest uses.

The time was not ripe then for recreation research. But meanwhile the growing populations of the seaboard metropolitan areas—Boston, New York, Philadelphia, Baltimore, Washington—put increasing pressures on the forest lands for recreational use. Year by year the pressures grew.

In 1959 the Station—then the Northeastern Station—began to survey the region's most pressing recreation problems. In June 1959 the Station's Advisory Committee devoted its annual meeting to needs for recreation research. Dick Lane, then division chief for timber-management research, prepared a regional analysis of the problem.

In August 1959 the Station established the first Forest Service research unit to investigate problems of forest recreation. Centered at Warren, Pennsylvania, near a National Forest recreation area, this unit started out modestly with studies of design and facilities for campsites and picnic areas. Later they studied use fees, impact of people on the environment, management of ground cover, and recreation carrying capacity of wild lands.

In the reorganization of 1966, the Warren unit and the Central States Station's research unit at Berea, Kentucky, were consolidated and moved to headquarters on the campus of the State University of New York College of Forestry at Syracuse. Later the original Warren recreation research unit was moved to Durham, New Hampshire.

Research is designed to help managers of both public and private campgrounds improve their facilities and their use of the land. Because most recreation areas are privately owned, attention is being focused on them. Besides campgrounds, Station researchers have studied lands bought or leased for special uses such as hunting clubs and fishing rights.

Some attention has been given to regional planning. In cooperation with the University of Maine Cooperative Extension Service, a survey was made and a planning guide was prepared for developing outdoor recreation facilities in Washington County, Maine.

More and more, attention in recreation research has shifted from physical facilities to people, to what people need and want and expect from outdoor recreation. Social and economic aspects of recreation have come to the fore.

Studies were made to find out what makes a campground successful, to help managers bring their facilities into line with what people want. It was established that water—lakes and streams—contribute to the success of a recreation area.

One series of surveys, spanning 8 years, is the only long-term study of people's shifting leisure interests ever conducted. This panel study, begun in 1964, documented a number of important trends in camping participation patterns.

The Station has recently added another first to its recreation-research program with the publication of a nation-wide survey of the camping market's potential for further growth. This study provides the first National profile of a rapidly expanding leisure market, which is now estimated to include nearly one-half of all United States households as past, present, or future campers.

The demands on forest land for recreation use are expected to increase, and this may impel the Station to intensify its recreation research. As an aid to planning ahead, the Station in 1971 sponsored (with the State University of New York College of Environmental Science and Forestry) a Forest Recreation Symposium at Syracuse, covering the planning, development, and management of recreational resources as well as socio-economic study of recreationists.

Environmental Forestry

Knowledge of ecology and concern for environment have always been implicit in Forest Service research and in the basic policy that the purpose of forestry is to manage the land for the benefit of the people—whether they live in urban, suburban, rural, or forested areas.

Concern for environment was evident in the Allegheny Station's early studies of the Anthracite Region of Pennsylvania. In the 1950s and 1960s this concern could be seen in studies to find ways to revegetate coal-mine spoil banks. Trees were tested for screening coal-region towns from unsightly mine spoils; and areas were surveyed and mapped to locate places where screens of trees could be used for this esthetic purpose.

Creation of a regular program of environmental forestry by the Station was a response to mushrooming public concern in recent years about man's deteriorating environment. This program got under way in 1970, when the Pinchot Institute for Environmental Forestry Research was established.

In the early 1960s the Milford, Pennsylvania, estate of Gifford Pinchot, first chief of the U.S. Forest Service, had been donated to the Forest Service. In 1963 President John F. Kennedy personally dedicated the Pinchot Institute for conservation studies. In July 1970, management of the estate was transferred from the Washington office to the Northeastern Station.

Thus the Milford estate became the focal point for the Station's new Pinchot Institute for Environmental Forestry Research. The Institute was designed to act as a catalyst for research into forest-environment problems common to the urban-forest interface in the densely populated megalopolis that stretches from Boston to Washington. Its main purpose is to find ways in which forest resources can be used to improve the human environment in and around the urban centers of the Northeast.

Consistent with the cooperative nature of Forest Service research, the Institute provides research grants to a consortium of nine leading universities and research institutes of the Northeast. Approximately half of the Forest Service funding for the Institute is used for research by the Station; the other half is granted to consortium members. The Station established two new research units—at Amherst, Massachusetts, and Pennington, New Jersey—to carry out its part of the research.

The Institute's scientists are studying ways to establish and maintain stands of trees and other plants in urban and suburban settings. It has been demonstrated that plants—especially trees—can improve the metropoliton environment. They ameliorate the microclimate: reduce temperature, affect light intensity, reduce humidity, filter out air pollution, abate noise, and change air movements. Esthetically, they provide the greenery, shade, flowers, and natural wildlife habitat that make the difference between tedium and pleasant living.

Woodlands that surround urban areas and are interspersed in suburban areas are also vital to water needs. Vegetation protects watersheds against erosion and protects the water supply. Station scientists are learning how urban water supplies can be increased through judicious cutting and species manipulation on watersheds.

Wildlife is important too. One Station project is concerned with developing urban areas to attract and maintain wildlife. Preliminary studies in the Boston area have shown that city cemeteries not only provide the only open space in some urban areas, but also provide habitat for a surprisingly large variety of wildlife. Detailed plans have been published, showing how a backyard can be developed, stage by stage, to attract and provide habitat for a variety of birds, small mammals, and other wildlife.

This mobile device was developed at the Delaware, Ohio, Laboratory for X-raying living trees as an aid to insect and disease research.

PUTTING RESEARCH RESULTS TO USE

In the early days, when the old Northeastern and Allegheny Stations were small, the directors and scientists published many articles and papers to describe their work and report their findings. In 1946, when the Station was beginning to expand, director Harper recruited a professional writer-editor, the start of an editorial staff to speed the research results into publication.

A small editorial and publications staff was built up that during the years has helped the Station scientists get their works published—sometimes more than 200 a year—in scientific journals throughout the world as well as in trade journals, popular periodicals, Department of Agriculture and Forest Service series, in newspapers, and on radio and television.

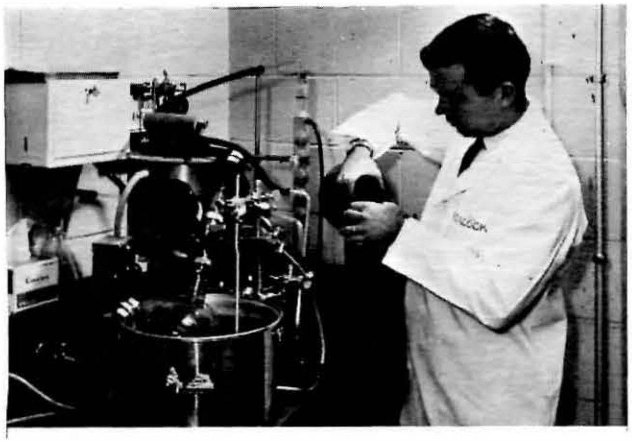
Besides these outside publications, the Station publishes its own series of research papers and notes. For a long time the Station maintained its own printing plant, but since 1970 its printing has been done through the Government Printing Office.

Station scientists have been active in making public their own research findings through talks at professional society meetings, local service clubs and civic organizations, at schools and at university seminars, on radio and television, and at demonstrations and field trips for a broad variety of interested groups.

In 1966 an information service was established by Director Lane, and public information specialists were recruited to broaden the dissemination of research results through the mass media—newspapers, magazines, television, radio, films, demonstrations, and displays—to help the general public understand and support Forest Service efforts.

The close association between the Experiment Station and the State and Private Forestry area office, stemming mainly from the reorganization of 1966, was another effective step toward getting research results put to use. And last but not least, the Advisory Counicls and Committees have steadily contributed toward this end.

The Station maintains its own library as a service to researchers and in 1961 recruited a professional librarian. Besides maintaining a collection of reference works and periodicals, the library assists scientists in obtaining bibliographic material through its inter-library loan arrangements and knowledge of a wide variety of information sources. The library also aids in the dissemination of Station research findings by maintaining a complete file of Station publications for loan or reproduction when copies are no longer available for distribution.



Laboratory work at Delaware, Ohio.

SUMMING UP

The Northeastern Forest Experiment Station has come a long way in the past 50 years. Two small experiment stations—each with a handful of scientists—were combined during World War II to create a new Northeastern Forest Experiment Station that has steadily grown to a size and complexity far beyond what anybody might have envisioned in 1923.

From a few projects in timber management, forest protection, economics, and genetics, the Station has grown to encompass research into almost every use of forests known to man. Scientists have been recruited from a score of different disciplines to carry out the multiple-use research called for by the complex demands made on our forest lands by the people of our nation.

Biometricians and statisticians have been added to the staff to help plan experiments and analyze results. Editors and public-information people have been added to speed publication of results and inform the general public. Library facilities have been developed. Management analysts have been recruited to systematize operations in a number of activities. The most modern electronic computers have been used for storing, sorting, and retrieving data; and computer programs have been devised in many studies for analyzing data.

Tomorrow will no doubt bring new demands and pressures on our forests—one of the few renewable natural resources our nation has, and one that man cannot do without. The Station will respond to these needs, as it has in the past, in the hope that its research efforts will continue to contribute toward the wise use of this great natural resource—our forests.

Forest engineering research. Much of this research deals with the machines used to bring logs out of the woods.

These young wild turkeys are being studied in a wildlife-habitat project.

BIBLIOGRAPHY

It would not be practicable to list here all the publications of the Forest Service experiment stations in the Northeast during the past 50 years, because they would number more than 6,000. Instead, only a few significant references used in this history are listed below.

Allegheny Forest Experiment Station.
1926-1944. ANNUAL REPORTS. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia.

Allegheny Forest Research Advisory Council.
1929-1944. MINUTES OF MEETINGS. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia.

Allegheny Forest Experiment Station.
1939. KANE EXPERIMENTAL FOREST OF THE ALLEGHENY FOREST EXPERIMENT STATION. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia. 13 p., illus.

Allegheny Forest Experiment Station.
1943. TIONESTA NATURAL AND SCENIC AREA, ALLEGHENY NATIONAL FOREST. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia. 10 p., illus.

Allegheny Forest Experiment Station.
1943. WARTIME WORK OF THE ALLEGHENY FOREST EXPERIMENT STATION. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia. 2 p.

Allegheny Forest Experiment Station.
1944. GUIDES FOR CUTTING TIMBER IN THE NORTHEAST. U.S. Dep. Agr. AWI-90. 12 p.

Behre, C. Edward.
1927. FORM CLASS TAPER CURVES AND VOLUME TABLES AND THEIR APPLICATION. J. Agr. Res. 35: 673-744, illus.

Behre, C. E., R. D. Forbes, J. C. Kendall, and J. G. Lipman.
1931. THE FORESTRY SITUATION IN NORTHEASTERN UNITED STATES. USDA Forest Serv. NE. Forest Exp. Sta. Amherst. 13 p.

Behre, C. Edward.
1933. NORTHEASTERN FOREST EXPERIMENT STATION SURVEYS ITS FIRST TEN YEARS. J. Forest. 31: 694-695.

Bevan, Arthur.
1947. FLOOD CONTROL SURVEYS IN THE NORTHEAST. USDA Forest Serv. NE. Forest Exp. Sta. Sta. Pap. 10. Upper Darby. 9 p.

Bickford, C. Allen, Carl E. Mayer, and Kenneth D. Ware.
1963. AN EFFICIENT SAMPLING DESIGN FOR FOREST INVENTORY: THE NORTHEASTERN FOREST RESURVEY. J. Forest. 61: 826-833, illus.

Blum, Barton M., and Melvin R. Koelling.
1968. VACUUM PUMPING INCREASES SAP YIELDS FROM SUGAR MAPLE TREES. USDA Forest Serv. Res. Pap. NE-106. Upper Darby. 14 p., illus.

Bratton, Allen W.
1949. COOPERATIVES AND SMALL WOODLANDS. U.S. Dep. Agr. Yearb. 1949: 183-190.

Burke, Hubert D.
1961. FOREST RECREATION RESEARCH: A NEW UNDERTAKING BY THE U.S. FOREST SERVICE. N. Y. Conserv. 15 (4): 27-29 illus.

Clapp, Earle H.
1926. A NATIONAL PROGRAM OF FOREST RESEARCH Amer. Tree Assoc. Washington. 232 p.

Clepper, Henry.
1973. A SALUTE TO SAMUEL T. DANA AT 90. J. Forest. 71: 200-202.

Czapowskyj, Miroslaw M.
1969. ANTHRACITE COAL-MINE SPOILS TODAY: FORESTS TOMORROW. Pa. Forests 59(3): 81-83.

Dana, Samuel T.
1923. WHAT THE NORTHEASTERN FOREST EXPERIMENT STATION SHOULD AIM AT. J. Forest. 21: 40-43.

Dana, Samuel T.
1926. THE MISSION OF FOREST RESEARCH. J. Forest. 24: 667-672.

Dana, Samuel T.
1930. TIMBER GROWING AND LOGGING PRACTICE IN THE NORTHEAST. U.S. Dep. Agr. Tech. Bull. 166. Washington. 122 p., illus.

Diller, Jesse D.
1965. A PROGRESS REPORT ON ATTEMPTS TO BRING BACK THE CHESTNUT TREE IN THE EASTERN UNITED STATES 1954-1964. J. Forest. 63: 186-188.

Doak, K. D.
1936. MYCORRHIZAE OF TREES AND SHRUBS. Univ. Pa. Morris Arbor. Bull. 1 (4): 45-49. illus.

Dochinger, Leon S.
1967. CHLOROTIC DWARF OF WHITE PINE, A PROBLEM OF AIR POLLUTION. Ohio Woodlands 5(4): 18-19, illus.

Doolittle, Warren T.
1969. RESEARCH IN URBAN FORESTRY. J. Forest. 67: 650, 652, 656.

Doolittle, Warren T.
1970. A NEW ROLE FOR THE PINCHOT ISNTITUTE. Pa. Forests 60(3): 81.

Doolittle, Warren T.
1971. TREE IMPROVEMENT AND ENVIROMENTAL FORESTRY. NE. Forest Tree Improve. Conf. Proc. 18: 65-69.

Dowden, Philip B.
1957. BIOLOGICAL CONTROL OF FOREST INSECTS IN THE UNITED STATES AND CANADA. J. Forest. 55: 723-726.

Forbes, R. D.
1930. THE FEDERAL FOREST EXPERIMENT STATIONS. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia. 4 p.

Forbes, R. D.
1933. HOW TO STOP FOREST DEVASTATION. *In* A National Plan for American Forestry. (Copeland Report.) 73d Cong. 1st Sess. Sen. Doc. 12: 1429-1454.

Forbes, R. D.
1940. ACCOMPLISHMENTS OF THE ALLEGHENY FOREST EXPERIMENT STATION, 1927-1940. USDA Forest Serv. Allegheny Forest Exp. Sta. Philadelphia 29 p.

Forbes, R. D.
1941. FORESTS AND JOBS IN THE ANTHRACITE REGION PENNSYLVANIA. J. Forest. 39: 197-201.

Forbes, R. D., and C. W. Beck.
1941. TAX DELINQUENCY OF FOREST LANDS IN THE ANTHRACITE REGION OF PENNSYLVANIA: A COUNTY OPPORTUNITY AND RESPONSIBILITY. USDA Forest Serv. Allegheny Forest Exp. Sta. Anthracite Surv. Pap. 3. Philadelphia. 16 p., illus.

Fowler, Marvin E.
1963. A GUIDE TO FOREST DISEASE RESEARCH IN THE NORTHEAST. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 45 p.

Frank, Robert M.
1964. A GUIDE FOR SCREEN AND COVER PLANTING OF TREES ON ANTHRACITE MINE-SPOIL AREAS. USDA Forest Serv. Res. Pap. NE-22. Upper Darby. 50 p., illus.

Gabriel, William J.
1964. SELECTION OF SUGAR MAPLES FOR HIGH SUGAR CONTENT IN SAP—DEVELOPMENT OF PROCEDURES. NE. Forest Tree Improve. Conf. Proc. 11: 8-11, illus.

Gilbert Adrian M.
1959. SAMPLING THE QUALITY OF HARDWOOD TREES. USDA Forest Serv. NE. Forest Exp. Sta. Pap. 114, Upper Darby. 18 p., illus.

Godwin, P. A., H. D. Rule, and W. E. Waters.
1964. SOME EFFECTS OF GAMMA IRRADIATION ON THE GYPSY MOTH, *Porthetria dispar*. J. Econ. Entomol. 57: 986-990.

Hagenstein, Perry R.
1965. FACTORS IN LOCATING PULP MILLS. Amer. Pulpwood Assoc. Annu. 1965: 49-52, illus.

Harper, Verne L.
1946. RESEARCH IN MANAGEMENT AND UTILIZATION OF FORESTS IN PENNSYLVANIA. Forest Leaves 36(1): 7-8.

Harper, V. L., Bernard Frank, and W. E. McQuilkin.
1957. FOREST PRACTICES AND PRODUCTIVITY. U.S. Dep. Agr. Yearb. 1957: 732-741.

Harper, Verne L.
1949. NEW HORIZONS IN FORESTRY. Forest Leaves 34(1): 1-2.

Hart, Arthur C.
1964. SPRUCE-FIR SILVICULTURE IN NORTHERN NEW ENGLAND. Soc. Amer. Forest. Proc. 1963; 107-110.

Hepting, George H., and Marvin E. Fowler.
1962. TREE DISEASES OF EASTERN FORESTS AND FARM WOODLANDS. U.S. Dep. Agr. Inform. Bull. 245. Washington. 48 p., illus.

Hetzel, J. E.
1939. A GUIDANCE LEAFLET FOR CCC PLANTING IN NORTHWESTERN PENNSYLVANIA. J. Forest. 37: 494-495, illus.

Horowitz, Sylvia, and Mary Buchanan.
1967. PUBLICATIONS OF THE NORTHEASTERN FOREST EXPERIMENT STATION, 1950-1965. USDA Forest Serv. Res. Pap. NE-62. Upper Darby. 134 p.

Hough, A. F.
1940. THE ALLEGHENY FOREST EXPERIMENT STATION. Forest Leaves 30(1): 9-10.

Hough, A. F., and R. D. Forbes.
1943. THE ECOLOGY AND SILVICS OF FORESTS IN THE HIGH PLATEAUS OF PENNSYLVANIA. Ecol. Monogr. 13 299-320, illus.

Hough, Ashbel F.
1965. A TWENTY-YEAR RECORD OF UNDERSTORY VEGETATION CHANGE IN A VIRGIN PENNSYLVAIA FOREST. Ecology 46: 370-373.

Ineson, Frank A., and Miles J. Ferree.
1948. THE ANTHRACITE FOREST REGION—A PROBLEM AREA. U.S. Dep. Agr. Misc. Bull. 648. Washington. 71 p., illus.

Jensen, Victor S.
1933. FORESTRY WORK FOR UNEMPLOYMENT RELIEF. USDA Forest Serv. NE. Forest Exp. Sta. Occas. Pap. 1. Amherst. 6 p.

Jordan, James.
1967. DEER HABITAT RESEARCH IN ALLEGHENY PLATEAU FORESTS. Pa. Fed. Sportsmens Clubs. 6 p.

Krochmal, Arnold, Russell S. Walters, and Richard M. Doughty.
1969. A GUIDE TO MEDICINAL PLANTS OF APPALACHIA. USDA Forest Serv. Res. Pap. NE-138. Upper Darby. 291 p., illus.

Lane, Richard D.
1958. WOODLAND MANAGEMENT RESEARCH IN THE NORTHEAST. NE. Logger 7(2): 40-43, 59, illus.

Lane, Richard D.
1959. NORTHEASTERN FORESTS: WE SEE THEM FOR THE PEOPLE. Soc. Amer. Forest. Proc. 1959: 75-77.

Larson, Edwin vH.
1950. BIBLIOGRAPHY OF THE NORTHEASTERN AND ALLEGHENY FOREST EXPERIMENT STATIONS, 1923-1949. USDA Forest Serv. NE. Forest Exp. Sta. Pap. 33. Upper Darby. 208 p.

Leak, William B.
1961. DEVELOPMENT OF SECOND-GROWTH NORTHERN HARDWOODS ON BARTLETT EXPERIMENTAL FOREST—A 25-YEAR RECORD. USDA Forest Serv. NE. Forest Exp. Sta. Pap. 155. Upper Darby. 8 p.

Leak, William B.
1971. SIMULATION OF FOREST SUCCESSION. Summer Computer Simulation Conf. Proc.: 820-825.

Lincoln, A. Charles.
1968. INSECT RESEARCH AT THE DELAWARE LABORATORY. Trees Mag. 28(2): 14-17, illus.

Little, S., and E. B. Moore.
1945. CONTROLLED BURNING IN SOUTH JERSEY'S OAK-PINE STANDS. J. Forest. 43: 499-506, illus.

Little, Silas, and E. B. Moore.
1949. THE ECOLOGICAL ROLE OF PRESCRIBED BURNS IN THE PINE-OAK FORESTS OF SOUTHERN NEW JERSEY. Ecology 30: 223-233.

Little, Silas, Jr.
1950. ECOLOGY AND SILVICULTURE OF WHITECEDAR AND ASSOCIATED HARDWOODS IN SOUTHERN NEW JERSEY. Yale Univ. School Forest. Bull. 56. 103 p., illus.

(Little, Silas. and John H. Noyes, editors.)
1971. TREES AND FORESTS IN AN URBANIZING ENVIROUMENT. Univ. Mass. Coop. Ext. Serv. Planning and Resource Develop. Ser. 17. Amherst. 168 p., illus.

Lockard. Charles R.
1951. HARDWOOD LOG GRADING—A PHASE OF QUALITY CONTROL. S. Lumberman 182 (2279): 84, 86, 88, 90.

Longwood, Frank R.
1964. THE FOREST PRODUCTS MARKETING RESEARCH PROGRAM OF THE FOREST SERVICE, USDA. *In* Wood for People. Univ. Mass. Coll. Agr. Coop. Ext. Serv. Pub. 414: 44-50.

Lull. Howard W.
1962. MANAGEMENT FOR WATER PRODUCTION ON MUNICIPAL WATERSHEDS. World Forest. Congr. Proc. 5: 1686-1690.

Lull, Howard W.
1966. AN ANNOTATED BIBLIOGRAPHY OF WATERSHED MANAGEMENT RESEARCH BY THE NORTHESTERN FOREST EXPERIMENT STATION, 1931-1965. USDA Forest Serv. Res. Pap. NE-48. Upper Darby. 36 p.

Lull, Howard W.
1968. A FOREST ATLAS OF THE NORTHEAST. USDA Forest. Serv. NE. Forest Exp. Sta. Upper Darby. 46 p., illus.

Lull, Howard W., and Kenneth G. Reinhart.
1972. FORESTS AND FLOODS IN THE EASTERN UNITED STATES. USDA Forest Serv. Res. Pap. NE-266. Upper Darby. 94 p.

Lutz, H. J.
1930. THE VEGETATION OF HEART'S CONTENT, A VIRGIN FOREST IN NORTHEASTERN PENNSYLVANIA. Ecology 11 : 1-29, illus.

McGuire. John R.
1958. OUR VITAL PRIVATE FOREST LANDS. U.S. Dep. Agr. Yearb. 1958: 386-391.

McLintock, Thomas F.
1947 SILVICULTURAL PRACTICES FOR CONTROL OF SPRUCE BUDWORM. J. Forest. 45: 655-658.

McQuilkin, W. E.
1957. LOOK TO THE HARDWOODS! USDA Forest Ser. NE. Forest Exp. Sta. Pap. 91. Upper Darby. 17 p.

McQuilkin, W. E.
1969. THIRTY YEARS OF FEDERAL FOREST RESEARCH IN

THE ANTHRACITE REGION. Pa. Forests 59(2): 58-62, illus.

Marquis, Ralph W.
1952. FOREST YIELD TAXES. U.S. Dep. Agr. Circ. 899. Washington. 50 p.

Marquis, Ralph W.
1956. FOREST RESEARCH IN THE NORTHEAST. S. Lumberman 193(2417): 193-194.

Marquis, Ralph W.
1961. HOW SHALL WE USE OUR FORESTS? NE. Logger 10(5): 22-23, 34-35.

Mesavage, Clement.
1939. FORESTRY AND THE FUTURE OF THE ANTHRACITE REGION. Forest Leaves 29(2): 3, 13.

Morey, Harold F.
1929. THE EFFECT OF SOIL ON TREE FORM. U.S. Forest Serv. Bull. 13(52): 4-5.

Northeastern Forest Experiment Station.
1924. FOREST INVESTIGATIONS UNDER WAY IN NEW ENGLAND AND NEW YORK. USDA Forest Serv. NE. Forest Exp. Sta. Amherst. 83 p.

Northeastern Forest Experiment Station.
1927. FOREST RESEARCH IN THE NORTHEAST: A SUMMARY OF PERMANENT SAMPLE PLOT EXPERIMENTS BY ALL AGENCIES IN THE REGION. USDA Forest Serv. NE. Forest Exp. Sta. Amherst. 40 p.

Northeastern Forest Experiment Station.
1930. FOREST INVESTIGATIONS UNDER WAY IN NEW ENGLAND AND NEW YORK. USDA Forest Serv. NE. Forest Exp. Sta. Amherst. 122 p.

Northeastern Forest Experiment Station.
1944. NORTHEAST FORESTS IN THE POSTWAR PERIOD. USDA Forest Serv. NE. Forest Exp. Sta. Philadelphia. 11 p.

Northeastern Forest Experiment Station.
1946-1971. ANNUAL REPORTS (new series). USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby.

Northeastern Forest Experiment Station.
1948. BELTSVILLE EXPERIMENTAL FOREST. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 7 p.

Northeastern Forest Experiment Station.
1948. A PROPOSED EXPERIMENTAL FOREST IN THE SPRUCE-FIR REGION OF MAINE. USDA Forest Serv. NE. Forest Exp. Sta. Philadelphia. 5 p.

Northeastern Forest Experiment Station.
1948. DELAWARE-LEHIGH EXPERIMENTAL FOREST, THE FIRST UNIT OF THE DELAWARE BASIN RESEARCH CENTER. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 6 p., illus.

Northeastern Forest Experiment Station.
1953. THE KANE EXPERIMENTAL FOREST. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 4 p., illus.

Northeastern Forest Experiment Station.
1953. BARTLETT EXPERIMENTAL FOREST. N.H. Forest Notes 38: 5-7, illus.

Northeastern Forest Experiment Station.
1959. WHAT'S KNOWN ABOUT MANAGING EASTERN WHITE PINE. USDA Forest Serv. NE. Forest Exp. Sta. Pap. 121. Upper Darby. 69 p., illus.

Northeastern Forest Experiment Station.
1963. THE FOREST PRODUCTS MARKETING LABORATORY AT PRINCETON, WEST VIRGINIA. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 8 p., illus.

Northeastern Forest Experiment Station.
1964. THE FERNOW EXPERIMENTAL FOREST AT PARSONS, WEST VIRGINIA. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 12 p., illus.

Northeastern Forest Experiment Station.
1964. THE HUBBARD BROOK EXPERIMENTAL FOREST. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 13 p., illus.

Northeastern Forest Experiment Station.
1964. THE TIMBER AND WATERSHED LABORATORY AT PARSONS, WEST VIRGINIA. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 6 p.

Northeasetrn Forest Experiment Station.
1971. RECREATION SYMPOSIUM PROCEEDINGS. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 211 p., illus.

Northeastern Forest Experiment Station.
1971. OAK SYMPOSIUM PROCEEDINGS. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 161 p., illus.

Northeastern Forest Research Advisory Council.
1924-1942. MINUTES OF MEETINGS. USDA Forest Serv. NE. Forest Exp. Sta. Amherst and New Haven.

Northeastern Forest Research Advisory Council.
1943-1962. MINUTES OF MEETINGS. USDA Forest Serv. NE. Forest Exp. Sta. Philadelphia and Upper Darby.

Northeastern Forestry Research Advisory Committee.
1963-1971. MINUTES OF MEETINGS. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby.

Northeastern Timber Salvage Administration.
1943. REPORT OF THE U.S. FOREST SERVICE PROGRAMS RESULTING FROM THE NEW ENGLAND HURRICANE OF SEPTEMBER 21, 1938. NE. Timber Salvage Adm. 594 p., illus.

Parker, Homer W.
1966. NEW U.S. FOREST SERVICE UNIT APPLIES ENGINEERING RESEARCH TO APPALACHIAN LOGGING. N. Logger 14(10): 16, 57, illus.

Rettie, James C., and Frank A. Ineson.
1950. OTSEGO FOREST PRODUCTS COOPERATIVE ASSOCIATION OF COOPERSTOWN, NEW YORK: AN EVALUATION. U.S. Dep. Agr. Inform. Bull. 17. Washington 42 p., illus.

Roach, Benjamin A., and Samuel F. Gingrich.
1962. TIMBER MANAGEMENT GUIDE FOR UPLAND CENTRAL HARDWOODS. USDA Forest Serv. Cent. States Forest Exp. Sta. and N. Cent. Region. 33 p., illus.

Rushmore, Francis M.
1956. THE ADIRONDACK RESEARCH CENTER. NE. Logger 4(12): 20-21, 50, illus.

Schnur, G. Luther.
1944. LUMBER PRODUCTION TRENDS: NORTHEASTERN STATES, 1943. USDA Forest Serv. Allegheny Forest Exp. Sta. Occas. Pap. 6. Philadelphia. 24 p., illus.

Schreiner, Ernst J.
1937. IMPROVEMENT OF FOREST TREES. U.S. Dep. Agr. Yearb. 1937: 1242-1279, illus.

Schreiner, Ernst J.
1949. POPLARS CAN BE BRED TO ORDER. U.S. Dep. Agr. Yearb. 1949: 153-157.

Schreiner, Ernst J.
1969. TREE BREEDING IN THE UNITED STATES FORESTRY PRACTICE. FAO-IUFRO 2nd World Consult. on Forest Tree Breeding Sect. IV. 22 p.

Shafer, Elwood L., Jr.
1970. THE NAME OF THE GAME IS RECREATION RESEARCH. Environ. Educ. (1): 30-34.

Shafer, Elwood L., Jr., and Warren T. Doolittle.
1972. THE PINCHOT INSTITUTE—BREAKING NEW GROUND THROUGHOUT MEGALOPOLIS. Pa. Forests 63(1): 20-24.

Shigo, Alex L.
1965. THE PATTERN OF DECAYS AND DISCOLORATIONS IN NORTHERN HARDWOODS. Phytopathology 55: 648-652, illus.

Shirley. Hardy L.
1943. FORESTRY IN THE POSTWAR WORLD. Forest Leaves 33(2-3): 5-9.

Shirley, Hardy L.
1943. RESEARCH AT THE ALLEGHENY FOREST EXPERIMENT STATION. Pa. Acad. Sci. Proc. 17: 90-94.

Simmons, Fred C.
1951. NORTHEASTERN LOGGERS' HANDBOOK. U.S. Dep. Agr. Handb. 6. Washington. 160 p., illus.

Simmons, Fred C.
1955. LOGGING FARM WOOD CROPS. U.S. Dep. Agr. Farmers' Bull. 2090. Washington. 52 p., illus.

Simmons, Fred C.
1956. SAWMILL RESIDUES: THEIR PRODUCTION AND USE IN THE NORTHEAST. S. Lumberman 193(2417): 204- 207, illus.

Spaulding, Perley, and Annie Rathbun-Gravatt.
1925. CONDITIONS ANTECEDENT TO THE INFECTION OF WHITE PINES BY *Cronartium ribicola* IN THE NORTHEASTERN UNITED STATES. Phytopathology 15: 573-583.

Spaulding, Perley.
1929. THE WHITE PINE BLISTER RUST: A COMPARISON OF EUROPEAN WITH NORTH AMERICAN CONDITIONS. U.S. Dep. Agr. Tech. Bull. 87. Washington. 58 p., illus.

Spaulding, Perley.
1944. DECAY OF LOGGING SLASH IN THE NORTHEAST. U.S. Dep. Agr. Tech. Bull. 876. Washington. 22 p., illus.

Stickel, Paul W.
1927. FOREST FIRE WEATHER RESEARCH. J. Forest. 25: 604-605.

Stickel, Paul W.
1938. NORTHEASTERN FOREST-FIRE DANGER METERS. USDA Forest Serv. NE. Forest Exp. Sta. Tech. Note 25. New Haven. 4 p.

Storey, Herbert C.
1949. WATERSHED RESEARCH IN THE DELAWARE AND LEHIGH. Forest Leaves 34(1): 15-16.

Trimble, George R., Jr., K. G. Reinhart, and Henry H. Webster.
1963. CUTTING THE FOREST TO INCREASE WATER YIELDS. J. Forest. 61: 635-640.

Trimble, George R., Jr.
1961. MANAGING MOUNTAIN HARDWOODS—A TEN YEAR APPRAISAL. USDA Forest Serv. NE. Forest Exp. Sta. Pap. 143. Upper Darby. 25 p., illus.

Trimble, George R., Jr., and Lester McClung.
1966. CLEARCUTTING. W. Va. Conserv. 30(7): 16-18.

USDA Forest Service.
1909-1972. REPORTS OF THE CHIEF FORESTER. Government Printing Office, Washington, D.C.

USDA Forest Service.
1923-1972. ORGANIZATIONAL DIRECTORIES. Government Printing Office, Washington, D.C.

Weitzman, Sidney.
1949. THE FERNOW EXPERIMENTAL FOREST. USDA Forest Serv. NE. Forest Exp. Sta. Upper Darby. 16 p., illus.

Weitzman, Sidney.
1956. RESEARCH ON THE FERNOW EXPERIMENTAL FOREST. N. Logger 4(7): 14-15, 31, illus.

Westveld, Marinus.
1931. REPRODUCTION ON PULPWOOD LANDS IN THE NORTHEAST. U.S. Dep. Agr. Tech. Bull. 223. Washington. 52 p., illus.

Westveld, Marinus.
1945. A SUGGESTED METHOD FOR RATING THE VULNERABILITY OF SPRUCE-FIR STANDS TO BUDWORM ATTACK. USDA Forest Serv. NE. Forest Exp. Sta. Philadelphia. 4 p.

Wood, O. M.
1935. FOREST REMOVAL AFFECTS LOCAL CLIMATE AND GROWING CONDITIONS. U.S. Dep. Agr. Yearb. 1935: 206-208. Washington, D.C.: Government Printing Office.

Wright, Jonathan W.
1955. A BIBLIOGRAPHY ON FOREST GENETICS AND FOREST TREE IMPROVEMENT. USDA Forest Serv. NE. Forest Exp. Sta. Pap. 90. Upper Darby. 60 p.

Zube, Ervin H., Hugh C. Davis, and Robert O. Brush.
1971. LANDSCAPE ARCHITECTURAL RESEARCH IN ENVIRONMENTAL FORESTRY: A RESEARCH PROGRAM FOR THE NORTHEASTERN UNITED STATES. Amer. Soc. Landscape Architect. Found. McLean, Va. 18 p., illus.

Other Sources of Information

In addition to the published works cited above, a number of unpublished Forest Service office reports were referred to in the preparation of this history. Information was also obtained from tape-recorded oral-history interviews conducted by Elwood R. Maunder and Susan R. Schrepfer of the Forest History Society. Interviews were conducted with Samuel T. Dana, C. Edward Behre, Walter H. Meyer, Verne L. Harper, Hardy Shirley, and Warren T. Doolittle.

■

PERSONNEL

The following list of personnel who have served at the old Northeastern, Allegheny, and present Northeastern Forest Experiment Stations includes mainly professional people, plus others who have contributed significantly to Station programs and publications.

Akcerman, P. E.
Adams, Edward L.*
Afanasiev, Michel
Allen, Rufus H., Jr.*
Amidon, Elliot L.
Anderson, A. H.
Anderson, Robert B.*
Araman, Philip B.*
Archer, Donald H.
Arner, Stanford L.*
Atkinson, Oscar L.*
Aubertin, Gerald M.*
Auchmoody, Luther R.*
Bain, Robert, assistant director, Support Services
Baird, J.
Banks, Wayne G.
Bard, George L.
Barger, Jack H.*
Barnard, Joseph E.*
Barraclough, Solon L.
Barrett, Harold J.
Baumgras, John E.*
Bean, James L.*
Behre, C. Edward, director 1929-41
Belotelkin, Konstantin T.
Berg, William A.
Berry, Frederick H.*
Bethlahmy, Nedavia
Bevan, Arthur
Bickford, C. Allen
Biller, Cleveland J.*
Bjorkbom, John C.*
Bloom, Jerry H.*
Blum, Barton M.*
Blythe, Richard H., Jr.
Boardman, Steven
Bolich, G.
Bones, James T.*
Borneman, Willis T.
Bowers, Teresa M.*
Boyce, John S., director 1928-29
Bradley, Dennis P.
Brandner, H. Phil
Brandt, Robert W.
Bratton, Allen W.
Brisbin, Robert L.*
Brock, Samuel M.
Bromfield, K.
Brown, J. Willcox
Brown, Raymond C., chief, Division of Forest Insect Research
Brush, Robert O.*
Burke, Hubert D.
Burnham, Chester F.
Burns, Denver P.
Buttrick, John
Callahan, K.
Camp, Harry W., Jr.
Campbell, Robert W.*
Cannon, William N., Jr.*
Caporaso, Allessio P.
Carl, Clayton M., Jr.*
Carlson, Tony C.
Carpenter, Roswell D.*
Carter, Roy M.
Cavallero, John B.
Cawelti, Stephen W.
Champagne, E. Garth
Chapman, Roger C.
Charlton, John W.
Church, Thomas W., Jr.*
Clark, Kenneth M.
Cole, Alexander B.
Corbett, Edward S.*
Cosenza, Benjamin J.
Craft, Edward P.*
Crosby, David
Crow, Alonzo B.
Croxton, Ralph J.
Cunningham, Frank E.
Cuppett, Donald G.*
Curry, John R.
Curtis, Brian M.
Curtis, Robert O.
Curtis, Willie R.*

*Still with the Station

Cuthbert, Roy A.*
Czapowskyj, Miroslaw M.*
Dale, Martin E.*
Dana, Samuel T., director 1923-27
Davidson, Walter H.*
Davis, Grant*
DeBald, Paul S.*
DeGraaf, Richard M.*
Demeritt, Maurice R., Jr.*
Dempsey, Gilbert P.*
Despard, Thomas L.*
Dickerman, Murlyn B.
Dickerson, A. Laverne*
Dickson, David R.*
Diebold, Charles H.
Dieckhaus, James W.
Diller, Jesse D.
Dochinger, Leon S.*
Dodd, Alfred N.
Donley, David E.*
Donnelly, John R.
Doolittle, Warren T., director 1970—*
Dorr, Frederick J.
Doverspike, George E.
Dowden, Philip B.
Dowdle, Barney
Dubois, Normand R.*
Dubois, Warren J.
Duffield, John W.
Duffy, Bernard F., assistant director, Support Services*
Eads, Larry D.
Echelberger, Herbert E.*
Edgerton, L. J.
Ellefson, Paul V.
Ellen, J. David
Ellsbury, Wendell M.
Elliott, Terry L.
Ellstrom, Raymond
Emanuel, David M.*
Eschner, Arthur
Etter, Daniel O., Jr.*
Fahnestock, George R.
Farver, James T.
Federer, C. Anthony*
Fenton, Richard H.
Ferguson, Roland H.*
Ferree, Miles J.
Filip, Stanley M.*
Fogerty, Virginia M.*
Folsom, John B.
Foote, Dean A.*
Forbes, Reginald D., director, Allegheny Forest Experiment Station, 1927-39
Fowler, Marvin E., chief, Division of Forest Disease Research
Frampton, Lois C.
Frank, Robert M., Jr.*
Franz, George J., Jr.
Frayer, Warren E.
Frost, Richard E.*
Furnish, James R.
Furnival, George M.
Gabriel, William J.*
Galford, Jimmy R.*
Gammon, Glenn L.*
Gansner, David A.*
Garrett, Lawrence D.*
Garrett, Peter W.*
Gast, P. R.
Gatchell, Charles J.*
Gedney, Donald R.
Gentry, Claude E.*
Gerhold, Henry H.
Gibbs, Carter B.
Gibson, Harry G.*
Gibson, Lester P.*
Gilbert, Adrian M.
Gill, John D.*
Gingrich, Samuel F.*
Girard, James W.
Gochenour, Donald L., Jr.*
Godwin, Paul A.*
Goodell, Bertram C.
Gordon, Barry D.*
Graber, Raymond E.*
Greene, Mary T.
Gregory, G. Robinson
Gregory, Garold F.*
Gregory, Robert*
Grisez, Ted J.*
Griswold, Frank S.
Griswold, Norman B.
Grossman, Sidney J.
Grove, Gerald H.
Gyure, Benjamin L.
Hagenstein, Perry R.
Haggard, Paul L.
Hahn, Glenn G.

Hamilton, Thomas E., assistant director, Division of Forest Economics, Survey, Marketing & Utilization*
Hampf, Frederick E.
Hanks, Leland F.*
Hansbrough, John R., chief, Division of Forest Disease Research
Hansen, Bruce G.*
Harper, Verne L., director, 1946-50
Hart, Arthur C.
Hart, George E., Jr.
Hartley, Carl
Hartman, Fred J.
Hartman, Robert L.
Hastings, Arthur R.
Hatch, A. B.
Hay, Cyrus J.*
Hazen, J. F.
Healy, William M.*
Heisler, Gordon M.*
Herrick, John W.*
Herrick, Owen W.*
Hicks, Halsey M.
Hirt, Ray R.
Holcolm, Carl J.
Holt, William R.
Homeyer, Jay W.*
Horsley, Stephen B.*
Hornbeck, James W.*
Hough, Ashbel F.
Houston, David R.*
Howard, John*
Howard, Lance F.*
Howe, George E.
Hoyle, Merrill C.*
Huberman, Morris A.
Huntzinger, Harold J.
Hutchins, Lee M.
Hutnik, Russell J.
Huttinger, William O.
Huyler, Neil K.*
Ineson, Frank A., chief, Division of Forest Economics
Jacot, Arthur P.
Janerette, Carol A.*
Jaynes, Harold A.
Jensen, Chester E.
Jensen, Keith F.*
Jensen, Victor S.
Johnson, Leonard R.*
Jones, Clark A.
Jones, Thomas W.*
Jordan, James S.*
Jorgensen, Richard N.
Kasiak, Edward
Katz, Barbara E.*
Kawelti, Stephen W.
Kelley, A. P.
Kendig, Thomas E.
Kennedy, Bruce H.*
Kenney, Robert J.
Kidd, Walter J., Jr.
King, Robert
Kingsley, Neal P.*
Klawitter, Ralph A., assistant director, Division of Insect and Disease Research
Klein, E. Lawrence
Knutson, Robert G.*
Kochenderfer, James N.*
Koelling, Melvin R.
Koenick, Leonard J.
Kraemer, J. Hugo
Krochmal, Arnold
Lane, Richard D., director, 1966-70
LaPage, Wilbur F.*
Large, Hollis R.*
Larsen, David N.*
Larson, Edwin vH.*
Lavigne, Raymond W.
LaVoy, Gerald C.
Leak, William B.*
Leonard, Raymond E.*
Lewis, Franklin B.*
Linch, John R.
Lincoln, A. Charles, Jr.
Lindahl, Robert R.
Lindell, Gary
Lindmark, Ronald
Linton, David*
Little, Elbert L., Jr.
Little, Silas, Jr.*
Lloyd, F. Thomas
Lockhard, Charlse R.
Longwood, Franklin R.
Lowe, James H., Jr.
Lucas, Edwin L., Jr.*
Lucas, John T.
Lucas, Robert F.
Lull, Howard W., chief, Division of Watershed Management Research

Lutz, Harold J.
Lyman, Robert R.*
MacKay, Benton
MacAloney, H. J.
McCauley, Orris D.*
McCay, Roger E.*
McConkey, Thomas W.
McElroy, James E.
McGuire, John R., chief, Division of Forest Resources Research
McHenry, Richard K.
McIntyre, Thomas
McLintock, Thomas F.
McManus, Michael L.*
McQuilkin, William E.
McWain, Percy
Maki, T. Ewald
Maki, Kalervo N.
Malkasian, Neil A.
Manthy, Robert S.
Marco, Herbert F.
Marquis, David A.*
Marquis, Ralph W., director, 1951-66
Marshall, Hubert
Martens, David G.*
Martin, A. Jeff*
Martin, C. Wayne
Martinson, Ernest O.
Marty, Robert J.
Marx, Harold G.*
Mayer, Carl E.*
Mazzone, Horace M.*
Mendel, Joseph J.*
Mesavage, Clement
Meyer, Emil F.
Meyer, Walter H.
Miller, James M.*
Miller, Orson
Miller, William C.*
Mills, Brooks B.
Misulia, Michael
Mitchell, Wilfred C.
Moeller, George H.*
Mollenhauer, William J.
Mook, Paul V.
Morey, Harold F.
Morse, J. Edwin
Mott, D. Gordon*
Nearn, William T.
Neely, Robert D.*
Nevel, Robert L., Jr.*
Niskala, George
Nofziger, Ed
O'Brien, James
ODell, Thomas M.*
Ohman, John
Olsen, Chad C.*
Olson, W. Z.
Ostrander, Myron D.
Ostrom, Carl E.
Parker, Homer W.
Parker, Johnson*
Parr, Nils
Parr, Sally Brockley
Patric, James E.*
Payne, Brian R.*
Peacock, John W.*
Pearce, John
Peirsol, Margaret K.*
Pendleton, Thomas H.*
Perkins, Philip B.*
Peters, John R.*
Peters, Robert C.
Phillips, John J.
Phillips, Ross A.*
Pierce, Raymond W.
Pierce, Robert S.*
Plass, William T.*
Plusnin, Basil A.
Podgwaite, John D.*
Pomeroy, Kenneth B., chief, Division of Timber Management
Poore, Charles P.
Potter, Howard S.
Potts, Samuel F.
Powell, Douglas S.*
Prota, Carl D.
Purcell, Thomas*
Quigley, Kenneth L., assistant director, Watershed, Engineering, Recreation and Wildlife Habitat Research*
Rabe, Colin A.
Ragain, Dale P.
Rammrath, Rita M.
Rast, Everette D.*
Reardon, Richard C.*
Recknagel, A. B.
Reeves, Calvin C., Jr.*
Reigner, Irvin C.
Reineke, Lester H.
Reinhart, Kenneth G.*
Rettie, James C., chief, Division of Forest Economics Research

Rexrode, Charles O.*
Reymers, Kenneth E., Jr.
Reynolds, Hugh W.*
Rich, Roger
Ritter, George J.
Roach, Benjamin A.*
Roberts, Kenneth L.
Roehrs, Douglas G.
Rogers, Earl J.
Rollins, James A.
Rollinson, William
Ross, Eldon W., assistant director, Division of Forest Insect & Disease Research*
Rude, John K.
Rule, Hubert D.
Rulison, Donald E.
Rushmore, Francis M.
Rutherford, William, Jr.
Rydberg, Ronald V.
Safford, Lawrence O.*
Sampson, Richard K.
Sander, Ivan L.
Sanderson, H. Reed*
Santamour, Frank S.
Sarles, Raymond L.*
Sartz, Richard S.
Schmidt, J. W., Jr.
Schmidt, Robert A.
Schmitt, Daniel M., assistant director, Division of Timber Management Research*
Schnur, G. Luther
Schreiner, Ernst J.
Schuler, James L.*
Schuster, Ervin G.
Seegrist, Donald W.*
Seliskar, Carl E., assistant director, Division of Forest Insect and Disease Research*
Sendak, Paul E.*
Shafer, Elwood L., Jr., assistant director, Pinchot Institute of Environmental Forestry Research*
Sharon, Edward M.*
Shepard, Harold B.
Shigo, Alex L.*
Shiner, James W.
Shirley, Hardy L., director, Allegheny Forest Experiment Station, 1939-45
Silverborg, Savel B.
Simmons, Frederick C.
Sims, Ivan H., chief, Division of Timber Management
Skratt, Thomas A.*
Smith, Frank F.
Smith, H. Clay*
Smith, Wendell E.
Snow, Albert G., Jr.
Solomon, Dale S.*
Sonderman, David L.*
Sopper, William E.
Spaulding, Perley, chief, Division of Forest Pathology
Staley, John M.
Stankewich, Joseph P.
Starr, W. K.
Stern, E. George
Stewart, Guy R.
Stickel, Paul W.
Stirler, Dennis J.*
Stoddard, Charles H.
Stoltenberg, Carl H., chief, Division of Forest Economics Research
Storey, Herbert C., chief, Division of Watershed Management Research
Striffler, William D.
Stuart, Alice
Sucoff, Edward I.
Sushko, Walter C.
Sweet, Brian
Talerico, Robert L.*
Tanner, C. B.
Taylor, Raymond F., chief, Division of Forest Management Research
Tegethoff, A.
Tepper, Herbert B.
Thomas, Jack Ward*
Thorner, Benjamin
Timson, Floyd G.*
Todd, Arthur S.
Toole, E. H.
Toumey, J. W.
Trefts, Hubbard
Trent, Roy E.
Trimble, George R., Jr.*
Tripp, Norman R.
Troendle, Charles A.*
Tuthill, Frank F.
Turberville, H. W.
Tuttle, Norman L.*
Van Buijtenen, Johannes P.
Van Lear, David H.

Varney, Gilbert L.
Vogel, Willis G.*
Wagar, J. Alan
Walker, John L.
Wallin, Walter B.*
Walters, Russell S.*
Walton, Gerald S.*
Ware, Kenneth D.
Wargo, Philip M.*
Wartluft, Jeffrey L.*
Waterman, Alma M.
Waters, William E., chief,
Division of Forest Insect Research
Way, Roger D.
Webb, James E.
Webster, Henry H.
Weigle, Weldon K.
Weitzman, Sidney
Wells, Roger W.
Welsch, David J.
Wen, C. I.
Wendel, George W.*
Westveld, Marinus
Wheaton, R. G.
Wheeland, Hoyt A.
Whelan, Donald E.
Whipkey, Ronald Z.
Whittaker, James C.
Whitten, Russell R.
Wilkinson, Ronald C.*
Williams, Carroll B., Jr.
Williams, Ellis T.
Williams, George P., Jr.*
Williamson, Malcolm J.
Wilson, Richard E.
Wilson, Robert W., Jr.*
Wisdom, Harold W.
Wolf, Charles H.*
Wollerman, Edward H.*
Wood, O. M.
Worley, David P.*
Wray, Robert D.
Wren, Thomas E.
Wright, Jonathan W.
Writer, Ross
Yawney, Harry W.*
Yelenosky, George
Zeedyk, William D.
Zerbe, John H.
Zorio, John W.

■

FOOTNOTES

[1]Dana, Samuel T. The development of forestry in Government and education. Interview by Amelia Fry, Univ. Cal. Oral Hist. Off., Berkeley, 1967. U.S. Forest Service. Report of the Forester for 1919: 2.

[2] Society of American Foresters, Allegheny Section. Forest investigations now being carried on by forestry organizations in Maryland, New Jersey, and Pennsylvania. 1927.

[3]Behre, C. Edward. Interview with Elwood R. Maunder, Forest History Society, 1973. Allegheny Forest Experiment Station, Annual report for 1943.

[4]Northeastern Forest Experiment Station. Annual report of the Northeastern Forest Experiment Station, 1946: 1-4.

[5]Doolittle, Warren T. Interview with Elwood R. Maunder, Forest History Society, 1973.

[6]Northeastern Forest Experiment Station. Annual report, 1951.

[7]Northeastern Forest Experiment Station. Annual report, 1955: 38.

[8]Northeastern Forest Experiment Station. Annual report, 1971: 17-20.

[9]Northeastern Forest Experiment Station. Annual report, 1963: 4-5; Annual report, 1967.
Gingrich, Samuel F. Timber management guide for central upland hardwoods, 1962.

[10]Kochenderfer, J. N., and J. H. Patric. Effects of clear-cutting—past and present—on water resources of the Monongahela National Forest.

[11]Northeastern Forest Experiment Station. Annual report, 1959: 7-8.

■